HHS Public Access

Author manuscript

Addict Disord Their Treat. Author manuscript; available in PMC 2016 September 01.

Published in final edited form as:

Addict Disord Their Treat. 2015 September ; 14(3): 139–151. doi:10.1097/ADT.0000000000000065.

Cannabis Motives and Quitting Tobacco: Smoking Expectancies and Severity among Treatment-seeking Cigarette Smokers

Dawn W. Foster, Ph.D.[1], **Nicholas P. Allan, M.A.**[2], **Norman B. Schmidt, Ph.D.**[2], and **Michael J. Zvolensky, Ph.D.**[3]

[1]Yale University, Yale School of Medicine, New Haven CT

[2]Florida State University, Department of Psychology, Tallahassee FL

[3]University of Houston, Department of Psychology, Houston TX

Abstract

Objective—The present research examined the impact of cannabis motives on tobacco outcomes.

Methods—The sample included 403 daily smokers (214 males, mean age 35.24 years). A bifactor model of cannabis motives was examined to determine whether this approach might best elucidate relations between cannabis motives and smoking.

Results—Coping motives were associated with reduced barriers for smoking, fewer negative smoking expectancies, and decreased positive reinforcement with respect to smoking. Conformity motives were associated with fewer internal smoking barriers. Expansion motives were associated with more positive reinforcement related to smoking. Enhancement motives were associated with reductions in smoking for appetite/weight control consequences. The general motives variable, comprised of each of the five motives subscales, was associated with more barriers related to tobacco addiction, more external barriers, greater positive reinforcement consequences, and more negative expectancies. Coping motives were negatively associated with quit status, and were positively associated with quit status.

Conclusions—Cannabis motives subscales were not uniformly predictive of quit success. Individuals who used cannabis for conformity reasons were more likely to successfully quit smoking, however, individuals who used cannabis for coping reasons were less likely to quit smoking. Thus, those who use cannabis for conformity reasons are less likely to turn to cannabis during times of stress or to relieve tension or anxiety, a view supported by existing literature. This suggests that individuals who use cannabis for coping reasons may represent a population vulnerable to cannabis misuse and problems. Additional work is needed to better understand underlying mechanisms.

Please direct all correspondence regarding this manuscript to Dawn W. Foster in the Yale School of Medicine, New Haven, CT 06519. Phone: (203)974-7892, dawn.foster@yale.edu.

Dawn Foster and Nicholas Allan drafted the manuscript. Michael Zvolensky and Norman Schmidt conceptualized theoretical bases of the grant 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.

Keywords

cannabis; marijuana; motivation; tobacco; cigarettes

Cannabis and tobacco frequently co-occur [1,2]. Cannabis use promotes the transition to greater tobacco use [3], and tobacco use is a key precursor to cannabis relapse [4]. Further, co-users tend to believe that they are more addicted to nicotine [5] and are less likely to quit smoking cigarettes relative to those who do not use cannabis [6,7]. Thus, efforts to better understand underlying mechanisms and cognitive processes are warranted in order to further inform co-use interventions.

A small but growing body of literature has examined the cross-substance links between cannabis and tobacco [8,9]. This work has included examinations from a motivational framework, and indicates that among tobacco users, cannabis motives are linked with increased quantity and frequency of cannabis use [8,10]. Moreover, explorations of individual characteristics show that anxiety sensitivity moderates the effect of enhancement motives on cannabis use among daily smokers [8]. Further, specific cannabis motives have been linked with use: coping motives are associated with negative emotional symptoms, whereas enhancement motives are linked with positive affect [11] and with the use of alcohol and tobacco [9]. Thus, cannabis motives contributed unique variance to non-cannabis substance use including nicotine dependence and the number of cigarettes smoked per day [9]. Taken together, the cross-substance literature indicate that substance use and reasons thereof can influence the use of and other substances. Although some work has shown cross-substance links with respect to motivation, additional work is needed to better understand the impact of motives not only on cognitively-based factors important to quit processes, but also the impact on actual success in quitting. Recent work in this arena has shown that among non-treatment seeking cannabis smokers have motives similar to cigarette smokers who later quit without formal treatment [12]. While this work evinced relations among motives and quit success in a convenience sample [12], there still exists a gap in knowledge with respect to quit success among treatment-seeking samples, and as such, further examination is needed.

Current study

The present research was designed to address this gap in the literature by better elucidating the impact of cannabis motives on cognitive factors associated with quitting tobacco and success in quitting tobacco use. We specifically sought to examine whether latent variables representing each of the five cannabis motives subscales (social, enhancement, coping, conformity, and expansion), and a general latent cannabis motives variable (comprised of all five subscales), would evince predictive validity with respect to tobacco-related barriers, expectancies, and quit success. Our hypothesis was that cannabis motives would be associated with tobacco outcomes such that having more reasons to use cannabis (e.g., reporting more motives) would be linked with more barriers to cessation, stronger smoking expectancies (e.g., desiring to control appetite/weight via cigarettes), and difficulty quitting (e.g., lower quit success). Structural equation modeling (SEM) was utilized to test this hypothesis, based on its strengths to account for measurement errors of the observed

variables by modeling them as latent constructs [13]. Further, a bifactor model of cannabis motives was examined to determine whether this approach might best elucidate the relations between cannabis motives and smoking consequences. The benefit of this approach, in which common variance among cannabis motives is separated from variance specific to a particular motive, is that the effects of each specific motive can be examined independent of overall desire to use cannabis [14,15].

Method

Participants

The sample consisted of 403 daily smokers who responded to advertisements about a smoking cessation treatment study. As shown in Table 1, the sample was primarily male (n = 214, 53%), with a mean age of 35.24 years (*SD* = 13.45). Participants were mainly White/Caucasian (n = 324, 85%) and had never married (n = 181, 47%). Of the sample, 46% met criteria for at least one current Axis I diagnosis, and the most common diagnoses were Social Phobia (11%), Generalized Anxiety Disorder (5%), Alcohol Abuse (3%), and Alcohol Dependence (3%).

