

**Cannabis Beliefs: Extending The Discussion On Cannabis Motives, Cannabis  
Expectancies, And Cannabis Social Norms To Never Users And Non-Current Users**

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A thesis submitted to the Department of Psychology,  
College of Liberal Arts and Social Sciences,  
in partial fulfillment of the requirements for the degree of:  
Master of Arts in Psychology

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University of Houston  
May, 2023

## **ACKNOWLEDGMENTS**

I would like to thank my thesis committee for their contributions to refining my thesis project's idea and providing constructive suggestions for improving it. I would like to thank my advisor, Dr. Neighbors, for his advice, support, and mentorship; without him the project would not have been possible.

## **ABSTRACT**

Cannabis has routinely been identified as one of the most frequently used illicit substances among adolescents, young adults, and the general adult population in the United States by large epidemiological studies. Recent policy changes in the legal status of cannabis have inspired calls for the replication of research and further exploration of the biopsychosocial relationships between cannabis use and outcomes. Theoretical psychological perspectives of behavior, such as outcome expectancies, social norms, and motivation, have found success in explaining why substance use occurs. Previous studies have suggested that there are underlying motivations, expectancies, and social norms for the discontinuing of cannabis use and maintenance of abstinence-oriented behaviors; presumably, these also exist within the population of lifetime abstinent individuals as well. The proposed study will seek to identify beliefs about cannabis in a process to construct a measure of cannabis-related beliefs. Two important types of validity for new assessment measure(s) are their unique content area, distinguishing them from existing measures (i.e. discriminant validity), and their ability to predict scores on other assessment measures (i.e. predictive validity). We will examine the relationships among cannabis-related beliefs in the context of social norms, expectancies, and motivation as well as their association with indicators of psychosocial well-being and cannabis-related consequences. Thus, results will indicate if the proposed cannabis belief scale(s) possesses construct and predictive validity. Future studies may identify unique associations between cannabis beliefs, psychosocial factors, or evidence of protective and risk factors for cannabis use and outcomes with prospective designs.

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## INTRODUCTION

### **Cannabis and Other Substance use**

Cannabis has routinely been identified as one of the most frequently used illicit substances among adolescents, young adults, and the general adult population in the United States (U.S.) by epidemiological studies (Johnston et al., 2019; Schulenberg et al., 2019; Substance Abuse and Mental Health Services Administration, 2022). With recent calls for further research on the biopsychosocial relationships of cannabis use, cannabis-related consequences, and cannabis-related outcomes by the National Academies of Sciences et al. (2017), it is important to develop better understandings of the perceptions of cannabis among both the cannabis-using and non-using populations. Associations between cannabis use with physical and mental health indicators have been well documented in previous research.

Psychological theories of behavior have found success in explaining aspects of why substance use occurs and why substance-related consequences happen. Predictions based upon social norm approaches (Cialdini et al., 1991; Deutsch & Gerard, 1955), outcome expectancy theories (Brown et al., 1987; Brown et al., 1980; Schafer & Brown, 1991), and theories of substance-related use motivations (Lee et al., 2009; Simons et al., 1998) have often found support for the existence of relationships between theoretical constructs and substance-related outcomes. Previous research has found cannabis-related social norms, expectancies, and motives to possess unique and independent associations with cannabis use and cannabis-related problems (Buckner, 2013). These theoretical perspectives each approach an understanding of substance use from different sets of assumptions about what is of critical importance in different aspects of human behavior.

#### *Social Norms Approach*

Social norms are defined broadly as the perceptions by which individuals judge what behavior is common/uncommon and acceptable/unacceptable within the general or a specific population in a given situation (Cialdini & Trost, 1998; Deutsch & Gerard, 1955). These norms are often operationalized as individuals' perceptions of 1) the frequency with which an associated behavior occurs within a reference population and 2) the valence associated with the behavior for the perceiver within a reference population (Cialdini et al., 1991; Cialdini et al., 1990; Reno et al., 1993). These two types of social norms are considered descriptive and injunctive respectively. Past examinations have found social norms to be a potentially critical psychosocial variable as part of normative interventions for alcohol use among heavy users.

Research on the perceptions of social norms has demonstrated that college students tend to overestimate their peers' drinking behaviors (Baer et al., 1991; Perkins & Berkowitz, 1986). It has been reliably demonstrated that targeting these misperceptions about alcohol norms can be efficacious in reducing alcohol-related problems and the quantity of alcohol consumption when presented in the framework of personalized normative feedback interventions (Lewis & Neighbors, 2006; Lewis et al., 2007; Neighbors et al., 2010; Neighbors et al., 2004). However, less is known about the use of these types of interventions to address cannabis-related behaviors with research finding mixed results (Elliott & Carey, 2012; Lee et al., 2010; Walukevich-Dienst et al., 2019). There is debate about the relative importance of descriptive norms, as opposed to injunctive norms, when it comes to understanding cannabis use (Ecker et al., 2019). This gap in the literature suggests that interventions seeking to utilize social norms when addressing cannabis-related behaviors need to develop a deeper understanding to



properly develop efficacious interventions that can be designed and administered to reduce cannabis-related harms.

### *Deviance Regulation Theory*

Deviance regulation theory takes an approach to social norms that assumes there are at least three perceptions of an individual's psychosocial environment which influence their decision-making about adopting a given behavior (Blanton & Christie, 2003). Two of these perceptions are of descriptive and injunctive social norms of the behavior and the third is the perception of the balance between the two types of social norms. These perceptions are posited to have differential influences on behavior depending upon their impact on an important social identity. This perspective further assumes that individuals seek to avoid deviations from the population's extant social norms which may cause harm to their social identity as a member of the group.

Understanding the modalities through which normative messages can be framed to facilitate the desired outcomes of a message is an important facet when implementing and assessing the efficacy of brief norms-based interventions (Blanton et al., 2001). One recent experimental study has found that negative framing of injunctive cannabis norms was capable of altering intentions to use cannabis in the future (Dvorak et al., 2018) but more comprehensive prospective designs are necessary to confirm this relationship with behavioral engagement. Further examination of how social norms of cannabis-related behaviors influence cannabis-related outcomes is needed to identify mechanisms through which social norms interventions can be used to address cannabis-related behaviors for general or specific populations.

### *Outcome Expectancies*

Outcome expectancies have been evaluated as playing an important role within the bodies of alcohol (Ham et al., 2015; Jones et al., 2001) and cannabis (Aarons et al., 2001; Torrealday et al., 2008) literature. Expectancy theories take the perspective that there are *expected* gains or *expected* consequences as a result of engaging in substance behavior, individuals are seen to be able to obtain or avoid these through engagement in the behavior (Brown et al., 1980). This perspective implies that individuals expect certain outcomes from engaging in substance use and avoiding or engaging with substances toward avoiding or acquiring those expected outcomes.

Experimental research on cannabis-related expectations has indicated that effects exist as a result of information about the type of cannabis being given to participants who consumed it; as part of balanced placebo designs (Metrik et al., 2012; Metrik et al., 2009). This suggests that expectations about the effects of cannabis influence individuals' response to perceived cannabis use independent of actually consuming psychoactive cannabis products. Previous correlational research has suggested unique links between cannabis expectancies and social anxiety, finding differential relationships between cannabis expectancies subscales and cannabis outcomes depending upon levels of social anxiety (Buckner & Schmidt, 2008) while another study identified social anxiety as a potential protective factor against cannabis use initiation (Schmits et al., 2015). Additionally, cannabis expectancies, and subjective evaluations of cannabis expectancy desirability, have been found to uniquely differentiate between cannabis users and non-users at the subscale level (Buckner et al., 2013). Together, these studies suggest that expectations about the outcomes of cannabis use compose a unique and important space for a variety of cannabis and psychosocial outcomes.

