Published in final edited form as:

Subst Use Misuse. 2016 January 28; 51(2): 165–178. doi:10.3109/10826084.2015.1082596.

Multi-Substance Use among Treatment-seeking Smokers: Synergistic Effects of Coping Motives for Cannabis and Alcohol Use and Social Anxiety/Depressive Symptoms

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Abstract

Objective—This study examined the impact of coping motives for cannabis and alcohol use on the relation between social anxiety/depressive symptoms and severity of substance use for alcohol, tobacco, and cannabis among treatment-seeking smokers who also use cannabis and alcohol.

Methods—The sample included 197 daily cigarette smokers (M_{Age} 34.81 yrs, $SD = 13.43$) who reported using cannabis and alcohol.

Results—Hierarchical multiple regression analyses were conducted wherein separate models were constructed for each dependent variable. Among individuals with higher social anxiety, alcohol coping motives were associated with heavier drinking, and this was more pronounced among those low in depressive symptoms. Similarly, those at greater risk for nicotine dependence were anxious individuals with lower depressive symptoms who endorse coping-oriented motives for using cannabis. Further, among those with higher social anxiety, cannabis coping motives were associated with marginally greater drinking, particularly for those high in depressive symptoms.

Conclusions—The present findings support the perspective that among multi-substance users, the interplay between social anxiety, depressive symptoms, and coping-oriented motives for using one substance (e.g., cannabis or alcohol) may pose difficulties in refraining from other substances (e.g., tobacco). This observation highlights the importance of tailoring multi-substance treatments to specific needs of multi-users for whom single-substance interventions may be less effective. Findings also support previous work exploring the benefits of concurrently treating co-occurring

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Dawn Foster conducted statistical analyses and drafted the manuscript. Julie Buckner contributed to data analytic strategy and manuscript drafts. Michael Zvolensky and Norman Schmidt conceptualized the grant, oversaw data collection, and provided guidance and feedback to manuscript drafts. All authors contributed to and have approved the final manuscript.

DISCLOSURES

The authors report no financial relationships with commercial interests, and have no additional income to declare.

substance use and lend credence to the perspective that motivation to use substances for coping reasons is of central theoretical and clinical relevance.

Keywords

coping; motives; cannabis; alcohol; tobacco; social anxiety; depressive symptoms

Tobacco use frequently co-occurs with alcohol (Falk, Yi, & Hiller-Sturmhofel, 2008; Falk, Yi, & Hiller-Sturmhofel, 2006) and cannabis (Haney et al., 2013). Multi-substance use has bi-directional implications, suggesting that the use of one substance increases risk for and levels of use for other substances (Burling & Ziff, 1988; Golub & Johnson, 2001; Harrison, Hinson, & McKee, 2009; Jiang & Ling, 2013; Kessler et al., 1997; Redonnet, Chollet, Fombonne, Bowes, & Melchior, 2012; Roxburgh, Miller, & Dunn, 2013; Van Zundert, Kuntsche, & Engels, 2012). Further, multi-substance use has been linked to psychological distress, such as greater anxiety and depression (Caldwell et al., 2002; Milani, Parrott, Turner, & Fox, 2004).

Motivational models of substance use suggest that using substances to cope with psychological distress is related to higher levels of use (Cooper, 1994a; Piper et al., 2004). One type of psychological distress, social anxiety, is related to coping motivated cannabis use (Buckner, Bonn-Miller, Zvolensky, & Schmidt, 2007; Buckner, Heimberg, Matthews, & Silgado, 2012; Buckner & Zvolensky, 2014; Buckner, Zvolensky, Farris, & Hogan, 2014; Buckner, Zvolensky, & Schmidt, 2012b). Social anxiety is associated with cannabis-related problems (e.g., Buckner et al., 2007; Buckner, Heimberg, et al., 2012; Buckner, Heimberg, & Schmidt, 2011; Buckner et al., 2012; Buckner, Mallott, Schmidt, & Taylor, 2006; Buckner & Schmidt, 2008, 2009) such as lower productivity (Buckner, Heimberg, et al., 2012) and coping motives at least partially account for the relation between social anxiety and cannabis-related problems (Buckner et al., 2007). In fact, cannabis coping motives predicted greater severity of cannabis problems (Buckner, 2013). Notably, social anxiety predict onset of subsequent cannabis and alcohol dependence (Buckner et al., 2008). In fact, recent work suggests that coping motives, across both alcohol and cannabis, are of central theoretical relevance (Foster, Neighbors, & Prokhorov, 2014; Zvolensky, Bernstein, Marshall, & Feldner, 2006). Examinations of affective-motivational models of cannabis and alcohol problems have documented associations between coping motives and both cannabis and alcohol use, as well as indirect associations with respect to affect-regulation and problems via coping (Gaher, Simons, Jacobs, Meyer, & Johnson-Jimenez, 2006; Simons, Gaher, Correia, Hansen, & Christopher, 2005). Further, cigarette smokers who engage in more coping-motivated alcohol or cannabis use may be at an increased risk for undesired substance-related consequences and negative emotional states, including anxiety and depression (Foster, Neighbors, & Prokhorov, 2014; Zvolensky, Bernstein, Marshall, et al., 2006). These findings suggest that among tobacco users who also use other substances, coping-oriented motives for using those substances may be related to multiple forms of use. Yet, it remains unclear what individual characteristics and psychological factors are important in relations between coping motives, multi-substance use, and health problems.