Most of the sample reported having started smoking cigarettes before the age of 18 (n = 322, 80%). Under half of the sample reported ten years or less of being a regular daily cigarette smoker (n = 160, 40%), and the other half of the sample reported smoking cigarettes daily for either 20 years or less (n = 77, 19%), 30 years or less (n = 72, 18%), 40 years or less (n = 61, 15%), or 50 years or less (n = 12, 3%). Participants reported the number of cigarettes smoked when smoking the heaviest as under 10 (n = 22, 5%), under 20 (n = 86, 21%), under 30 (n = 49, 12%), under 40 (n = 63, 16%), under 50 (n = 48, 12%), or at least 50 (n = 17, 4%). The majority of the sample reported having started using cannabis before the age of 18 (n = 291, 72%). Most of the respondents indicated being a regular daily cannabis user for 10 years or less (n = 231, 57%). Of the remaining, 30 participants (7%) indicated using cannabis regularly for 20 years or less, 17 (4%) endorsed 30 years or less, and 7 (2%) endorsed 40 years or less of regular cannabis use.

Measures

Demographics: Participants reported demographic information including gender, age, and race/ethnicity.

Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I): Diagnostic assessments were conducted using the SCID-I-NP Non-Patient Version; [16] to assess DSM-IV-TR diagnoses for past and current Axis I disorders [16,17]. All SCID-I interviews were administered by trained research assistants or doctoral level staff and were supervised by independent doctoral-level professionals. Additionally, interviews were audio-taped and the reliability of a random selection of 12.5% of interviews were reviewed for accuracy (MJZ); no cases of diagnostic coding disagreement were noted.

Motives for cannabis use: The Marijuana Motives Questionnaire (MMQ) was utilized to assess reasons or motives for using cannabis [18,19]. The MMQ is comprised of 25 items and

has shown high levels of internal consistency for each of the five factors [20]. Respondents rated items on a 5-point scale ranging from 1 (*Never/Almost Never*) to 5 (*Almost Always/ Always*). The MMQ yields five subscales including social motives (six items; e.g., "Because it helps me enjoy a party"; α = .89), coping motives (four items; e.g., "To forget my worries"; α = .90), enhancement motives (five items; e.g., "Because I like the feeling"; α = . 92), conformity motives (five items; e.g., "Because my friends pressure me to use marijuana"; α = .90), and expansion motives (five items; e.g., "Because it helps me be more creative and original"; α = .95).

Smoking consequences: The Smoking Consequences Questionnaire (SCQ) [21] is a 50-item measure that assesses tobacco outcome expectancies believed to underlie smoking motivation on a Likert-type scale, ranging from 0 ("*completely unlikely*") to 9 ("*completely likely*"). The four constituent factors of the SCQ are: 1) Negative Consequences (perceived unpleasantness of smoking effects; α = .88); 2) Positive Reinforcement-Sensory Satisfaction (positive emotional states; α = .87); 3) Negative Reinforcement-Negative Affect Reduction (negative emotional states, α = .94); and 4) Appetite-Weight Control (desired outcome of controlling weight; α = .91). The SCQ has demonstrated adequate psychometric properties and predictive validity [22], and the subscales demonstrated high levels of internal consistency in the current sample (all α's > .80).

Barriers to smoking cessation: The Barriers to Cessation Scale (BCS) assesses barriers or specific stressors associated with smoking cessation [23]. The BCS consists of 19-items on which respondents indicate, on a 4-point Likert-style scale (0 = *"not a barrier"* to 3 = *"large barrier"*), the extent to which they identify with each of the listed barriers to cessation. Good internal consistency has been reported, as has good content and predictive validity [23,24]. Three subscales reflect different types of stressors associated with quitting smoking: 1) Addictive Barriers (withdrawal symptoms of feeling lost without cigarettes; α = 89); 2) External Barriers (triggers or encouragement from friends; α = 75); and 3) Internal Barriers (emotions or feeling in control of moods; α = 74) [23].

Positive and negative symptoms: The Positive Affect Negative Affect Schedule (PANAS) is a 20-item, trait-like measure of positive and negative affect [25]. Mood descriptors, such as "Nervous" or "Excited," were rated on a 5-point Likert-style scale, with instructions to rate "to what extent you generally feel this way, that is, how you feel on average." Both 10-item positive and negative affect subscales have demonstrated good psychometric properties [26], strong internal consistency and test-retest reliability [25]. The PANAS negative affect scale was used for the present study, with higher scores reflecting greater self-reported negative affectivity (α = .92 in the current sample).

Quit status: Smoking cessation was assessed two weeks following baseline. The quit status variable was dummy coded such that participants with carbon monoxide (CO) levels of 4 ppm or below at Week 2 were categorized as quitters and received a 1. Those with CO levels greater than 4 ppm at Week 2 were categorized as non-quitters and received a 0 [27].

Cigarette smoking history: The Smoking History Questionnaire [28], a 31-item measure, was used to assess smoking rate, age of onset of initiation, years of being a daily smoker,

and other characteristics [28]. Smoking rate was obtained from the open-ended question, "Since you started regular daily smoking, what is the average number of cigarettes you smoked per day?"

Cannabis use history: Cannabis use was assessed using the 40-item Marijuana Smoking History Questionnaire (MSHQ). The MSHQ assesses history and patterns of cannabis use [29]. Example items include "How many years have you smoked marijuana?" and "Think about your smoking during the last week, how much marijuana did you smoke per occasion in an average day?" Participants rated the latter item 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. Previous research has used the MSHQ as a successful indicator of cannabis use [30].

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 [31]. Items include quantity and frequency of drinking, heavy consumption, tolerance, dependence, and alcohol problems. The AUDIT has demonstrated good psychometric properties [32]. The AUDIT's internal consistency alpha was .85 in the present sample, and in past work it has reliably distinguished between harmful, hazardous, and no drinking histories [31,33]. For example, a score of 8 on the AUDIT produces 85% sensitivity and 89% specificity for hazardous or harmful drinking [34].