### *Substance Use Motivation*

Similar to expectancies, motivational approaches to substance use address the reasonably anticipated consequences of substance use from a slightly different focus. Motives for alcohol, tobacco, and cannabis use have been conceptualized as generally addressing a four-factor model, a matrix composed of approach/avoidance by self/other motivation for substance use (Cooper et al., 2016) with an assumption that expectancies are mediated by motivations for use. This body of literature suggests that there are typical patterns that exist for motivations around substance use behaviors that have significant grey areas outside of alcohol research. A potentially significant limitation of this body of literature is the assumption that individuals who do not use do not have the motivation to engage in the behavior or are motivated against the behavior. Understanding new aspects of motivation, particularly how it might function in non-users, can provide deeper insights into individual differences and decisions regarding cannabis use.

Motivations to quit cannabis have been identified, specifically that legal and social acceptability concerns seem to be predictive of abstinence maintenance among a sample of individuals engaging in good-faith attempts at cannabis cessation (Chauchard et al., 2013). Motivations for cannabis, alcohol, and simultaneous alcohol and cannabis use have been found to possess unique associations with substance-specific outcomes at the daily-level (Patrick et al., 2019). These studies suggest that motivations for and against substance use have several unique pathways to cannabis-related outcomes that require further examination.

### *Traditional Research Questions & Recovery*

Questions about substance use proposed by these theoretical perspectives have largely sought to address are questions of ‘why do individuals decide and engage in substance use

behaviors and how can that behavior better be understood’. Another perspective of this same question is to ask ‘why do individuals decide *not* to engage in substance use behaviors and how can this behavior be better understood’. Questions regarding non-use have been studied using cross-sectional correlational studies, experimental designs, and longitudinal observations and experiments. However, these questions only address one aspect of substance use, particularly the existing patterns of substance use behavior (i.e. use vs. non-use), and subtly neglect transitional phases that individuals may have experienced.

Within the treatment-assisted recovery literature, a relevant question of interest is ‘how are individuals with problematic substance use best assisted when they are interested in reducing or ceasing their use’. This body of research investigates the efficacy of treatments from many methodological perspectives, including cognitive behavioral therapy, motivational enhancement therapy, and contingency management, largely finding small to medium effect sizes for most intervention modalities (Nordstrom & Levin, 2007; Stea et al., 2015). Stea and colleagues noted that the majority of cannabis users do not seek treatment and that treatment modalities could target either abstinence or moderation outcomes for the limited population of those that do. This literature’s focus on those in the treatment process, and engaging people into entering treatment, limit generalizability to a broader population in contributing to the prevention of cannabis use disorders and cannabis-related problems.

Through an alternative formulation of substance-related questions, the natural recovery literature (Bischof et al., 2012; Klingemann & Sobell, 2001; Sobell et al., 2000) has endeavored to understand the question of ‘why do people who have engaged in substance use behavior *stop* engaging in it’. Research about this phenomenon has observed its occurrence

for natural remission in alcohol (Sobell et al., 1993) and cannabis use (Ellingstad et al., 2006). One prospective study from this perspective found unique associations among cannabis cessation, relapse, and expectancies about cannabis use (Boden et al., 2013). Overall, researchers found that individuals who maintained their recovery from alcohol reported anticipating negative impacts on their life, concerns for children, and religion to function as key motivators in their maintenance; while for marijuana changing views and anticipated negative effects were reported as the primary reasons for self-change (Neighbors et al., 2012). These studies provide evidence that underlying motivations, expectancies, and social norms exist for the discontinuation of substance use and in maintaining subsequent abstinence behaviors.

#### *Substance Use Beliefs*

Beliefs about substance use represent a unique space wherein individuals internalize a constellation of cognitions related to perceived truth about behavior and outcomes of engaging in such behavior. Leigh (1987) examined beliefs regarding alcohol and how they related to the perception of self and others in two separately obtained samples, finding that individuals tended to believe that the effects of alcohol were more likely to happen to others than themselves. Specifically, Leigh found that men and women responded differently to their beliefs measure such that women report more cognitive-impairment self-beliefs while men reported more nastiness self-beliefs and that women reported greater nastiness, disinhibition, and depressant effects as other-beliefs than men.

In redefining how researchers examined college-specific alcohol beliefs, Osberg et al. (2010) developed and validated the College Life Alcohol Salience Scale (CLASS) to assess the beliefs regarding the centrality of alcohol to the college experience. Osberg and colleagues

found this new measure to be associated with several alcohol-related measures, such as protective behavioral strategies, drinking motives, and alcohol-related outcomes (such as; weekly typical, heavy, and binge drinking). A similar measure to the CLASS, the Perceived Importance of Marijuana to the College Experience Scale (PIMCES) has been developed and validated in addressing cannabis use beliefs specific to college students and the college experience (Pearson et al., 2017). Other investigators have assessed metacognitive beliefs about alcohol (Spada & Wells, 2008) and cannabis-related beliefs among adolescents (Chabrol et al., 2004).

One significant limitation of measures such as the CLASS and PIMCES is their focus on the use of substances as they relate specifically to the college experience or specific populations. This limits the generalizability of conclusions regarding the role of beliefs about substance use behavior in a few circumstances or populations. To better understand the role of beliefs in substance use behavior, within a more general population, a measure addressed toward more generalized beliefs related to cannabis is needed.

#### *Proposing a Different Perspective on Cannabis Use*

The present question of interest lay in identifying what people believe to be true about cannabis as a single measure. Additionally, we need to know how these beliefs relate to psychosocial indicators and cannabis-related outcome measures. Several theoretical perspectives have implications for substance use. DRT would suggest individuals choose to avoid using because they believe it to be a deviation from their applicable social norms and to lack sufficient benefit for, or poses sufficient harm to, their social identity. This perspective relies on a tendency for individuals to avoid deviations from their group's norms which may harm their social identity (e.g. the group dislikes those who use substances) or to engage in

behaviors that may bolster their social identity within the group's conception of deviant exceptionalism. In congruence with more behaviorist perspectives, expectancy theories would suggest that engagement or non-engagement of cannabis reflects the perceived relative likelihood and valence of expected outcomes. Finally, extant motivational approaches to understanding cannabis use imply, by unidirectional assessment among users, that people who do not use cannabis are not motivated to use or are motivated to avoid use. Motivational measures are typically designed to assess motivation to use while overlooking motivations against use, thereby limiting their utility among abstaining populations. However, the question remains as to what roles beliefs about cannabis use play, if any, alongside other psychosocial variables.

Individuals, when prompted, are generally capable of producing rationales for their engagement, or lack thereof, in a specific behavior. This is a basic assumption of conducting correlational survey research to engage in a focused discussion about specific behaviors. Considering the totality of the potential cannabis-using population (i.e., lifetime users, non-current users, current users, and non-users) questions about the etiology and psychosocial outcomes related to cannabis use can be better distinguished. First, it is important to know how cannabis users differ from non-users in psychosocial outcomes. This allows the identification of differential outcomes associated with being a member of one group or the other. However, it is an oversimplification that ignores the impacts on people who have only experimented with cannabis or transitioned to recovery. These differential relationships between populations may shape what people believe to be true about cannabis and how they perceive or experience cannabis-related outcomes.