Psychological symptoms and disorders, including depressive and anxiety symptoms, have been linked independently with tobacco use (Buckner & Vinci, 2013; Leventhal, Ameringer, Osborn, Zvolensky, & Langdon, 2013), cannabis use (Bonn-Miller & Zvolensky, 2009; Bovasso, 2001; Zvolensky, Bernstein, Sachs-Ericsson, et al., 2006), and alcohol consumption (Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007a). Among tobacco users, depressive symptoms and anxiety have been associated with cannabis dependence (Mathews, Hall, & Gartner, 2011), and also related to the use of cannabis and alcohol (Buckner et al., 2008). Psychological problems including depressive symptoms and anxiety have been studied with respect to coping motives in the context of alcohol (Hussong, Galloway, & Feagans, 2005; Lewis et al., 2008) and cannabis (Bujarski, Norberg, & Copeland, 2012), and coping motives have been shown to play a moderating role in the relationship between psychological problems and substance misuse (Buckner et al., 2007; Bujarski et al., 2012; Lewis et al., 2008; Ralston & Palfai, 2012). Social anxiety is one type of anxiety that appears to be uniquely related to cannabis- and anxiety-related impairment among anxiety conditions. Although adolescents with social anxiety disorder are five and seven times more likely to experience alcohol and cannabis dependence respectively by age 30, no other anxiety disorders in adolescence significantly prospectively predicted these substance use disorders after adjusting for co-occurring disorders and/or other substance use (Buckner et al., 2008).

One alcohol-oriented study found that drinkers at highest risk for alcohol problems were high in negative affect *and* coping motives (Martens et al., 2008). Although examinations of motives have been conducted in the context of multi-substance use (Foster, Allan, Zvolensky, & Schmidt, 2015; Foster, Neighbors, & Prokhorov, 2014), research exploring links and interactive relations between coping motives for multiple substances and psychological factors remains relatively scarce. Previous work indicates that alcohol coping motives are associated with alcohol and tobacco outcomes (Foster et al., 2015). However, to our knowledge, no study has explored cross-substance effects of coping motives for alcohol and cannabis and psychological problems with respect to multiple substance use. As a result, comparatively little is known about whether coping motives among tobacco users uniquely contribute to the prediction of multiple substance use over and above theoretically related variables (e.g., gender, education level, and marital status).

Although research includes examinations of depression as a mediator of the relation between anxiety and drinking (Lechner et al., 2014), the moderating effects between social anxiety and depressive symptoms with respect to coping motives for substance use remain unexamined. It is clinically important to better understand how substance use is influenced by interactions between these constructs, and examinations of this nature will help to clarify if the potential interplay of social anxiety and depressive symptoms on substance use and cross-substance outcomes depends on the strength of coping-motivated use. That is, whether potential interactive relations between social anxiety and depressive symptoms emerge differentially among individuals for whom coping motives for cannabis and alcohol use are high versus low.

Together, the present study was designed to evaluate relations among social anxiety, depressive symptoms, and coping motives for cannabis and alcohol use among treatment-

seeking smokers who engage in multi-substance use by examining the influence of these variables on multiple substance use. First, we hypothesized that, consistent with previous work, coping motives for cannabis and alcohol use would be associated with greater substance use and related problems (Foster, Neighbors, & Prokhorov, 2014). Second, we hypothesized that psychological problems (social anxiety and depressive symptoms) would moderate the association between coping motives and substance use outcomes, such that coping motives would be associated with greater substance use, particularly among individuals high in social anxiety (Cannabis Coping Motives X Social Anxiety; Alcohol Coping Motives X Social Anxiety) and depressive symptoms (Cannabis Coping Motives X Depressive Symptoms; Alcohol Coping Motives X Depressive Symptoms). Third, we hypothesized that individuals would be at greater risk for increased substance use if they were high in coping motives *and* psychological problems (Cannabis Coping Motives X Social Anxiety X Depressive Symptoms; Alcohol Coping Motives X Social Anxiety X Depressive Symptoms).

Method

Participants

The sample consisted of 197 daily smokers. All participants reported at least some cannabis and alcohol use. Participants responded to advertisements about a larger study of smoking cessation treatments. The sample was primarily male ($n = 197$, 57.87%), with a mean age of 34.81 years ($SD = 13.43$). Additional details regarding demographic information, cigarette smoking, cannabis use, and alcohol consumption is presented in Table 1.