Medical history: The current research team developed the Medical Screening Questionnaire (MSQ) to assess medical history. Items of interest for the present study involved those specific to substance-use disease in which participants indicated having ever been diagnosed with the following (0 = no, 1 = yes): heart problems, hypertension, respiratory disease, and asthma. As in past work [35], a composite score for health problems was created from this measure, ranging from 0–4, with greater scores reflecting the occurrence of multiple markers of tobacco-related disease.

Procedure—Participants included in the present analyses were daily smokers recruited to a larger study via community-based advertisements including radio announcements, newspaper ads, and flyers. The larger study examined efficacy of a standard smoking cessation program and novel four-session smoking cessation behavioral intervention focused on vulnerability to panic (Panic-Smoking Program). Data for the present analyses came from the baseline assessment and two-week follow-up of the larger trial. Participants were scheduled for an in-person baseline assessment during which they provided written informed consent and were evaluated according to inclusion and exclusion criteria. Participants were then interviewed using the SCID and completed a battery of self-reported measures. Carbon monoxide was assessed during follow-up. This study was approved by the institutional review boards (IRBs) at Florida State University and the University of Vermont.

Data Analytic Procedure

Zero-order correlations and univariate statistics were first computed for all relevant variables. Confirmatory factor analysis (CFA) in Mplus version 7 [36] was then used to

examine the measurement model of the cannabis motives factors (i.e., Social, Coping, Enhance, Conform, and Expansion Motives). Two models were compared, a correlated factors model, in which cannabis motives factors were created using item-level data and were allowed to correlate freely across factors. However, because prior studies have shown a high degree of overlap among the factors, which can result in multicollinearity when using cannabis motives jointly as predictors, another model, in which common variance, attributable to all items, formed a common Cannabis Motives factor, and variance attributable only to the cluster of items associated with each cannabis motives scale, formed specific, orthogonal factors.

Cannabis motive items were treated as categorical and the default robust weighted least squares estimator was used (WLSMV in Mplus). Models were scaled by fixing the variance of the factors to 1. The correlated factors model was compared to the bifactor model using the DIFFTEST option in Mplus. A nonsignificant value indicated that the bifactor model did not improve upon model fit of the correlated factors model. Overall model fit was examined using the χ^2 statistic with a nonsignificant value indicating good model fit. However, the χ^2 statistic may be too restrictive, especially with larger sample sizes and many items per factor (Hu & Bentler, 1999; Moshagen, 2012; Mulaik, 2007). Therefore, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA) were also used to provide additional model fit information. CFI values greater than .90 and RMSEA values less than .08 indicate adequate fit and CFI values greater than .95 and RMSEA values less than .05 indicate good fit [37,38]. Confidence intervals (CIs) for the RMSEA were also employed, with a lower bound CI containing .05 indicating that good fit cannot be rejected and an upper bound CI containing .10 indicating that poor fit cannot be rejected.

Once the best-fitting model of cannabis motives was selected, structural equation models (SEMs) were conducted to examine the concurrent relations between cannabis motives and 1) the BCS factors (i.e., BCS Addiction, BCS External, and BCS Internal), and 2) the SCQ scales (i.e., SCQ Negative Consequences, SCQ Positive Reinforcement, SCQ Negative Reinforcement, and SCQ Appetite/Weight Control), separately. The SCQ variables were treated as scales because a CFA indicated that these scales did not form distinct latent factors. Control variables included smoking rate (as measured by SHQ item 4), AUDIT total score, PANAS NA, health problems, and gender (females coded as 0, males as 1). Items for the BCS were treated as categorical. Finally, an SEM was conducted to examine the effects of the cannabis motives on smoking cessation at week 2 (0 = did not quit smoking, 1 = quit smoking), including all prior control variables as well as treatment condition (1 = active, 2 = control).

Results

Descriptive Statistics and Correlations

Descriptive statistics and correlations for all relevant predictor, control, and outcome variables are provided in Table 2. Regarding missing data, 7 individuals did not have PANAS NA scores, 16 did not have AUDIT scores and one did not have medical history. These were included in the analyses by including the means in the SEMs. At week two, the sample consisted of 173 participants, 67 of whom had not quit smoking and 101 who had

quit smoking. Comparison of mean baseline levels of independent and dependent variables indicated that individuals who dropped out had higher levels of MMQ Coping Motives (M = 9.94, SD = 5.82) than did individuals who were present at week 2 follow-up (M = 8.20, SD = 4.29; $F_{1, 401}$ = 10.99, p < .001). Individuals who dropped out also had higher levels of MMQ Expansion Motives (M = 9.88, SD = 6.21) than did individuals who were present at week 2 follow-up (M = 8.52, SD = 5.22; $F_{1, 401}$ = 5.41, p < .05). Finally, individuals who dropped out had lower levels of SCQ Negative Consequences (M = 6.47, SD = 1.36) than did individuals who were present at week 2 follow-up (M = 6.74, SD = 1.13; $F_{1, 401}$ = 10.99, p < .05). There were no other significant differences in independent or dependent variables.

Confirmatory Factor Analysis of Cannabis Motives

The correlated factors model of the five cannabis motives factors provided adequate overall model fit (χ^2 = 720.02, df = 265, p < .05, CFI = .99, RMSEA = .07, 95% CI [.06, .07]). The bifactor model of including orthogonal general and specific cannabis motives factors also provided adequate model fit (χ^2 = 634.98, df = 250, p < .05, CFI = .99, RMSEA = .06, 95% CI [.06, .07]). Model comparison using the DIFFTEST option in Mplus indicated that the bifactor model fit the data better than the correlated factors model ($\Delta\chi^2$ = 71.70, df = 15, p < .001. Standardized model parameters are provided in Figure 1. With the exception of item 9 (“Because it’s exciting”) on the Enhancement factor, all items loaded significantly on the specific factors as well as on the General Cannabis Motives factor.