Secondly, it is important to understand how use-status relates to what people believe about cannabis. This requires distinguishing between several different potential use-status groups. We conceive of four such types of users that imply different perspectives; a) people who have made a good-faith attempt to quit using cannabis (i.e. no observable use with the intent of never using again), b) those who have suspended their use but are likely to use again in the future (i.e. no observable use but a disposition toward using in the future), c) those who report current use (i.e. observable use), and d) those who report lifetime abstention. Respectively we would classify these four types as lifetime users, non-current users, current users, and non-users. It is important to make distinctions between these groups because of the potential differences and similarities that these groups may present in their beliefs about cannabis use.

## **METHOD**

### **Present Studies**

The present studies sought to address two critical aspects of evaluating beliefs about cannabis among a diverse population. Firstly, it sought to a) define space through the generation of the potential items and b) evaluate the structure of these items from a psychometric perspective through exploratory factor analyses. Secondly, it sought to examine the relationship of any derived subscales of cannabis-related beliefs with a) cannabis outcomes, b) measures of psychosocial functioning, and c) differences in cannabis beliefs between categories of users and non-users.

### **Preliminary Development**

#### *Participants*

The present study consisted of 470 individuals recruited through Amazon's Mechanical Turk (MTurk) during the Spring of 2021 who contributed adequate (non-automated) responses to the cannabis beliefs question. Participants were compensated with



one dollar and eighty cents USD for completing a brief survey. Participants were expected to complete the survey in less than 15 minutes. Participants were required to be 18 years of age and to have an 80% completion rate on the platform to participate in the study in addition to informed consent. After examination of the cannabis beliefs questions, participants suspected to be bots, automated responses, and random responses were omitted from analyses (n = 54) resulting in an analytic sample of 416 reliable records.

The composition of the present sample was largely White (74.3%), approximately 39.7 (SD = 12.2) years of age, and male (54.8%; see table 1 for more details). About half of the sample reported any cannabis use (52.4%), with 12.3% reporting daily use (N = 51), and half of the users reported seven or fewer use days per month (N = 109; 50.0%). The most frequent degree (N = 415) held by the sample was a bachelor's degree (41.5%), followed by some college experience (16.9%), and a master's degree (11.1%), with only four reporting a doctoral degree. The most frequent income range (N = 412) of the sample was between \$50,000 and \$74,999 (25.0%) followed by \$75,000 to \$99,999 (17.0%) and \$35,000 to \$49,999 (14.6%) while nine participants reported earning \$200,000 or more. Finally, in the past 30 days, the sample was also composed largely of users (52.4%) as opposed to non-users (47.6%).

### *Measures*

*Cannabis Beliefs.* Participants were asked to think of up to ten of their personally held beliefs about cannabis and instructed to fill in ten writing boxes on the webpage with those beliefs. Participants were prompted to do this by the following survey item and provided clarification of what was meant by cannabis:

“We are interested in understanding what people believe about cannabis (including: marijuana, hash, hashish, pot, dab-pens, blunts, edibles, or other THC containing products). In the 10 text boxes below, in no particular order, please describe up to 10 beliefs you hold regarding cannabis. Please write about each belief in its own response box. Please take your time to think about each belief fully.

By beliefs, we mean the following: If people were to describe their beliefs about chocolate they might say things like 'it tastes good', 'it's fattening', 'it's messy', or 'it's bad for dogs'. We would like you to do the same thing in describing your beliefs about cannabis.”

### *Results*

The sample resulted in 3653 useful individual cannabis beliefs to evaluate for unique characteristics. These responses were reviewed by the researcher and two research assistants for their uniqueness of item content. The researcher had the final determination on what was considered as being unique within the question space. There was significant duplication of items identified by participants as representing their beliefs.

Following this, six experts (Drs: Christine Lee, Robert Dvorak, Julia Buckner, Kristina Jackson, Michael Zvolensky, and Matthew Pearson) in the psychology-focused cannabis field were contacted to request feedback on the item pool and to suggest edits, omissions, or additions to the generated items. Five experts responded to the request and provided feedback. This feedback was utilized to clarify the consistency of framing (e.g., positive/negative separation), reference (i.e., 'it' in place of 'cannabis'), and to improve the phrasing of the item pool (e.g., avoiding double-barreled questions; see table 2 for the final item pool). The resulting item pool consisted of 79 potentially unique cannabis beliefs that could be examined in a subsequent survey.

## **Quantitative Examination**

### *Participants*

Participants of the present study consisted of undergraduate students ( $N = 674$ ) recruited through the SONA system of the university's psychology department. These students were compensated with SONA credit for their participation, which could be used for awards of extra credit in psychology courses at the university. Students needed to be at least 18 years of age and provide informed consent to participate in this study. The analytic sample of the present study consisted of 612 complete analytical records.

The present sample was very diverse. The most frequent ethnicity reported was Hispanic (31.5%), followed by Asian (22.7%), White (16.2%), and Black (14.1%; see table 3 for more details). The sample was mostly female (78.8%). As expected of SONA samples, about half of the sample reported some college experience (50.9%), High-school (26.7%), and associate degrees (18.0%) as the highest level of education. There was also a broad range of household incomes reported by the sample with \$50,000 to \$74,999 being endorsed most frequently (16.4%) followed closely by \$100,000 to 149,999 (14.0%) and \$35,000 to \$49,999 (12.8%). Overall, the sample of college students was very diverse with a mean age of 21 years ( $SD = 3.4$ ).

### *Measures*

*Cannabis Beliefs* were assessed using the items identified in the preliminary development study. These items were presented to participants on a Likert-type scale from one ("Not at all") to five ("Very much"). Following the advice of expert reviewers, we opted to use the term 'marijuana' as the primary descriptor of the substance; reasoning that participants would likely be more familiar with the term. The cannabis beliefs items were presented with the following prompt:

“Please indicate the degree to which you agree with each of the follow statements about marijuana (including: cannabis, hash, hashish, pot, dab-pens, blunts, edibles, or other THC containing products)”

*Descriptive Cannabis Norms* were evaluated by a single item asking participants about the number of days they thought similar others (“same age and gender”) used cannabis in the past 30 days. On average, participants reported believing that similar others used cannabis on about 11 days in the past 30 days ( $M = 10.8$ ,  $SD = 8.4$ ; see table 4 for means, standard deviations, and,  $\alpha$  coefficients)