Measures

Motives for cannabis use—The Marijuana Motives Questionnaire (MMQ) was used to examine motives or reasons for using cannabis (Simons, Correia, & Carey, 2000; Simons, Correia, & Carey, 1998). The MMQ is comprised of 25 items and assesses motives for using cannabis. The MMQ has shown high levels of internal consistency for each of the five factors (Zvolensky et al., 2007), coping, social, enhancement, conformity, and expansion motives. For the purposes of the present study, only the coping motives subscale was utilized, which was comprised of five items: 1) To forget my worries; 2) Because it helps me when I feel depressed or nervous; 3) To cheer me up when I am in a bad mood; 4) Because I feel more self-confident and sure of myself; and 5) To forget about my problems. Participants rated items on a 5-point scale ranging from 1 (*Never/Almost Never*) to 5 (*Almost Always/Always*). Items were summed (Cronbach's $\alpha = .88$).

Motives for alcohol use—The Drinking Motives Questionnaire (DMQ) is a 20-item measure used to assess motives for drinking (Cooper, 1994b). The DMQ demonstrates adequate psychometric properties (Cooper, Russell, Skinner, & Windle, 1992). A cross-national evaluation of the DMQ demonstrated that the 4-factor motive structure was invariant across large samples of American, Canadian, and Swiss late adolescents (Kuntsche, Stewart, & Cooper, 2008) and adults (Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007b; Nemeth, Kuntsche, Urban, Farkas, & Demetrovics, 2011). The DMQ yields four subscales that reflect coping, social, enhancement, and conformity motives, however

for the purposes of this research, we utilized only the coping motives subscale. This was comprised of five items: 1) To forget your worries; 2) Because it helps you when you feel depressed or nervous; 3) To cheer up when you are in a bad mood; 4) Because you feel more self-confident and sure of yourself; and 5) To forget about your problems. Respondents rated items on a 5-point scale ranging from 1 (*Never/Almost Never*) to 5 (*Almost Always/Always*). Items were summed (Cronbach's $\alpha = .90$).

Cannabis use—Cannabis use was assessed using an item from the 40-item Marijuana Smoking History Questionnaire (MSHQ). The MSHQ assesses history and patterns of cannabis use (Bonn-Miller & Zvolensky, 2009). Previous research has used the MSHQ as a successful indicator of cannabis use (Buckner, Zvolensky, & Schmidt, 2012a). For the present analyses, the item “Think about your smoking during the last week, how much marijuana did you smoke per occasion in an average day” was used to assess the quantity of cannabis used over the previous week. Participants responded to this on an eight-point Likert scale. Scores correspond to pictures depicting increasing sizes of cannabis joints, with 1 indicating the smallest cannabis joint and 8 indicating the largest cannabis joint.

Alcohol use—Alcohol consumption was assessed using the Alcohol Use Disorders Identification Test (AUDIT), a 10-item measure that screens for harmful or hazardous drinking (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). Items include quantity and frequency of alcohol consumption, heavy use, tolerance, dependence, and related problems. The AUDIT has demonstrated good psychometric properties (Maisto, Conigliaro, McNeil, Kraemer, & Kelley, 2000). The AUDIT's internal consistency α was .84 in the present sample, and the total score was used as an indicator of hazardous drinking. In past work the AUDIT has reliably distinguished between harmful, hazardous, and no drinking histories (Fleming, Barry, & MacDonald, 1991). For example, a score of 8 on the AUDIT produces 85% sensitivity and 89% specificity for hazardous or harmful drinking (Cherpitel, 1995).

Tobacco use—Smoking rate, age of onset of initiation, years of being a daily smoker, and other characteristics were assessed using the Smoking History Questionnaire (SHQ; (Brown, Lejuez, Kahler, & Strong, 2002). For example, the item assessing smoking rate was “Since you started regular daily smoking, what is the average number of cigarettes you smoked per day?” Individuals indicated their quit methods by endorsing items (0 = *No* or 1 = *Yes*), including “Cold turkey,” “Behavior modification,” “Nicotine patch,” “Gradual reduction,” and “Telephone counseling.”

Nicotine Dependence—The Fagerström Test for Nicotine Dependence (FTND) is a 6-item scale that assesses gradations in tobacco dependence and exhibits positive relations with key smoking variables, adequate internal consistency, and high test-retest reliability (Heatherton, Kozlowski, Frecker, & Fagerström, 1991; Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994). FTND scores range from 0 to 10, and higher scores indicating greater dependence on nicotine (Fagerstrom, Heatherton, & Kozlowski, 1990); Cronbach's $\alpha = .59$).

Inventory of Depression and Anxiety Symptoms (IDAS)—The IDAS is a 64-item questionnaire that assesses dimensions of major depression and anxiety disorders (Watson et al., 2007). The IDAS contains 12 subscales indexing criteria related to DSM-IV-TR anxiety and depressive disorders. In the present work, two of the subscales were examined to gauge indices of anxiety and depressive symptoms: Social Anxiety subscale (8 items; e.g. “I was worried about embarrassing myself socially”) and General Depression subscale (20 items; e.g. “I felt depressed”). The General Depression subscale contains items regarding dysphoria, suicidality, lassitude, insomnia, appetite loss, and well-being, thereby serving as an overall index of depressive symptoms (Watson et al., 2007). The two IDAS subscales showed good internal consistency (both Cronbach α 's > .80) in the current sample.