Structural Equation Models of the Relations between Cannabis Motives and Smoking Variables

The SEM including the General Cannabis Motives factor, the specific cannabis motives factors, and the control variables predicting the BCS Addiction, BCS External, and BCS Internal factors provided adequate fit to the data (χ^2 = 1691.74, df = 948, p < .05, CFI = .98, RMSEA = .04, 95% CI [.04, .05]). Model parameters are provided in Table 3. Accounting for the control variables, the BCS Addiction factor was significantly, negatively associated with the Coping Motives factor (β = −.21, p < .01) and the Conformity Motives factor (β = −.15, p < .05) and significantly, positively associated with the General Cannabis Motives factor (β = .18, p < .05). The BCS External factor was significantly, positively associated with the General Cannabis Motives factor (β = .19, p < .05). Finally, the BCS Internal factor was significantly, negatively associated with the Conformity Motives factor (β = −.14, p < .05).

The SEM including the specific and General Cannabis Motives factors and the control variables predicting the SCQ manifest variables (i.e., Negative Consequences, Positive Reinforcement, Negative Reinforcement, and Appetite/Weight Control) provided adequate fit to the data (χ^2 = 908.77, df = 431, p < .05, CFI = .99, RMSEA = .05, 95% CI [.05, .06]). Model parameters are provided in Table 4. Accounting for the control variables, the SCQ Negative Consequences scale was significantly, negatively associated with the Coping Motives factor (β = −.16, p < .05). The SCQ Positive Reinforcement scale was significantly, negatively associated with the Coping Motives factor (β = −.17, p < .05), and significantly, positively associated with the Expansion Motives factor (β = .18, p < .01) and the General Cannabis Motives factor (β = .24, p < .001). The SCQ Negative Reinforcement scale was

significantly, positively associated with the General Cannabis Motives factor only (β = .14, $p < .05$). Finally, the SCQ Appetite/Weight Control scale was not significantly associated with any of the cannabis motives factors.

Structural Equation Model Examining the Effects of the Cannabis Motives on Quit Status Following a Smoking Intervention

The SEM including the specific and General Cannabis Motives factors and the control variables (including treatment condition) predicting quit status at week 2) provided adequate fit to the data ($\chi^2 = 698.39$, $df = 403$, $p < .05$, CFI = .98, RMSEA = .07, 95% CI [.06, .07]). Model parameters (in probit regression coefficients) are provided in Table 5. The only significant predictors of week 2 quit status were the Coping Motives factor ($B_{probit} = -.42$, $p < .01$), which was negatively associated with having quit, and the Conformity Motives factor ($B_{probit} = .24$, $p < .05$), which was positively associated with having quit. At mean levels of all predictors, the probability of having quit smoking at week 2 was 53.2%. The probability of having quit smoking at week 2 was 68.4% at 1 *SD* below the mean levels of Coping Motives and only 35.9% at 1 *SD* above the mean levels of Coping Motives. The probability of having quit smoking at week 2 was 42.9% at 1 *SD* below the mean levels of Conformity Motives and 61.8% at 1 *SD* above the mean levels of Conformity Motives.

Discussion

The present research examined relationships among cannabis motives, barriers to cessation, smoking consequences, and follow-up quit status were examined in a sample of daily cigarette smokers. Our hypothesis was that cannabis motives would be associated with more barriers to cessation, stronger smoking expectancies, and greater difficulty quitting over and above theoretically relevant variables. Results supported these expectations and showed that cannabis motives were associated with subscales of the barriers to cessation scale. Specifically, coping motives were associated with reduced barriers related to tobacco addiction, fewer negative smoking expectancies, and decreased positive reinforcement with respect to smoking. Conformity motives were associated with fewer internal smoking barriers. Expansion motives were associated with reporting more positive reinforcement related to smoking. The general motives variable, comprised of variance common to all cannabis motives, was associated with reporting more barriers related to tobacco addiction, having more external barriers, reporting greater positive reinforcement consequences, and more negative expectancies. Taken together, these findings lend support to the cross-substance perspective that motives for using one substance (cannabis) influence cognitive factors important to quitting another (tobacco).

Results from a bifactor model supported predictions in that significant relationships emerged between motives and quit factors. When examining quit status at Week 2 in the bifactor model, two significant relationships emerged, the first being between conformity motives and quit status, and the second being between coping motives and quit status. Conformity motives positively predicted the probability of having quit smoking at Week 2, whereas coping motives negatively predicted quit status. In other words, individuals who used cannabis for conformity reasons were more likely to successfully quit smoking, however,

individuals who used cannabis for coping reasons were less likely to quit smoking. It is possible that relative to those who use cannabis for coping reasons, those who use cannabis for conformity reasons are less likely to turn to cannabis during times of stress or to relieve tension or anxiety. Extant literature supports this view, and suggests that individuals who use cannabis for coping reasons may represent a population vulnerable to cannabis misuse and problems [39,40].

To our knowledge, the current study is the first to examine the factor structure of cannabis motives using bifactor modeling [14,15]. An important benefit of SEM is the ability to model latent variables with reduced measurement error. In spite of this, many studies involving the relations between MMQ subscales and external variables are conducted using regression-based techniques [41,42]. One barrier might be the increased likelihood of multicollinearity when conducting SEM as compared to SEM, due to the reduction in measurement error. Results from a simulation study indicate that in instances of high multicollinearity (i.e., correlations between factors greater than .80), the likelihood of producing improper solutions (i.e., inaccurate parameter estimates and standard error estimates as well as Type II errors) was likely [43]. Even in instances of more moderate multicollinearity (i.e., correlations between factors from .60 to .80) there was still a greater than 50% chance of Type II errors, especially when reliability is low and the effects are small. Although not reported, most of the correlations between MMQ factors exceeded .60 (7 of 10) and one even exceeded the .80 threshold. Therefore, results of the present analyses indicate that researchers interested in examining MMQ subscales using SEM would likely benefit from separating cannabis motives into a general motivation to use cannabis factor orthogonal to more specific motivations for using cannabis to examine specificity of each of the cannabis motives.