*Marijuana Motives Measure* was used as one method to evaluate cannabis use motives and consists of twelve subscales evaluating various aspects (Lee et al., 2009; Phillips et al., 2017). Enjoyment motives evaluate seeking positive reinforcement through cannabis use (i.e., “To feel good”;  $M = 2.7$ ,  $SD = 1.7$ ,  $\alpha = 0.98$ ). Conformity motives evaluate desires for social integration (i.e., “To be cool”,  $M = 1.5$ ,  $SD = 0.9$ ,  $\alpha = 0.90$ ). Coping motives evaluate the desire to use for affective regulation (i.e., “to forget your problems”,  $M = 1.9$ ,  $SD = 1.3$ ,  $\alpha = 0.95$ ). Experimentation motives evaluate desires to use for experiential purposes (i.e., “To see what it felt like”,  $M = 2.3$ ,  $SD = 1.4$ ,  $\alpha = 0.96$ ). Boredom motives track a non-regulated approach to use; a lack of other stimuli to engage in sensation seeking with (i.e., “Because you wanted something to do”,  $M = 2.0$ ,  $SD = 1.4$ ,  $\alpha = 0.97$ ). Alcohol motives catalog reasons for cannabis use that are intermingled with the presence of alcohol (i.e., “Because you were drunk”,  $M = 1.6$ ,  $SD = 1.0$ ,  $\alpha = 0.92$ ). Celebration motives relate to use in a celebratory capacity to make special events (i.e., “Because it was a special day”,  $M = 2.1$ ,  $SD = 1.4$ ,  $\alpha = 0.98$ ). Altered perception motives track with the desire to use cannabis and change how one perceives the external world (i.e., “To allow you to think differently”,  $M = 2.0$ ,  $SD = 1.4$ ,  $\alpha = 0.97$ ). Social

anxiety motives are closely related to coping motives, in that they are associated with use to cope specifically with social anxiety (i.e., “To make you feel more confident”,  $M = 1.9$ ,  $SD = 1.3$ ,  $\alpha = 0.94$ ). Relatively low-risk motives reflect use based on the perception that cannabis use is not a likely source of potential harm to themselves (i.e., “Because it is not a dangerous drug”,  $M = 2.1$ ,  $SD = 1.4$ ,  $\alpha = 0.94$ ). Sleep motives are the reasons that people use cannabis as a sleep-aid (i.e., “To help you sleep”,  $M = 2.1$ ,  $SD = 1.4$ ,  $\alpha = 0.94$ ). Availability motives are another sort of non-regulated use pattern based on the abundance or freed of access to use cannabis (i.e., “Because it is readily available”,  $M = 1.9$ ,  $SD = 1.2$ ,  $\alpha = 0.89$ ). Each subscale was calculated as a mean of their items according to the validation research.

*Marijuana Motives Questionnaire* was utilized as a method to compare and confirm results between two different measures of motivated marijuana use (Simons et al., 1998). This measure evaluates motivated cannabis use derived from the research on motivated alcohol use based on a four-factor model presented in the drinking motives questionnaire (Cooper, 1994). However, it also extends the model to include a fifth factor to better explain cannabis-specific motivated use that is similar to those present in the marijuana motives measure: Social ( $M = 2.0$ ,  $SD = 1.3$ ,  $\alpha = 0.95$ ), Coping ( $M = 2.0$ ,  $SD = 1.2$ ,  $\alpha = 0.95$ ), Enhancement ( $M = 2.4$ ,  $SD = 1.5$ ,  $\alpha = 0.96$ ), Conformity ( $M = 1.4$ ,  $SD = 0.8$ ,  $\alpha = 0.93$ ), and Expansion ( $M = 2.0$ ,  $SD = 1.3$ ,  $\alpha = 0.95$ ). Each subscale was calculated as a mean of their items according to the validation research.

*Cannabis Expectancies* were evaluated using the marijuana effect expectancy questionnaire (MEEQ), a measure frequently used among users and non-users to evaluate positive and negative perceptions of cannabis (Aarons et al., 2001). This measure asks

participants to rate their agreement with a series of 48 statements on a Likert-style scale from 1 = Disagree Strongly to 5 = Agree Strongly. The measure assesses both positive (e.g. “Marijuana makes a person feel more creative and perceive things differently...”) and negative (e.g. “Marijuana makes it harder to think and do things...”). The MEEQ breaks down into six unique subscales reflecting 1) cognitive and behavioral impairment (M = 3.2, SD = 0.8,  $\alpha = 0.87$ ), 2) relaxation and tension reduction (M = 3.3, SD = 1.1,  $\alpha = 0.93$ ), 3) social and sexual facilitation (M = 3.0, SD = 0.7,  $\alpha = 0.74$ ), 4) Perceptual and cognitive enhancement (M = 3.1, SD = 0.9,  $\alpha = 0.87$ ), 5) global negative effects (M = 2.5, SD = 0.9,  $\alpha = 0.89$ ), and 6) craving and physical effects (M = 3.5, SD = 1.1,  $\alpha = 0.91$ ). Each subscale was calculated as a mean of their items according to the validation research.

*Perceived Importance of Marijuana to the College Experience Scale (PIMCES)* was used to evaluate perceptions of the centrality of the college experience of marijuana (Pearson et al., 2017). This measure was presented to participants on a five-point Likert-type scale ranging from one (“Strongly Disagree”) to five (“Strongly Agree”). The scale demonstrated good internal reliability (M = 2.3, SD = 0.8,  $\alpha = 0.86$ ) and was calculated as the mean of all items according to the validation research.

*College Life Alcohol Saliency Scale* was employed to evaluate perceptions of alcohol use as being central to the college experience (Osberg et al., 2010). This measure was presented to participants on a five-point Likert-type scale ranging from one (“Strongly Disagree”) to five (“Strongly Agree”). The scale demonstrated good internal reliability (M = 5.5, SD = 0.8,  $\alpha = 0.90$ ) and was calculated as the mean of all items according to the validation research.

*Depression, Anxiety, and Stress Scales* were used to evaluate general negative affect across three large domains simultaneously (Antony et al., 1998). This measure uses 21 items to evaluate depression (i.e., “I felt down-hearted and blue”;  $M = 1.0$ ,  $SD = 1.1$ ,  $\alpha = 0.94$ ), anxiety (i.e., “I found it hard to wind down”;  $M = 0.9$ ,  $SD = 0.9$ ,  $\alpha = 0.89$ ), and stress (i.e., “I was aware of dryness of my mouth”;  $M = 1.1$ ,  $SD = 1.0$ ,  $\alpha = 0.90$ ) on a five-point Likert-type scale ranging from zero (“Did not apply to me at all”) to four (“A great deal”). Each affective scale was calculated as a mean of their items according to the validation research.

*Basic Psychological Needs Satisfaction and Frustration Scales* is a measure rising from the research of self-determination theory, designed to evaluate participants’ basic psychological needs being met for the three large theorized domains of functioning (Chen et al., 2014). This measure evaluates the need for 1) competence, 2) autonomy and 3) relatedness and whether or not those needs are being either satisfied or frustrated; resulting in six subscales of the measure. Participants were asked to rate 24 states on how much each statement applied to them using a five-point Likert-type scale ranging from one (“Not true at all”) to five (“Completely True”). Each subscale was calculated as a mean of their items according to the validation research; autonomy satisfaction ( $M = 3.4$ ,  $SD = 0.9$ ,  $\alpha = 0.79$ ), autonomy frustration ( $M = 2.7$ ,  $SD = 0.9$ ,  $\alpha = 0.76$ ), relatedness satisfaction ( $M = 3.7$ ,  $SD = 1.0$ ,  $\alpha = 0.90$ ), relatedness frustration ( $M = 2.1$ ,  $SD = 0.9$ ,  $\alpha = 0.82$ ), competence satisfaction ( $M = 3.5$ ,  $SD = 1.0$ ,  $\alpha = 0.90$ ), competence frustration ( $M = 2.7$ ,  $SD = 1.1$ ,  $\alpha = 0.88$ ).