Descriptive information—Participants reported demographic information including gender, age, race/ethnicity, marital status, and education. Diagnostic assessments were conducted using the *Structured Clinical Interview for DSM-IV Axis I Disorders* (Non-Patient Version; First, Spitzer, Gibbon, & Williams, 1995) to examine DSM-IV-TR diagnoses for past and current Axis I disorders (Spitzer, & Gibbon, 2007; First et al., 1995). All SCID-I interviews were administered by trained research staff and supervised by independent doctoral-level professionals. Interviews were audio-taped and the reliability of a random selection of 12.5% of interviews were reviewed (MJZ) for accuracy. No cases of diagnostic coding disagreement were noted.

Procedure

Participants were daily cigarette users who responded to community-based advertisements (e.g., flyers, newspaper ads, radio announcements) to participate in a larger study examining the efficacy of two smoking cessation interventions: a novel four-session smoking cessation behavioral intervention that focused on vulnerability to panic (Panic-Smoking Program), and a standard smoking cessation program. Data for the current study came from the baseline assessment of this larger trial, prior to randomization. Interested respondents were scheduled for in-person baseline assessments and were evaluated according to study inclusion and exclusion criteria. After providing written informed consent, participants were interviewed using the SCID and completed an online battery of questionnaires. This study was approved by the institutional review boards (IRB) at the University of Vermont and Florida State University.

Statistical analyses

Zero-order correlations were obtained to assess relationships between predictor and criterion variables. Incremental validity of dummy coded covariates (gender, education level, and marital status) and centered primary predictor variables (coping motives for cannabis and alcohol use, depressive symptoms, and social anxiety) was examined in relation to the dependent variables (cannabis use, hazardous alcohol use, and nicotine dependence) using hierarchical multiple regression (Cohen & Cohen, 1983). Separate models were constructed for each dependent variable. At Step 1, coping motives for cannabis and alcohol use, depressive symptoms, and social anxiety were included in the model along with gender, education level, and marital status as covariates to ensure any observed effects were not due to these factors. At Step 2, two-way interactions between motives and social anxiety and

depressive symptoms were examined (Cannabis Coping Motives X Social Anxiety; Cannabis Coping Motives X Depressive Symptoms; Alcohol Coping Motives X Social Anxiety; Alcohol Coping Motives X Depressive Symptoms). At Step 3, three-way interactions between motives, social anxiety, and depression (Cannabis Coping Motives X Social Anxiety X Depressive Symptoms; Alcohol Coping Motives X Social Anxiety X Depressive Symptoms) were tested (Table 4).

Significant three-way interactions were graphed. Parameter estimates from the regression equation where high and low values were specified as one standard deviation above and below their respective means (Cohen, Cohen, West, & Aiken, 2003). Three-way interactions were represented graphically as two two-way interactions. Specifically, the regression lines of two-way interactions between coping motives and depressive symptoms was graphed separately for individuals with high and low social anxiety. Additionally, simple slopes analyses were conducted for each of the two-way interactions (Cannabis Coping Motives X Depressive Symptoms and Alcohol Coping Motives X Depressive Symptoms) at low and high social anxiety (Aiken & West, 1991). In each simple slopes analysis, two regression equations were constructed wherein one represented the relationship between the independent variable and dependent variable at a lower level of the moderator (-1 SD), and the other represented the relationship between the independent variable and dependent variable at a higher level of the moderator ($+1$ SD). All analyses were conducted using SAS 9.3. The present analyses include statistical significance levels of $p < .05$ and marginal significance levels of $p < .10$, as well as measures of effect sizes (R^2) to indicate substantive significance.

Results

Descriptive data and correlations among variables

Means, standard deviations, and bivariate correlations for all of the study variables are presented in Table 2. Alcohol coping motives were significantly and positively correlated with cannabis coping motives. Both alcohol and cannabis coping motives were positively correlated with social anxiety, depressive symptoms, and hazardous alcohol consumption. Cannabis coping motives were positively correlated with cannabis use, whereas alcohol coping motives were marginally positively correlated with cannabis use. Social anxiety and depressive symptoms were significantly and positively correlated. Moreover, depressive symptoms and alcohol consumption were marginally positively correlated; however, cannabis use and alcohol consumption were significantly positively correlated. Further, nicotine dependence and alcohol consumption were marginally negatively correlated. Gender, dummy coded such that males received a 1 and females a 0, was marginally positively correlated with cannabis use, suggesting that males used marginal increases in cannabis relative to females.

Primary analyses

Cannabis use—At Step 1, the model accounted for 16% of the variance (Table 3). Education level and cannabis coping motives significantly predicted quantity cannabis use. At Step 2, the model accounted for 15% of the variance, with no significant two-way

interactions emerging. The model at Step 3 accounted for 16% of the variance. A marginal three-way interaction emerging between cannabis coping motives, social anxiety, and depressive symptoms ($t = 1.76, p < .08, \beta = .17$), and it accounted for 21% of the unique variance.