Limitations

The strengths of the present work must be considered in light of its limitations. First, regarding the present data, results indicate short term impact (two weeks) of cannabis motives on smoking cessation. Although this is an improvement on cross-sectional designs, additional work is needed to understand whether motives for cannabis use have more distal impacts on quitting tobacco. Thus, further research is needed to evaluate the behavioral significance of these results and assess clinical benefit versus cost of implementing interventions or programs designed to target cannabis motives. Second, the relatively homogeneous demographic composition of the present sample may limit generalizability of findings to other racial/ethnic or age groups. Also related to generalizability, the present sample was comprised of adult smokers who volunteered for a smoking cessation intervention, and as such, additional work is needed to understand whether findings extend to populations that are not treatment-seeking. Third, we oriented the present work on an *a priori* basis on the role of cannabis motives in terms of smoking processes and behavior. However, explorations of the role of smoking motives on cannabis processes and behavior are warranted. Finally, key variables were assessed via self-report, and thus, there is the possibility that observed relations were in part a function of shared method variance.

Conclusions

The present study was designed to examine the impact of cannabis motives on cognitively-based factors important to quitting tobacco use. In particular, we examined effects of latent cannabis motives variables on tobacco-related barriers and expectancies, and success in quitting. Results supported expectations that significant relationships would emerge, however closer examinations revealed that cannabis motives subscales were not uniformly predictive of quit success. Additional work is needed to better understand underlying mechanisms and potential points of intervention.

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.

References

1. Agrawal A, Lynskey MT. Tobacco and cannabis co-occurrence: does route of administration matter? Drug and alcohol dependence. 2009; 99(1–3):240–247. [PubMed: 18926646]
2. Leatherdale ST, Hammond DG, Kaiserman M, Ahmed R. Marijuana and tobacco use among young adults in Canada: are they smoking what we think they are smoking? Cancer causes & control: CCC. 2007; 18(4):391–397. [PubMed: 17235494]
3. Agrawal A, Madden PA, Bucholz KK, Heath AC, Lynskey MT. Transitions to regular smoking and to nicotine dependence in women using cannabis. Drug and alcohol dependence. 2008; 95(1–2): 107–114. [PubMed: 18325694]
4. Haney M, Bedi G, Cooper ZD, et al. Predictors of marijuana relapse in the human laboratory: robust impact of tobacco cigarette smoking status. Biological psychiatry. 2013; 73(3):242–248. [PubMed: 22939992]
5. Okoli CT, Richardson CG, Ratner PA, Johnson JL. Adolescents' self-defined tobacco use status, marijuana use, and tobacco dependence. Addictive behaviors. 2008; 33(11):1491–1499. [PubMed: 18571870]
6. Ford DE, Vu HT, Anthony JC. Marijuana use and cessation of tobacco smoking in adults from a community sample. Drug and alcohol dependence. 2002; 67(3):243–248. [PubMed: 12127195]
7. Gourlay SG, Forbes A, Marriner T, Pethica D, McNeil JJ. Prospective study of factors predicting outcome of transdermal nicotine treatment in smoking cessation. Bmj. 1994; 309(6958):842–846. [PubMed: 7950614]
8. Norberg MM, Olivier J, Schmidt NB, Zvolensky MJ. Cannabis use among treatment-seeking smokers: motives and the moderating effects of anxiety sensitivity. The American journal on addictions/American Academy of Psychiatrists in Alcoholism and Addictions. 2014; 23(1):7–14. [PubMed: 24313235]
9. Foster, DW.; Allan, NP.; Zvolensky, MJ.; Schmidt, NB. The influence of cannabis motives on alcohol, cannabis, and tobacco use among treatment-seeking cigarette smokers. Manuscript submitted for review. under review
10. Bonn-Miller MO, Zvolensky MJ, Bernstein A. Marijuana use motives: concurrent relations to frequency of past 30-day use and anxiety sensitivity among young adult marijuana smokers. Addictive behaviors. 2007; 32(1):49–62. [PubMed: 16647822]
11. Bonn-Miller MO, Vujanovic AA, Feldner MT, Bernstein A, Zvolensky MJ. Posttraumatic stress symptom severity predicts marijuana use coping motives among traumatic event-exposed marijuana users. Journal of traumatic stress. 2007; 20(4):577–586. [PubMed: 17721963]