*Cannabis Use Intentions* were evaluated by a single item relating to the likelihood of their using cannabis in the next 30 days with response options from one (“Absolutely will

not”) to five (“Absolutely will”). Overall, participants reported intentions to use cannabis on the low side of the distribution ( $M = 1.3$ ,  $SD = 1.4$ ).

*Cannabis Use Frequency* was assessed by a single item that asked participants to report the number of days in the past 30 days on which they used cannabis. Participants who had never used cannabis were instructed to respond with the “0 (None)” response option. On average, participants reported using cannabis for approximately four of 30 days ( $M = 3.8$ ,  $SD = 8.0$ ).

*Cannabis Use Quantity* was evaluated by a single matrix asking participants to report the number of grams of cannabis they used on each day of an average week. This measure was based on the daily drinking questionnaire (Collins et al., 1985). Participants were also presented with a visual aid to convert the size into the weight of cannabis and to report quantity accurately ( $M = 1.6g$ ,  $SD = 4.2g$ ) Due to the requirements of the analytic approach below, the grams reported by participants were converted to centigrams by multiplying by 100 to remove decimal places ( $M = 155.0cg$ ,  $SD = 422.2$ ).

*The brief Marijuana Consequences Questionnaire (B-MACQ)* was used to gauge the extent to which cannabis users experienced consequences as a result of their use (Simons et al., 2012). The 36 questions of the B-MACQ (i.e., “I have spent too much time using marijuana”) were presented in a yes/no binary format. A summed score was taken to represent the overall number of consequences each participant reported experiencing ( $M = 1.9$ ,  $SD = 3.9$ ).

*Cannabis Use Disorder Identification Test–Revised (CUDIT)* was utilized to evaluate the likelihood of participants having a problematic pattern of cannabis use (Adamson et al.,



2010; Adamson & Sellman, 2003). CUDIT scores of eight or more indicate hazardous use while scores of 12 or more indicate possible cannabis use disorder. Participants had an average score on the CUDIT of about four ( $M = 4.3$ ,  $SD = 6.2$ )

*Marijuana Protective Behavioral Strategies* were evaluated to understand what protective behaviors participants who used cannabis engaged in to compensate for potential problems (Pedersen et al., 2016; Pedersen et al., 2017). This measure evaluates 36 behaviors that marijuana users can engage in to protect themselves from possible consequences of use ( $M = 2.9$ ,  $SD = 1.8$ ,  $\alpha = 0.99$ ). These items were presented to participants asking them to rate the frequency with which they engaged in each behavior on a six-point Likert-type scale ranging from one (“Never”) to six (“Always”). Due to the requirements of the analytic approach below, a summed score was utilized in place of the traditional mean score to remove decimal places for hurdle analyses ( $M = 66.8$ ,  $SD = 65.5$ ).

*User Status* was conceptualized as a researcher-generated variable calculated as a combination of cannabis use frequency, intentions to use cannabis, and reported lifetime cannabis use. This variable broke down into four categories of possible use statuses. The first category ( $N = 258$ ), and the referent group, was composed of participants who had no reported cannabis use in their lifetime. The second category ( $N = 71$ ) was composed of participants who reported lifetime cannabis use but no intentions to use it in the future. The third group ( $N = 53$ ) was composed of participants who reported lifetime use, had the intention to use in the future, but reported no use in the last thirty days. The fourth and final category ( $N = 237$ ) was composed of participants who reported use in the last 30 days.

Respectively, we labeled these four categories ‘non-user’, ‘quitter’, ‘potential user’, and ‘user’.

## *Results*

### *Analytic Approach*

Analyses were conducted using STATA statistical software (StataCorp, 2017).

Analyses were approached in two steps. First, we conducted an exploratory factor analysis (EFA) to determine the structure of our novel measure for analytic purposes. Secondly, we examined cannabis beliefs for group-based mean differences using a generalized linear model framework. In the third step, multiple regression analyses were conducted to examine the relationships between novel subscales, identified in the EFA, with important cannabis-related outcomes and to see if these relationships were uniquely distinguishable in the context of other commonly used cannabis perception and cognition measures. Many of the dependent variables of interest contained a significant proportion of zeroes due to how questions were worded, instructing participants who did not use cannabis to respond with options that are represented by zeroes, resulting in zero inflation. As such, multiple regressions were conducted within Hurdle models (Atkins et al., 2012), considering the structure data where appropriate.

### *Exploratory Factor Analysis*

In pursuit of the first analytic goal, we conducted an exploratory factor analysis to examine the factorial structure of the novel measure of cannabis beliefs. We utilized principal factors analysis with Promax rotation. Three factors were extracted based on Eigenvalues (see table 4) and a scree plot (see figure 1). The first three factors accounted for 44%, 25%, and 10% of the variance, respectively. The next three factors were 4%, 3%, and 2%, followed by

the typical scree pattern. Items were determined to be unique to a factor based upon standardized factor loadings greater than  $|0.35|$  (Hair, et al., 1998) with no cross-loadings at or beyond this threshold given our large sample size. Initial analyses of Eigenvalues and scree plots suggested a five-factor solution would best fit the data.

Horn's Parallel analysis suggested a five-factor solution; however, the fourth and fifth factors were composed majorly of items that were non-unique based upon the presence of significant standardized cross-loadings with the other three factors beyond the specified threshold. This persisted in a four-factor solution as well. As such, the following analyses were based on a three-factor solution utilizing Promax rotation. Most commonly, items with significant cross-loadings that were excluded were those loading between factors one and two and often, but not always, in opposite directions. Items excluded from scale calculations regarded topics such as spirituality/morality (see table 3, i.e., item 74), relative use (i.e., item 60), and complex social interactions (i.e., item 21). Overall, fifteen items were excluded from the following analysis as component items of any factors due to the presence of significant cross-loading.

The three-factor model (see table 5) possessed enough unique items split between the factors for the utilization of composite scores. From the initial 79 items, 64 possessed standardized loadings above the threshold on one factor with no significant cross-loadings on the other two factors. We examined the factors' content to determine what concepts were captured in their items. The first factor contained 22 items with standardized loadings ranging from 0.39 to 0.78 and represented a mix of beliefs about cannabis. Such as relaxation and tension reduction (see table 2; i.e., items 14, 37, & 35), the common side effects of use (i.e.,

items 2 & 8), social facilitation (i.e., items 20, 28, & 33), and as a medicinal substance (i.e., items 9, 1, & 50). There were also other unique components of the first factor, such as social justice (i.e., item 30), medication replacement (i.e., item 3), and alleviating attention deficit hyperactivity disorder (i.e., item 42). Overall, we determined this factor to largely be representative of popular culture and was thus labeled culturally positive beliefs.

The second factor consisted of 26 items with standardized loadings ranging from 0.37 to 0.72 and consisted of items related to the harms of cannabis use. These harms ranged from social harms (i.e., items 27 & 32) to behavioral harms (i.e., items 63, 26, 66, & 25) and included biological hazards (i.e., items 38, 13, & 4). Overall, this factor consisted of beliefs about cannabis which could lead to harm in one way or another. We decided to label this factor culturally negative beliefs because of this theme.