Alcohol use—At Step 1, the model accounted for 30% of the variance with drinking motives emerging as a significant predictor (Table 4). The model at Step 2 accounted for 29% of the variance with no significant two-way interactions emerging, however, at Step 3, the model accounted for 32% of the variance, and two significant three-way interactions emerged: Alcohol Coping Motives X Social Anxiety X Depressive Symptoms and Cannabis Coping Motives X Social Anxiety X Depressive Symptoms. Simple slopes analyses involving the Alcohol Coping Motives X Social Anxiety X Depressive Symptoms interaction (Figure 1) demonstrated that among individuals with lower social anxiety symptoms, higher coping motives for alcohol use were associated with significantly greater drinking among those with greater depressive symptoms ($t = 3.9, p < .0002, \beta = .67$). Furthermore, among those with lower social anxiety symptoms, higher coping motives for alcohol use were associated with marginally greater drinking when depressive symptoms was low ($t = 1.88, p < .06, \beta = .28$). Simple slopes analyses further revealed that among smokers with higher social anxiety, coping motives for alcohol use were associated with significantly greater hazardous drinking, and this positive association was evinced among individuals both low ($t = 3.76, p = .0003, \beta = .88$) and high ($t = 5.32, p < .0001, \beta = .57$) in depressive symptoms.

Simple slopes analyses involving the Cannabis Coping Motives X Social Anxiety X Depressive Symptoms interaction (Figure 2) revealed that among smokers with higher social anxiety and higher depressive symptoms, cannabis coping motives were associated with a marginally greater alcohol consumption ($t = 1.76, p = .08, \beta = .34$). The regression line for those with lower depressive symptoms was not significantly different from zero ($t = -.73, p = .47, \beta = -.27$) indicating that the apparent association between cannabis coping motives and drinking among anxious individuals low in depressive symptoms was not significantly different from a slope of zero. Further, simple slopes analyses among smokers with lower social anxiety did not evince significant associations between coping motives for cannabis use and hazardous alcohol consumption for high ($t = -.43, p = .67, \beta = -.09$) or low ($t = 1.55, p = .12, \beta = .28$) depressive symptoms. This suggests that among smokers with lower social anxiety, cannabis coping motives are unrelated to drinking among those with both higher and lower depressive symptoms.

Nicotine dependence—At Step 1, the model accounted for 3% of the variance, with marital status emerging as a significant predictor (Table 4). The model at Step 2 accounted for 3% of the variance, with no significant two-way interactions. At Step 3, the model accounted for 4% of the variance and a significant three-way interaction emerged between cannabis coping motives, social anxiety, and depressive symptoms. Simple slopes analyses (Figure 2) revealed that among smokers with higher social anxiety, coping motives for cannabis use was associated with significantly greater nicotine dependence among those low in depressive symptoms ($t = 2.00, p = .049, \beta = .73$), but was unrelated to nicotine

dependence among those with higher depressive symptoms ($t = -1.59, p = .12, \beta = -.31$). Further, among smokers with lower social anxiety, the associations between coping motives for cannabis use and nicotine dependence were not significant among those higher ($t = -.48, p = .63, \beta = -.10$) and lower ($t = -.30, p = .77, \beta = -.05$) in depressive symptoms.

Discussion

The present study examined relations among coping motives for cannabis and alcohol use, social anxiety, and depressive symptoms with respect to hazardous alcohol consumption, nicotine dependence, and cannabis use in a sample of treatment-seeking smokers who reported cannabis and alcohol use. Consistent with predictions and with prior work (Buckner, 2013; Bujarski et al., 2012; Martens et al., 2008; Norberg, Olivier, Schmidt, & Zvolensky, 2014), cannabis coping motives were positively associated with cannabis use, and alcohol coping motives were positively associated with hazardous drinking. Also consistent with predictions, three-way interactions between coping motives and psychopathology variables emerged with respect to multiple substance use outcomes.

Alcohol coping motives, social anxiety, and depressive symptoms interacted significantly with respect to hazardous alcohol use. Regardless of anxiety level, alcohol coping motives were associated with higher levels of alcohol consumption, particularly among those with higher depressive symptomatology. However, among individuals with higher social anxiety, the positive association between alcohol coping motives and drinking was more pronounced (i.e., steeper slope) among those low in depressive symptoms. Further, individuals with lower social anxiety also reported greater hazardous drinking, regardless of their depressive symptoms or coping motives. Among individuals with lower social anxiety, the positive relationship between alcohol coping motives and drinking was less pronounced (ie, less steep slope) among those low in depressive symptoms. These results suggest that those at greater risk for more hazardous drinking were individuals reporting higher alcohol coping motives and higher depressive symptoms. Additionally, these results indicate that whether depressive symptoms or anxiety levels were high or low, alcohol coping motives were related to heavier drinking. Moreover, these findings also suggest that lower depressive symptomatology may not necessarily be 'protective' against using substances for coping reasons, as evinced by the steeper slope for the positive relation between alcohol coping motives and drinking among those lower in depressive symptoms. This finding is consistent with previous alcohol studies demonstrating that coping drinking motives were associated with greater drinking levels, particularly among individuals *lower* (versus higher) in depressive symptoms (Foster, Young, et al., 2014). It is possible that since drinking tends to be a social activity (e.g., Christiansen, Vik, & Jarchow, 2002), and as such, perhaps socially anxious persons with greater depression are more anhedonic and therefore less likely to attend social events (thus, these individuals may be less likely to drink to cope in those anxiety-provoking situations), whereas those with less depression may attend social events and thus drink to cope with elevated negative affectivity experienced during anxiety-provoking social interactions.