12. Chauchard E, Levin KH, Copersino ML, Heishman SJ, Gorelick DA. Motivations to quit cannabis use in an adult non-treatment sample: are they related to relapse? Addictive behaviors. 2013; 38(9):2422–2427. [PubMed: 23685328]
13. Kline, RB. Principles and practice of structural equation modeling. New York, NY: Guilford Press; 2011.
14. Chen FF, Hayes A, Carver CS, Laurenceau JP, Zhang Z. Modeling general and specific variance in multifaceted constructs: a comparison of the bifactor model to other approaches. Journal of personality. 2012; 80(1):219–251. [PubMed: 22092195]
15. Reise SP. Invited Paper: The Rediscovery of Bifactor Measurement Models. Multivariate behavioral research. 2012; 47(5):667–696. [PubMed: 24049214]
16. First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JB. Structured Clinical Interview for DSM-IV Axis I Disorders- Patient Edition (SCID -I/P, Version 2.0). New York: Biometric Research Department; 1995.
17. BFM; WWJB; Spitzer, RL.; Gibbon, M. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Clinical Trials Version (SCID-CT). New York: Biometrics Research, New York State Psychiatric Institute; 2007.
18. Simons J, Correia CJ, Carey KB. A comparison of motives for marijuana and alcohol use among experienced users. Addictive behaviors. 2000; 25(1):153–160. [PubMed: 10708331]
19. Simons JC, Christopher J, Carey Kate B, Borsari Brian E. Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. Journal of Counseling Psychology. 1998; 45(3):265–273.
20. Zvolensky MJ, Vujanovic AA, Bernstein A, Bonn-Miller MO, Marshall EC, Leyro TM. Marijuana use motives: A confirmatory test and evaluation among young adult marijuana users. Addictive behaviors. 2007; 32(12):3122–3130. [PubMed: 17602842]
21. Brandon TH, Baker TB. The Smoking Consequences Questionnaire: The subjective expected utility of smoking in college students. Psychological Assessment. 1991; 3:484–491.
22. Wetter DW, Smith SS, Kenford SL, et al. Smoking outcome expectancies: factor structure, predictive validity, and discriminant validity. Journal of abnormal psychology. 1994; 103(4):801–811. [PubMed: 7822583]
23. Macnee CL, Talsma A. Development and testing of the barriers to cessation scale. Nursing research. 1995; 44(4):214–219. [PubMed: 7624231]
24. Macnee CL, Talsma A. Predictors of progress in smoking cessation. Public health nursing. 1995; 12(4):242–248. [PubMed: 7667177]
25. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. Journal of personality and social psychology. 1988; 54(6): 1063–1070. [PubMed: 3397865]
26. Merz EL, Malcarne VL, Roesch SC, et al. Psychometric properties of Positive and Negative Affect Schedule (PANAS) original and short forms in an African American community sample. Journal of affective disorders. 2013; 151(3):942–949. [PubMed: 24051099]
27. Perkins KA, Karelitz JL, Jao NC. Optimal carbon monoxide criteria to confirm 24-hr smoking abstinence. Nicotine & tobacco research: official journal of the Society for Research on Nicotine and Tobacco. 2013; 15(5):978–982. [PubMed: 22990219]
28. Brown RA, Lejuez CW, Kahler CW, Strong DR. Distress tolerance and duration of past smoking cessation attempts. Journal of Abnormal Psychology. 2002; 111(1):180–185. [PubMed: 11866171]
29. Bonn-Miller MO, Zvolensky MJ. An evaluation of the nature of marijuana use and its motives among young adult active users. The American journal on addictions/American Academy of Psychiatrists in Alcoholism and Addictions. 2009; 18(5):409–416. [PubMed: 19874161]
30. Buckner JD, Zvolensky MJ, Schmidt NB. Cannabis-related impairment and social anxiety: the roles of gender and cannabis use motives. Addictive behaviors. 2012; 37(11):1294–1297. [PubMed: 22766487]
31. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, 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. 1993; 88(6):791–804. [PubMed: 8329970]

32. Maisto SA, Conigliaro J, McNeil M, Kraemer K, Kelley ME. An empirical investigation of the factor structure of the AUDIT. Psychological assessment. 2000; 12(3):346–353. [PubMed: 11021159]
33. Fleming MF, Barry KL, MacDonald R. The alcohol use disorders identification test (AUDIT) in a college sample. The International journal of the addictions. 1991; 26(11):1173–1185. [PubMed: 1743817]
34. Cherpitel CJ. Analysis of cut points for screening instruments for alcohol problems in the emergency room. Journal of studies on alcohol. 1995; 56(6):695–700. [PubMed: 8558901]
35. Leventhal AM, Zvolensky MJ, Schmidt NB. Smoking-related correlates of depressive symptom dimensions in treatment-seeking smokers. Nicotine & tobacco research: official journal of the Society for Research on Nicotine and Tobacco. 2011; 13(8):668–676. [PubMed: 21471305]
36. Muthen, BO.; Muthen, KL. Mplus User's Guide. 7. Muthen & Muthen; Los Angeles, CA: 1998–2012.
37. Brown, TA. Confirmatory factor analysis for applied research. New York, NY: The Guilford Press; 2006.
38. Yu, CY. Doctoral Dissertation. University of California; 2002. Evaluating Cutoff Criteria of Model Fit Indices for Latent Variable Models with Binary and Continuous Outcomes.
39. Buckner JD, Zvolensky MJ, Farris SG, Hogan J. Social anxiety and coping motives for cannabis use: The impact of experiential avoidance. Psychology of addictive behaviors: journal of the Society of Psychologists in Addictive Behaviors. 2014; 28(2):568–574. [PubMed: 24274436]
40. Bujarski SJ, Norberg MM, Copeland J. The association between distress tolerance and cannabis use-related problems: the mediating and moderating roles of coping motives and gender. Addictive behaviors. 2012; 37(10):1181–1184. [PubMed: 22698896]
41. Chabrol H, Duconge E, Casas C, Roura C, Carey KB. Relations between cannabis use and dependence, motives for cannabis use and anxious, depressive and borderline symptomatology. Addictive behaviors. 2005; 30(4):829–840. [PubMed: 15833585]
42. Fox CL, Towe SL, Stephens RS, Walker DD, Roffman RA. Motives for cannabis use in high-risk adolescent users. Psychology of addictive behaviors: journal of the Society of Psychologists in Addictive Behaviors. 2011; 25(3):492–500. [PubMed: 21688873]
43. Grewal R, Cote JA, Baumgartner H. Multicollinearity and measurement error in structural equation models: Implications for theory testing. Marketing Science. 2004; 23(4):519–529.