The third factor consisted of 16 items with standardized loadings ranging from 0.36 to 0.67 and contained a strange mix of beliefs that seemed to be of a more persuasive orientation. These beliefs were things such as solving problems (i.e., items 7, 16, & 56), non-harm (i.e., items 71, 65, & 18), and motivation (i.e., items 45, 39, & 59). This factor also possessed some unique items, such as beliefs about God (item 73) and drug interactions (item 11). This factor's content included strongly positive items that appeared to advocate cannabis use. We thus labeled it cannabis advocacy.

#### *Mean Differences in Cannabis Beliefs*

A series of generalized linear models (see table 6) were utilized to examine mean differences in cannabis beliefs based on two criteria. The first factor was grouping based on gender identity, and the second was by user status. The analysis of culturally positive beliefs ( $f(2, 603) = 2.28, p > 0.05$ ) revealed no mean differences as a function of gender identity.

Examining culturally negative beliefs ( $f(2, 603) = 4.92, p < 0.01, R^2 = 0.02$ ) showed that women ( $M = 2.99, SD = 0.80$ ) reported more culturally negative beliefs than men ( $M = 2.24, SD = 0.77, t = 2.83, p < 0.01$ ) while non-binary participants did not differ from either men or women. There were no identifiable differences in cannabis advocacy beliefs ( $f(2, 603) = 0.71, p > 0.05$ ) based on gender identity.

When it came to user status, we found that culturally positive beliefs ( $f(3, 606) = 51.83, p < 0.001, R^2 = 0.20$ ) among non-users ( $M = 2.7, SD = 0.94$ ) were reported at lower levels than quitters ( $M = 3.49, SD = 0.84, t = 6.55, p < 0.001$ ), potential users ( $M = 3.59, SD = 0.73, t = 4.60, p < 0.001$ ), and users ( $M = 3.76, SD = 0.72, t = 12.09, p < 0.001$ ). Multiple comparisons using the Bonferroni correction indicated no other mean differences in culturally positive beliefs among the groups. There was a mean difference in culturally negative beliefs ( $f(3, 606) = 3.01, p < 0.05, R^2 = 0.01$ ) between non-users ( $M = 3.03, SD = 0.93$ ) and users ( $M = 2.81, SD = 0.67, t = -2.99, p < 0.01$ ). Multiple comparisons using the Bonferroni correction found that there were no additional mean differences in culturally negative beliefs among the groups. Finally, for cannabis advocacy beliefs ( $f(3, 606) = 48.10, p < 0.001, R^2 = 0.19$ ), we found that in comparison to non-users ( $M = 1.90, SD = 0.64$ ), quitters ( $M = 2.17, SD = 0.73, t = 2.55, p < 0.05$ ), potential users ( $M = 2.35, SD = 0.74, t = 5.11, p < 0.001$ ), and users ( $M = 2.61, SD = 0.65, t = 11.91, p < 0.001$ ) reported more endorsement of this subscale. Multiple comparisons using the Bonferroni correction found that users endorsed cannabis advocacy beliefs more than either quitters ( $f = 15.97, p < 0.001$ ) or potential users ( $f = 8.19, p < 0.05$ ).

### *Correlational Structure*

Correlations between the novel cannabis beliefs subscales revealed interesting patterns of association with variables of interest (see tables 7-10). In regards to our dependent variables of interest, culturally positive beliefs were moderately correlated with negative cultural beliefs and strongly with cannabis advocacy beliefs. Culturally positive beliefs were also positively correlated with the frequency of use, the quantity of use, consequences, PBS use, intent to use, and CUDIT scores. Interestingly, negative cultural beliefs were correlated weakly with cannabis advocacy beliefs. Negative cultural beliefs also had weak negative correlations with the frequency of use and intent to use. Cannabis advocacy beliefs were significantly positively correlated with the frequency of use, the quantity of use, consequences, PBS use, intent to use, and CUDIT scores.

Evaluating the proposed covariates for cannabis beliefs, we first examined the patterns concerning the marijuana motives measure. Culturally positive beliefs were correlated with enjoyment, coping, expansion, boredom, alcohol, celebration, altered perception, perceived risk, social anxiety, sleep, and availability. Negative cultural beliefs were correlated with enjoyment, celebration, perceived risk, and sleep. Cannabis advocacy beliefs were correlated with enjoyment, conformity, coping, expansion, boredom, alcohol, celebration, altered perception, social anxiety, perceived risk, sleep, and availability.

Turning to cannabis descriptive norms, expectancies, and beliefs about the college experience, we found that culturally positive beliefs and cannabis advocacy beliefs were positively correlated with cannabis descriptive norms. For cannabis expectancies, culturally positive beliefs were correlated with cognitive behavioral impairment (CBI), relaxation and tension reduction (RTR), social and sexual facilitation (SSF), perceptual and cognitive

enhancement (PCE), and craving and physical effects (CPE). Negative cultural beliefs were correlated with CBI, RTR, SSF, PCE, global negative effects (GNE), and CPE. Cannabis advocacy beliefs were correlated with RTR, SSF, PCE, and CPE. In terms of the beliefs about the college experience, culturally positive beliefs were correlated with the PIMCES and CLASS. Negative cultural beliefs were not correlated with either measure. Cannabis advocacy beliefs were correlated with the PIMCES and CLASS.

### *Statistical Approach*

After establishing the factor structure of the cannabis beliefs measure and examining potential mean differences based on gender identity and user status, we examined several regression models. We regressed several common cannabis-related measures, from the literature regarding cannabis use, onto these beliefs in an attempt to identify any associations between these important constructs and cannabis beliefs. We examined six measures for dependent associations with cannabis beliefs to evaluate the predictive validity of the novel measure: cannabis use frequency, cannabis use quantity, cannabis-related consequences, cannabis-related protective behavioral strategies (PBS), the Cannabis Use Disorder Identification Test (CUDIT), and intent to use cannabis in the next 30-days. Additionally, to assess the discriminative validity of the novel measure, we examined these dependent variables in parallel models controlling for different independent variables: cannabis descriptive norms, two different measures of cannabis use motives, cannabis expectancies, and college beliefs about substance use. We also examined if measures of general psychological functioning were associated with cannabis beliefs by regressing beliefs onto the depression, anxiety, and stress scales and variables derived from the basic psychological need satisfaction and frustration scales.

Due to the structure of the data, cannabis use frequency and quantity, consequences, PBS, and the CUDIT were examined using Hurdle models to account for the excessive proportion of zeroes present. These zeroes were structurally present due to the instructions provided to participants to respond with the ‘none’ or ‘zero’ option if they were not cannabis users on these measures. These types of models break down into two separate analyses. The first is a logistic regression model distinguishing between zeroes and non-zeroes (non-users vs. users), while the second is a truncated negative binomial model examining the relationship between IVs and the DV within reports greater than zero. Intentions to use cannabis (see table 13) and psychological functioning analyses were conducted using separate ordinary least-squares regression models. Finally, we conducted tests of differential endorsement for key cannabis belief items based on CUDIT hazardous cut-off criteria.