Findings also indicated that cannabis coping motives, social anxiety, and depressive symptoms interacted with respect to nicotine dependence and alcohol use, and marginally

with respect to cannabis use. In terms of alcohol consumption, among those with higher social anxiety, coping motives for cannabis use was associated with marginally greater drinking, particularly for those high in depressive symptoms. These results may indicate that to some extent, those at greater risk for hazardous drinking tend to be anxious individuals high in cannabis coping motives and depressive symptoms. It is possible that coping-oriented cannabis users may engage in more hazardous drinking as a function of seeking to use substances as a way to reduce stress or negative affect (Buckner, Schmidt, Bobadilla, & Taylor, 2006; Merrill, Wardell, & Read, 2009; Polivy, Schueneman, & Carlson, 1976; Stewart, Karp, Pihl, & Peterson, 1997). These findings are generally consistent with tension-reduction based models of substance misuse (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Conger, 1956; Terlecki & Buckner, 2014) in that more anxious individuals may use substances to cope with negative affect; however, further examinations, particularly of temporal relationships, are warranted. This pattern of findings may also reflect the social nature of substance use. Again, this may in part be explained by anxious individuals with more depressive symptoms being more anhedonic and less likely to participate in social activities, and in turn less likely to use cannabis for coping reasons in those situations (Auther et al., 2012).

Overall, to better understand problem drinking, it be useful to consider the role of coping-oriented motives with respect to cognitive-based substance-use processes. Previous work has found cross-substance effects (e.g., effects of cannabis motives on alcohol use and vice versa) for conformity and expansion motives, but not for coping motives (Foster et al., 2015). Cross-substance effects did not emerge in the present analyses. It is possible that beyond motives for coping, there are other variables at play which could be acting as risk factors for multi-substance use. Substance use studies have documented risk factors including smoking expectancies (Foster, Neighbors, & Prokhorov, 2014), self-efficacy related to resisting alcohol (Foster, Yeung, & Neighbors, 2014), and drink-related implicit associations (Foster, Neighbors, & Young, 2014). Moreover, associations between cognitively-based smoking processes (e.g., reasons for quitting, barriers to cessation) and alcohol consumption may indicate the possibility that individuals attempting to quit one substance might utilize other substances during change efforts (Foster, Neighbors, & Prokhorov, 2014). This observation, in conjunction with present findings, further supports the perspective that among multi-substance users, coping motives for using one substance (e.g., cannabis or alcohol) may pose difficulties to quitting or refraining from other substances (e.g., tobacco). These findings highlight the potential importance of tailoring multi-substance treatments to the specific needs of multi-users for whom single-substance interventions may be less effective (Holt, Litt, & Cooney, 2012; Joseph, Willenbring, Nugent, & Nelson, 2004). Thus, although it seems evident that anxiety is linked with adverse substance use outcomes, the relationship between depressive symptoms, and specifically the interactive relation between depressive symptoms and coping motives with respect to substance use remains more complex and in need of further theory-driven tests.

Taken together, the present findings suggest that with some exceptions, socially anxious individuals who report more coping reasons for using cannabis or alcohol might be at greater risk for adverse outcomes related to multiple substances. These results provide additional support to multi-substance use literature, which indicates that anxiety and other

negative affective factors may represent potential points of intervening against substance misuse and undesired consequences (Brook, Lee, Rubenstone, Brook, & Finch, 2014; Degenhardt, Hall, & Lynskey, 2001). Moreover, these findings support the perspective of examining benefits of concurrently treating co-occurring substance use (Holt, Litt, & Cooney, 2012; Joseph et al., 2004). However, it is also important to note that the present findings suggest that there may be a subset of individuals for whom these otherwise protective processes might be associated with increases in substance use. For instance, the present data showed that although increases in social anxiety was generally linked with adverse outcomes, the moderating effect of depressive symptoms appeared somewhat more complex. Depressive symptoms appeared to exacerbate the influence of social anxiety on outcomes in some instances (e.g., when alcohol coping motives was low with respect to drinking or when cannabis coping motives was low with respect to drinking), but not others (e.g., when cannabis coping motives was high with respect to nicotine dependence; Figure 2). These mixed results warrant additional examination to understand underlying mechanisms. It bears noting that treatment-seeking, multi-substance using samples may represent a population that engages health risk behaviors for complex reasons, and adequately tailored interventions are needed in order to meet specific needs of this population.