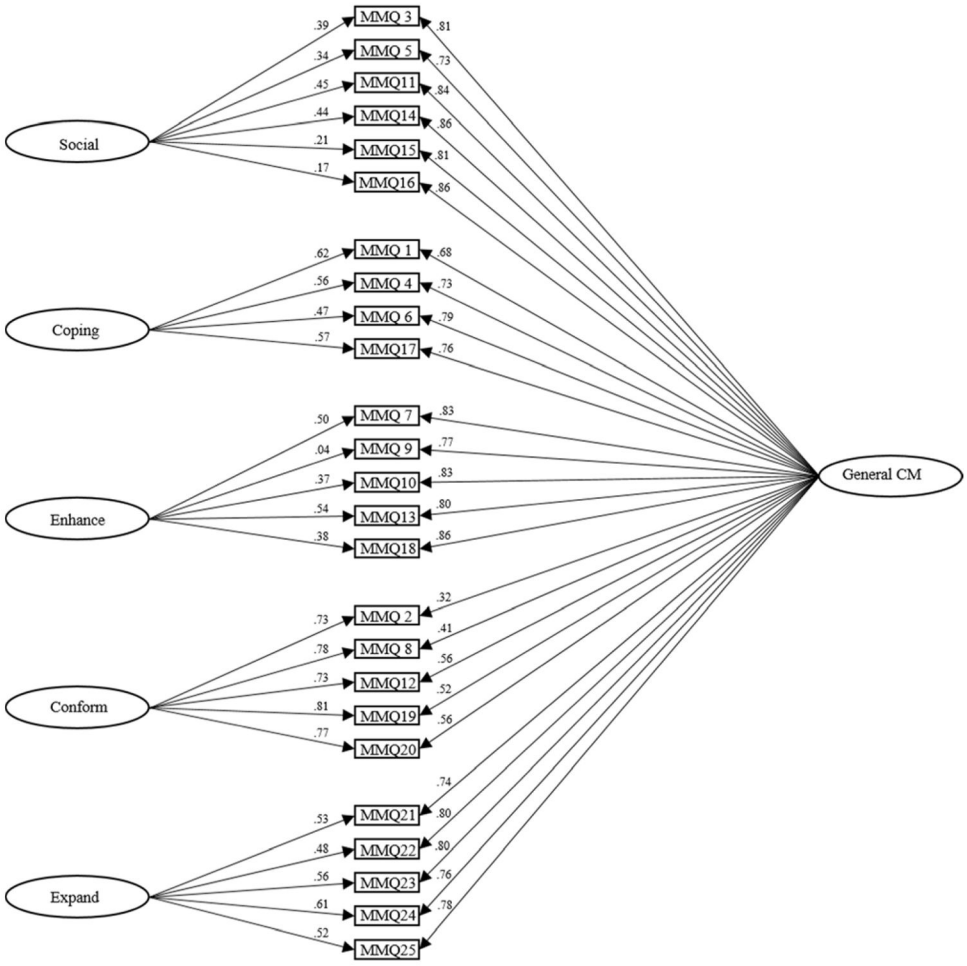

Figure 1.

Standardized factor loadings for the General CM (Cannabis Motives) factor and the specific factors. Social = Social Motives factor. Coping = Coping Motives factor. Enhance = Enhancement Motives factor. Conform = Conformity Motives factor. Expand = Expansion Motives factor. MMQ = Marijuana Motives Questionnaire.

Table 1

Respondent Characteristics: Demographics and Axis I Disorders (N = 403)

DEMOGRAPHICS	***n***	**%**
Gender		
Male	214	53%
Female	189	47%
Race/Ethnicity		
Caucasian/White	324	85%
Black/non-Hispanic	34	9%
Black Hispanic	2	1%
Hispanic	11	3%
Asian	2	1%
Other	9	2%
Marital Status		
Married	122	32%
Widowed	7	2%
Separated	16	4%
Divorced	56	15%
Never Married	181	47%
Highest Level of Education		
Some High School	16	4%
High School	82	21%
Some College	147	38%
2 year College	38	10%
4 year College	48	13%
Some Graduate School	21	6%
Graduate School	30	8%
AXIS-I DISORDERS	*n*	%
Social phobia	40	11%
Generalized anxiety disorder	19	5%
Alcohol abuse	10	3%
Alcohol dependence	10	3%

Table 2

Means, Standard Deviations, and Correlations among Variables (N = 387–403)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Coping motives	-															
2. Expand motives	.59*	-														
3. Social motives	.64	.60*	-													
4. Enhance motives	.62*	.62*	.73*	-												
5. Conform motives	.25*	.23*	.45*	.22*	-											
6. BCS Addiction	.06	.10*	.13*	.07	.00	-										
7. BCS External	.10	.15*	.12*	.10	.04	.46*	-									
8. BCS Internal	.10*	.05	.08	.03	−.03	.61*	.37*	-								
9. SCQ Neg	−.03	−.05	.02	.002	−.03	.42*	.11*	.32*	-							
10. SCQ PR	.12*	.25*	.20*	.21*	.09	.47*	.28*	.29*	.25*	-						
11. SCQ NR	.20*	.12*	.13*	.05	.03	.46*	.21*	.56*	.34*	.58*	-					
12. SCQ App/W	.08	.03	.07	−.03	.06	.22*	.08	.19*	.22*	.29*	.39*	-				
13. Smoking Rate	.003	−.08	−.004	−.07	.09	.11*	−.05	.08	.06	.05	.03	.07	-			
14. Alcohol Use	.16*	.24*	.15*	.26*	.09	.05	.06	.02	.01	.18*	.12*	−.003	−.12*	-		
15. Negative Affect	.19*	.07	.10	.07	.07	.27*	.19*	.47*	.20*	.18*	.36*	.14*	.03	.22*	-	
16. Health Problems	−.11*	−.08	−.09	−.09	−.10*	−.04	−.01	−.07	.03	−.14*	−.10*	−.004	−.01	−.15*	.001	-
17. Gender	.01	−.13*	−.09	−.16*	−.06	.21*	.03	.25*	.19*	.03	.17*	.26*	−.09	−.10	.14*	−.02
M	9.20	9.30	11.02	13.63	7.04	14.33	5.54	4.15	6.59	5.78	5.71	4.10	16.34	6.67	19.54	0.37
SD	5.28	5.83	6.04	6.89	3.82	6.12	4.11	2.78	1.27	1.47	1.75	2.36	8.80	6.13	7.52	0.61
Min	5.00	5.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2	0.00	10.00	0.00
Max	25.00	25.00	25.00	25.00	25.00	24.00	20.00	9.00	9.00	9.00	9.00	9.00	60	30.00	48.00	3.00

Note. Coping, Expand, Social, Enhance, and Conform motives = Marijuana Motives Questionnaire scales. BCS = Barriers to Cessation Scale. SCQ = Smoking Consequences Questionnaire. Neg = Negative consequences scale. PR = Positive reinforcement scale. NR = Negative reinforcement scale. APP/W = Appetite/Weight Control scale. Smoking rate = average cigarettes per day as measured by Smoking Health Questionnaire Item 4. Alcohol Use measured by Alcohol Use Disorders Identification Test. Negative Affect measured by Positive and Negative Affectivity Scales NA scale.