### *Statistical Analysis*

In terms of logistic associations (see tables 11 & 12), the estimated hurdle regression models demonstrated an important consistency in cannabis beliefs’ association with the cannabis-related IVs. Across all models, we saw there to be medium effects for each subscale in relation to the dependent variables in the beliefs only models. When only examining the association between beliefs and IVs, controlling for other beliefs, culturally positive beliefs and advocacy beliefs were positively associated with the odds of reporting any cannabis 1) use frequency, 2) quantity of use, 3) consequences, 4) PBS use, and 5) CUDIT while culturally negative beliefs were negatively associated with all of the IVs. This pattern of association only remained consistent when controlling for descriptive cannabis norms (see table 13). When controlling for the marijuana motives measure (MMM), advocacy beliefs remained associated with cannabis use frequency and the CUDIT. When controlling for



cannabis expectancies, advocacy remained associated with cannabis 1) use frequency, 2) use quantity, 3) consequences, 4) PBS use, and 5) the CUDIT, while culturally negative beliefs remained associated with cannabis 1) use quantity, 2) PBS use, and 3) the CUDIT. When controlling for college substance use beliefs, advocacy beliefs were no longer associated with cannabis consequences but remained associated when competing with other cannabis-related independent variables. Finally, when controlling for the marijuana motives questionnaire (MMQ), culturally negative beliefs and advocacy beliefs remained associated with cannabis use frequency and the CUDIT, while culturally negative beliefs remained associated with cannabis use quantity and PBS use.

When it came to the truncated negative binomial models, culturally positive beliefs were associated negatively with cannabis consequences and positively with cannabis PBS use. Culturally negative beliefs were associated negatively with cannabis use frequency and positively with cannabis consequences. Advocacy beliefs were associated positively with cannabis 1) use frequency, 2) use quantity, 3) consequences, and 4) CUDIT scores. These patterns remained consistent when controlling for cannabis descriptive norms and college substance-related beliefs.

When controlling for the marijuana motives measure (MMM), culturally positive beliefs and culturally negative beliefs remained associated with cannabis consequences, while advocacy beliefs remained associated with cannabis use quantity. Controlling for cannabis expectancies, cannabis advocacy beliefs remained associated with cannabis use quantity and CUDIT scores, while other associations were nullified. For college substance use beliefs, cannabis advocacy beliefs remained associated with cannabis use frequency, quantity, and

CUDIT scores, while culturally negative beliefs remained associated with cannabis use frequency and consequences. Finally, when controlling for the marijuana motives questionnaire, culturally negative beliefs remained associated with cannabis use frequency and consequences, while cannabis advocacy beliefs only remained associated with cannabis use quantity.

We next examined ordinary least-squares regression models estimating intentions to use cannabis from cannabis beliefs in the context of the same covariates. In a beliefs-only model, culturally positive beliefs were positively related to intentions to use, culturally negative beliefs were negatively related, and cannabis advocacy beliefs were positively related. When controlling for descriptive social norms and college substance use beliefs, these relations remained. When controlling for cannabis expectancies, the MMM and the MMQ, culturally positive beliefs were no longer associated with intentions to use in these separate models.

When it came to psychosocial functioning, when controlling for the frequency of cannabis use, stress was associated positively with culturally positive beliefs, while anxiety was associated with cannabis advocacy beliefs (See table 14). Examining basic psychological need satisfaction and frustration scales (see table 15), also controlling for cannabis use frequency, we found that relatedness satisfaction and competence satisfaction were positively associated with culturally positive beliefs. Interestingly, relatedness satisfaction was also positively associated with culturally negative beliefs, while relatedness frustration was positively associated with it as well. Relatedness frustration was positively associated with cannabis advocacy beliefs.

In our final statistical examination (see table 16) of the cannabis beliefs measure, we examined mean differences in scale items highly endorsed by those reporting hazardous cannabis use according to the CUDIT measure. Overall, culturally positive and cannabis advocacy beliefs were more strongly endorsed by hazardous users, while there was no difference in culturally negative beliefs. For culturally positive cannabis beliefs at the item level, hazardous users endorsed items 2, 24, 37, 41, and 78 more strongly than non-hazardous users. For culturally negative beliefs at the item level, there were no statistically significant differences in the strength with which hazardous users endorsed items 38, 52, 55, 58, or 77. Finally, for cannabis advocacy beliefs at the item level, items 15, 18, 46, 56, and 59 were more strongly endorsed by hazardous cannabis users.

## **DISCUSSION**

The present study sought to understand what individuals believe to be true about cannabis and to evaluate the utility of such a measurement tool. We derived what constituted these beliefs about cannabis from a relatively natural sample rather than generating them from the researcher's perspective alone. We then tested this measure among college students to examine the correlational relationships such a construct possessed internally and with important cannabis-related outcomes. The measure demonstrated utility and uniqueness in two key aspects of the analysis. It demonstrated a consistent capability of distinguishing between users and non-users in our hurdle models, while the cannabis advocacy beliefs subscale possesses unique and relatively consistent associations with cannabis use quantity when competing with extant cannabis perception measures. However, the measure seemed to possess extensive overlap, across subscales, with our measures of cannabis expectancies and use motives when it came to other cannabis-related outcomes. We also observed that the

culturally negative and cannabis advocacy beliefs scales were consistently and uniquely associated with intentions to use cannabis, regardless of controlling for other important predictors.

One possible utility of this cannabis beliefs measure is to better understand cannabis use in the frameworks proposed by psychological theory, such as that presented in the health beliefs model (Becker, 1974). In this theoretical framework, the proposed cannabis beliefs scale would function as a perception of the behavior's benefits and/or severity. This would conceptually explain the observed overlap of the measure with cannabis expectancies with outcomes. Expectancies capture the perceptions of the outcomes of cannabis use in both negative and positive directions, which is a component identified in the dynamic between our culturally positive and negative cannabis beliefs. In future studies, advocacy beliefs may serve as a unique mediator of the relationships among antecedents and cannabis-related outcomes in such a path analysis model, as they seem to possess unique associations with cannabis use quantity.

Similarly to its potential as a component within the health beliefs framework, this measure of cannabis beliefs could also fulfill a similar role within the extended framework of the theory of reasoned action and planned behavior (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975). Particularly, this measure of beliefs may be an adequate proxy for, or antecedent to, attitudes towards cannabis. It's reasonable to consider that those who strongly endorse culturally positive beliefs about cannabis will likely have a positive attitude toward it. Likewise, those who strongly endorse culturally negative beliefs about cannabis will likely have a negative attitude toward it. Parallel to this would potentially be advocacy beliefs,

where items seemed to capture motivated beliefs that cannabis has beneficial properties, generating an attitude that ‘not only is cannabis positive, it can help people solve their problems.’ In evidence of this contention, we observed reliable associations with cannabis use intentions for culturally negative and cannabis advocacy beliefs in our analysis, above and beyond the inclusion of covariates. We suggest that this measure of cannabis beliefs may be an important conceptual antecedent to cannabis use intentions and behaviors for future studies to consider.

Another utility of measuring cannabis beliefs is examining its role in predicting behavioral willingness within the prototype willingness framework (Gerrard et al., 2008). The cannabis beliefs measure detailed herein suggests three different categories of beliefs about cannabis. Culturally positive and negative beliefs, respectively, described a generally benign nature and expected harms of cannabis as it is extant within the zeitgeist of society. Meanwhile, cannabis advocacy beliefs seemed to detail a more extreme, positive perspective on cannabis with a motivated focus on solving some extant problem. Within the prototype willingness model, these beliefs could potentially serve as risk images within a reaction-based path of behavior. These beliefs capture what sorts of associative networks individuals possess within them as it regards cannabis. It is reasonable to postulate that these associative networks would influence willingness to use cannabis or the openness to use within a cannabis-accessible situation.