There are a number of study limitations. First, the current sample is relatively homogenous with respect to race (e.g., primarily Caucasian) and is comprised of a group of adult daily smokers who volunteered to participate in cessation treatment. A large proportion of cigarette smokers attempt to quit on their own without treatment (Raupach, West, & Brown, 2013), and thus, it will be important for researchers to draw from populations other than those included in the current study to address potential biases related to self-selection and to increase generalizability to other populations. Second, the present data were cross-sectional in nature. Accordingly, findings cannot elucidate processes over time or isolate causal relations between variables. Third, it is worth noting that the FTND exhibited low internal consistency, which is an issue that can emerge with this scale (Korte, Capron, Zvolensky, & Schmidt, 2013).

In conclusion, findings from the present study suggest that while there is significant interplay between coping motives for cannabis and alcohol, depressive symptoms, and social anxiety, many of these relationships are complex. Future theory-driven work is needed to explicate the nature of these interrelations in efforts to stimulate treatment efforts among multi-substance using populations.

ACKNOWLEDGMENTS

FUNDING

This project was supported by National Institute of Mental Health grant R01 MH076629-01 (Drs. Zvolensky and Schmidt). Additionally, preparation of this manuscript was supported in part by National Institute on Drug Abuse grant K12-DA-000167 (Dr. Foster). NIMH and NIDA had no direct role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication. The contents of this manuscript do not necessarily represent the policy of the NIMH or NIDA, and as such, endorsement by the Federal Government should not be assumed.

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Alcohol Coping Motives Interaction

Low Social Anxiety

High Social Anxiety

Slope	<i>t</i>	<i>p</i>	β	<i>t</i>	<i>p</i>	β
High Depression	3.9	0.0002	0.67***	5.32	<.0001	0.57***
Low Depression	1.88	0.06	0.28†	3.76	0.0003	0.88***

Figure 1.
Three-way interactions between social anxiety, depressive symptoms, and coping motives for alcohol use.

Cannabis Coping Motives Interactions

Low Social Anxiety

High Social Anxiety

Slope	<i>t</i>	<i>p</i>	β	<i>t</i>	<i>p</i>	β
High Depression	-0.43	0.67	-0.09	1.76	0.08	0.34†
Low Depression	1.55	0.12	0.28	-0.73	0.47	-0.27

Slope	<i>t</i>	<i>p</i>	β	<i>t</i>	<i>p</i>	β
High Depression	-0.48	0.63	-0.1	-1.59	0.12	-0.31
Low Depression	-0.3	0.77	-0.05	2	0.049	0.73*

Figure 2.

Three-way interactions between social anxiety, depressive symptoms, and coping motives for cannabis use.

Table 1

Demographic and substance use characteristics.

	Variable	%
Race/Ethnicity	White/Caucasian	82.23
	Black/Non-Hispanic	9.64
	Black/Hispanic	1.02
	Hispanic	3.05
	Asian	0.51
	Other	3.55
Relationship Status	Never Married	50.25
	Married/Serious Relationship	27.92
	Divorced or Annulled	16.24
	Widowed	2.54
	Separated	3.05
Education	Less than High School	2.59
	High School	23.86
	College	46.65
	Some Graduate School	20.3
	Graduate School	6.6
Most Common DSM-IV Axis I	Social Phobia	9.69
	Post-Traumatic Stress Disorder	3.06
	Alcohol Abuse	3.57
	Alcohol Dependence	3.06
	Generalized Anxiety Disorder	3.06
Cigarette Age of Onset	Before age of 18	83
Number of Years as Daily Cigarette Smoker	10 yrs	43
	20 yrs	18
	30 yrs	19
	40 yrs	17
	50 yrs	2
Number of Cigarettes Smoked at Heaviest Time	< 10	7
	< 20	35
	< 30	12
	< 40	16
	< 50	15
	50	6
Cannabis Age of Onset	Before age of 18	78
Number of Years as Daily Cannabis User	10 yrs	71
	20 yrs	10
	30 yrs	9

Variable		%
40 yrs		3
Alcohol Age of Onset	Before age of 18	82
Number of Years as a Regular Drinker	10 yrs	53
	20 yrs	14
	30 yrs	12
	40 yrs	10

Table 2Means, Standard Deviations, and Correlations among Variables ($N = 197$)

	1.	2.	3.	4.	5.	6.	7.	8.
1. Alcohol Coping Motives	-							
2. Cannabis Coping Motives	0.34***	-						
3. Social Anxiety	0.23**	0.31***	-					
4. Depressive Symptoms	0.30***	0.27***	0.56***	-				
5. Cannabis Use	0.12 [†]	0.34***	0.06	0.07	-			
6. Alcohol Consumption	0.54***	0.17*	0.07	0.13 [†]	0.17*	-		
7. Nicotine Dependence	0.04	-0.003	0.06	0.10	-0.11	-0.13 [†]	-	
8. Gender	0.01	-0.02	-0.10	-0.09	0.12 [†]	0.13	-0.04	-
<i>M</i>	42.74	49.64	8.23	42.09	2.30	8.71	7.58	57.87% male
<i>SD</i>	20.85	26.24	3.69	13.57	2.93	6.14	2.24	NA
Min	25.00	25.00	5.00	22.00	0.00	0.00	1.00	0.00
Max	125.00	125.00	24.00	82.00	22.00	25.00	12.00	1.00

 $p < .001$,**
 $p < .01$,*
 $p < .05$.[†]
 $p < .10$

Gender was dummy coded such that males received a 1 and females a 0

Table 3

Hierarchical regression analysis for variables predicting cannabis use from social anxiety, depressive symptoms, and coping motives related to alcohol and cannabis.