* $p < .05$.

Table 3

Structural Equation Model Parameters Predicting Barriers to Cessation and Smoking Severity from Cannabis Motives and Covariates

	BCS Addiction factor			BCS External factor			BCS Internal factor		
Predictors	***B***	***SE***	**β**	***B***	***SE***	**β**	***B***	***SE***	**β**
Coping	−.16**	.06	−.21	−.07	.07	−.09	−.04	.07	−.05
Expand	.03	.05	.05	.02	.07	.03	.04	.07	.04
Social	−.04	.08	−.05	−.13	.08	−.19	−.02	.09	−.02
Enhance	−.07	.07	−.09	−.13	.08	−.19	−.001	.08	−.001
Conform	−.11*	.06	−.15	−.05	.06	−.07	−.12*	.06	−.14
General	.13*	.05	.18	.13*	.06	.19	.07	.06	.08
Covariates									
Smoking	.02**	.01	.20	−.001	.01	−.01	.01*	.01	.12
Alcohol	−.001	.01	−.01	−.002	.01	−.02	−.02	.01	−.11
NA	.02***	.01	.24	.01	.01	.12	.06***	.01	.49
Health	−.01	.07	−.01	.09	.08	.08	−.11	.07	−.08
Gender	.33***	.08	.22	−.01	.08	−.01	.46***	.09	.27

Note. Coping = Coping Motives factor. Expand = Expand Motives factor. Social = Social Motives factor. Enhance = Enhancement Motives factor. Conform = Conformity Motives factor. General = General Marijuana Use Motives factor. Smoking = average cigarettes per day assessed by Smoking Health Questionnaire Item 4. Alcohol = Alcohol Use measured by Alcohol Use Disorders Identification Test. NA = Negative Affect measured by Positive and Negative Affectivity Scales NA scale. BCS = Barriers to Cessation Scale. *** $p \leq .001$,

** $p \leq .01$,

* $p \leq< .05$.

Table 4

Structural Equation Model Predicting Smoking Cessation Questionnaire Scales from Cannabis Motives and Covariates

	SCQ Negative Consequences			SCQ Positive Reinforcement			SCQ Negative Reinforcement			SCQ Appetite/Weight Control		
Predictors	***B***	***SE***	**β**	***B***	***SE***	**β**	***B***	***SE***	**β**	***B***	***SE***	**β**
Coping	−.20*	.09	−.16	−.26*	.11	−.17	.14	.12	.08	−.01	.19	−.004
Expand	−.16	.09	−.12	.27*	.11	.18	.06	.12	.04	.05	.20	.02
Social	−.10	.13	−.08	−.13	.16	−.09	−.04	.17	−.02	.06	.25	.03
Enhance	−.03	.11	−.02	.003	.13	.002	−.30	.16	−.17	−.42	.23	−.18
Conform	−.11	.09	−.08	−.07	.11	−.05	−.12	.11	−.07	.14	.15	.06
General	.05	.08	.04	.35***	.10	.24	.24*	.11	.14	.22	.16	.09
Covariates												
Smoking	.02	.01	.10	.02*	.01	.13	.01	.01	.05	.02	.02	.08
Alcohol	.001	.01	.01	.02	.02	.06	.01	.02	.04	.01	.02	.02
NA	.03**	.01	.17	.03*	.01	.14	.06***	.01	.27	.02	.02	.06
Health	.11	.11	.05	−.22	.13	−.09	−.16	.15	−.06	.13	.21	.04
Gender	.48***	.13	.19	.10	.15	.03	.60***	.17	.17	1.21***	.23	.26

Note. Coping = Coping Motives factor. Expand = Expand Motives factor. Social = Social Motives factor. Enhance = Enhancement Motives factor. Conform = Conformity Motives factor. General = General Marijuana Use Motives factor. Smoking = average cigarettes per day assessed by Smoking Health Questionnaire Item 4. Alcohol = Alcohol Use measured by Alcohol Use Disorders Identification Test. NA = Negative Affect measured by Positive and Negative Affectivity Scales NA scale. SCQ = Smoking Consequences Questionnaire.

*** $p \leq .001$,

** $p \leq .01$,

* $p \leq .05$.

Table 5

Structural Equation Model Predicting Week 2 Quit Status from Cannabis Motives and Covariates

	Week 2 Quit Status	
Predictors	***B***	***SE***
Coping Motives	−.42**	.15
Expansion Motives	−.25	.24
Social Motives	−.24	.46
Enhancement Motives	−.39	.46
Conformity Motives	.24*	.12
General Cannabis Motives	.18	.25
Covariates		
Smoking	.01	.03
Alcohol	.03	.04
NA	−.03	.05
Health	.45	.92
Gender	.04	.19
Condition	−.01	.20

Note. Smoking = average cigarettes per day assessed by Smoking Health Questionnaire Item 4. Alcohol = Alcohol Use measured by Alcohol Use Disorders Identification Test. NA = Negative Affect measured by Positive and Negative Affectivity Scales NA scale.

** $p \leq .01$,

* $p \leq .05$.