Predictor	B	SE	t	p	β	R ²	F
Step 1							
Gender	0.46	0.40	1.16	0.2488	0.08	0.1918	6.41***
Education Level	-1.20	0.43	-2.79	0.0058	-0.19**		
Marital Status	-0.93	0.45	-2.07	0.0395	-0.14		
Cannabis Motives (MMQ)	0.04	0.01	4.36	<.0001	0.32***		
Alcohol Motives (DMQ)	-0.0005	0.01	-0.05	0.9623	-0.003		
Anxiety	-0.06	0.06	-0.94	0.3490	-0.08		
Depressive Symptoms	0.01	0.02	0.54	0.5893	0.04		
Cannabis Use							
Step 2							
MMQ*Anxiety	-0.002	0.002	-0.98	0.3294	-0.07	0.1978	4.15***
MMQ*Depression	-0.0001	0.001	-0.15	0.8834	-0.01		
DMQ*Anxiety	-0.0003	0.003	-0.09	0.9315	-0.01		
DMQ*Depression	0.0000	0.001	0.05	0.9584	0.005		
Step 3							
MMQ*Anxiety*Depression	0.0003	0.0002	1.76	0.0802	0.17†	0.2144	3.84***
DMQ*Anxiety*Depression	-0.0002	0.0002	-1.11	0.2700	-0.13		

Note. N = 197 All predictor variables were centered.

Gender was dummy coded such that males received a 1 and females a 0.

Education level was dummy coded such that college completers received a 1 and non-completers a 0.

Marital status was dummy coded such that married individuals received a 1 and non-married a 0.

Table 4

Hierarchical regression analysis for variables predicting alcohol use and nicotine dependence, from social anxiety, depressive symptoms, and coping motives related to alcohol and cannabis.

	Predictor	B	SE	t	p	β	R ²	F
Alcohol Use	Step 1						0.3263	13.08***
	Gender	1.22	0.76	1.60	0.1110	0.10		
	Education Level	-0.80	0.83	-0.97	0.3353	-0.06		
	Marital Status	-1.23	0.86	-1.42	0.1561	-0.09		
	Cannabis Motives (MMQ)	-0.004	0.02	-0.23	0.8161	-0.02		
	Alcohol Motives (DMQ)	0.16	0.02	8.27	<.0001	0.54***		
	Anxiety	-0.11	0.12	-0.92	0.3565	-0.07		
	Depressive Symptoms	0.01	0.03	0.34	0.7307	0.03		
	Step 2						0.3303	8.29***
	MMQ*Anxiety	0.004	0.004	1.02	0.3094	0.07		
Alcohol Use	Step 3						0.3628	8.01***
	MMQ*Anxiety*Depression	0.001	0.0004	2.13	0.0343	0.19*		
	DMQ*Anxiety*Depression	-0.001	0.0004	-2.45	0.0151	-0.25*		
	Step 1						0.0694	2.01†
	Gender	0.07	0.33	0.23	0.8195	0.02		
	Education Level	0.17	0.35	0.48	0.6312	0.03		
	Marital Status	1.20	0.37	3.25	0.0014	0.24***		
	Cannabis Motives (MMQ)	-0.002	0.01	-0.26	0.7985	-0.02		
	Alcohol Motives (DMQ)	0.01	0.01	0.72	0.4732	0.06		
	Anxiety	0.03	0.05	0.54	0.5873	0.05		
Nicotine Dependence	Step 2						0.0802	1.47
	MMQ*Anxiety	0.001	0.002	0.71	0.4764	0.06		
	MMQ*Depression	-0.001	0.0005	-1.15	0.2521	-0.09		
	DMQ*Anxiety	0.002	0.003	0.64	0.5209	0.06		
	DMQ*Depression	-0.0001	0.001	-0.23	0.8148	-0.02		
	Step 3						0.1079	1.70†
	MMQ*Anxiety*Depression	-0.0003	0.0002	-2.22	0.0276	-0.23*		
	DMQ*Anxiety*Depression	-0.0003	0.0002	-2.22	0.0276	-0.23*		
	DMQ*Anxiety*Depression	-0.0003	0.0002	-2.22	0.0276	-0.23*		
	DMQ*Anxiety*Depression	-0.0003	0.0002	-2.22	0.0276	-0.23*		

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Predictor	B	SE	t	p	β	R ²	F
DMQ*Anxiety*Depression	0.0002	0.0002	1.16	0.2476	0.14		

Note. N = 197 All predictor variables were centered.

Gender was dummy coded such that males received a 1 and females a 0.

Education level was dummy coded such that college completers received a 1 and non-completers a 0.

Marital status was dummy coded such that married individuals received a 1 and non-married a 0.