The beliefs related to cannabis possessed important implications for the above-described theories. As researchers, we often aim to test theoretical models as they apply to specific behavioral patterns. To do so, we need the ability to operationalize the full model of

the theory to conduct a proper test of it. This measure of cannabis beliefs permits us to incorporate a broad understanding of the substance into tests of path models and arrive at a more holistic understanding. Importantly, it potentially allows us to understand antecedents to cognitive components of theoretical models and understand how the endogenous components of these theories might form and function before their relationship with enacted behaviors.

In terms of practical utility for this measure of beliefs, we examined items and factors based on hazardous use status as determined by the CUDIT. Overall, we found structural differences in subscales and item endorsement by hazardous cannabis users as opposed to others. The cannabis beliefs scale has the potential to be utilized in clinical diagnoses to better identify and address harmful beliefs about cannabis among clinical populations. Particularly, endorsement of items such as 41 “It helps with winding down after a long day,” 46 “It helps set people's mental frame to start their days,” and 56 “It makes people sexually aroused.”.

These beliefs could potentially be addressed within a clinical setting through cognitive behavioral therapies addressing alternative methods of winding down, starting the day, or preparing for sexual encounters. Particularly, the differences in advocacy beliefs as individuals who used cannabis presenting with higher endorsement of this scale than those naïve to cannabis use or have terminated their cannabis use, at least temporarily. The inclusion of this information, identify potentially problematic underlying beliefs about cannabis and cannabis use, could bolster the approaches that clinicians take in treating cannabis use disorder among their clients. This method of assessing cannabis beliefs would be an important area for future research on this topic, particularly in prospective or experimental designs as this measure takes a quantitative perspective.

### *Limitations*

The current study faces methodological and conceptual limitations. This study utilized cross-sectional designs, limiting the ability to determine causality among the observed variables. This study also focused on examining cannabis-related covariates, which limited our ability to consider other conceptual covariates such as cognition, culture, and age. These would be excellent areas for future research upon which to expand. We also relied upon a convenience sample of college students to examine the structure of our measure, which limits our ability to make generalizations. This study also represents a singular investigation into cannabis beliefs. Given the formative nature of this work, we conducted a large number of analyses without strict adherence to the minimization of alpha inflation. More studies examining cannabis beliefs are needed to corroborate the findings we obtained and to account for possible sources of error within this study.

### *Conclusion*

In past research, particularly in the cannabis field, researchers have largely focused on clinical or researcher-imposed understandings of cannabis uses. In this study, we developed and examined holistic concepts of people's beliefs about cannabis. We identified three primary subscales of beliefs reflecting three broad categories, culturally positive, culturally negative, and cannabis advocacy beliefs. Regression analyses of these beliefs suggested that these cannabis beliefs, particularly cannabis advocacy beliefs, possess unique content in association with important cannabis outcome measures. We also found that this measure, though extensively overlapping in some aspects of extant measures, possessed unique utility in examining and explaining statistical associations. Interestingly, we found that there seemed

to be a structural difference in beliefs based upon hazardous cannabis use and suggesting possible clinical applications of our measure. Overall, we sought to bring a better understanding of perceptions of cannabis to research by engaging with the general population and including their perspective in the process by extending the research process beyond the institutions of academia.



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## TABLES

Table 1. Sample 1 Demographics

| Ethnicity            | N    | %      |
|----------------------|------|--------|
| White                | 309  | 74.3%  |
| Hispanic             | 19   | 4.6%   |
| Black                | 37   | 8.9%   |
| Asian                | 36   | 8.7%   |
| South Asian          | 11   | 2.6%   |
| Native American      | 1    | 0.2%   |
| Middle Eastern       | 3    | 0.7%   |
| Age                  | M    | SD     |
|                      | 39.7 | 12.2   |
| Sex                  | N    | %      |
| Male                 | 228  | 54.80% |
| Female               | 188  | 45.20% |
| Degree               | N    | %      |
| Some High-School     | 2    | 0.5%   |
| High-School          | 63   | 15.2%  |
| Some College         | 70   | 16.9%  |
| Associate's Degree   | 44   | 10.6%  |
| Bachelor's Degree    | 172  | 41.5%  |
| Professional Degree  | 7    | 1.7%   |
| Some Graduate School | 7    | 1.7%   |
| Master's Degree      | 46   | 11.1%  |
| Doctoral Degree      | 4    | 1.0%   |
| Income               | N    | %      |
| \$0-\$14,999         | 26   | 6.3%   |
| \$15,000-\$24,999    | 35   | 8.5%   |
| \$25,000-\$34,999    | 44   | 10.7%  |
| \$35,000-\$49,999    | 60   | 15.6%  |
| \$50,000-\$74,999    | 103  | 25.0%  |
| \$75,000-\$99,999    | 70   | 17.0%  |
| \$100,000-\$149,999  | 48   | 11.7%  |
| \$150,000-\$199,999  | 17   | 4.1%   |
| \$200,000 or More    | 9    | 2.20%  |
| 30-Day Cannabis Use  | N    | %      |
| Any Use              | 218  | 52.4%  |
| No Use               | 198  | 47.6%  |

Table 2. Cannabis Beliefs Item Pool

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1. It helps with managing chronic health conditions (such as: Diabetes, Cancer, MS, Migraines, Glaucoma, PTSD, Chron's, etc...)
2. It makes people hungry
3. It is a healthier alternative to pain medications
4. It causes people to gain weight
5. It can brown or yellow teeth if used too much
6. It helps protect people from cancer
7. It helps clear up people's skin
8. It gives people dry mouth
9. It's a natural medicine
10. It is more dangerous with alcohol
11. It mixes well with alcohol
12. It causes cancer
13. It disrupts the digestive system
14. It helps relax people's bodies
15. People can't overdose on it
16. It helps with healing broken bones
17. It is more dangerous now than it used to be
18. It has no hangover
19. It helps people's vision
20. It helps people open up in social situations
21. It could cause one to lose their job, or be kicked out of school if they use it
22. It has a bad social reputation
23. Its use by others has no impact on me
24. It is enjoyable to use
25. It makes people unreliable
26. It makes people irresponsible
27. It is harmful to one's grades or work performance
28. It is good for social bonding
29. It improves sex
30. It is illegal to primarily punish people of color
31. It impairs people's driving ability
32. It impairs people's ability to manage money
33. It's primarily a social drug
34. It can facilitate the development of friendships
35. It soothes anxiety
36. It helps people think
37. It helps people sleep
38. It can cause memory and perception problems
39. It is energizing
40. It induces a false sense of well-being
41. It helps with winding down after a long day
42. It helps with ADD/ADHD
43. It helps people speak their minds
44. It decreases motivation
45. It increases motivation
46. It helps set people's mental frame to start their days

47. It lowers impulse control
48. It is a meditation aid
49. People use it to escape from reality
50. It is a tool to help people recover from traumatic experiences
51. It impairs judgments
52. It impairs coordination
53. It can cause panic attacks
54. Its long-term use can cause people to become violent
55. It impairs reaction time
56. It makes people sexually aroused
57. It makes people more creative
58. It makes people lose track of time
59. It helps with concentration
60. It is a better coping mechanism than drinking alcohol
61. It causes burnout
62. It ruins the drive to live a meaningful life
63. It increases risk-taking
64. It is a gateway drug (i.e. using it leads to using other drugs such as heroin or cocaine)
65. It is not addictive
66. It is addictive
67. More research should be done on it
68. It is better than drinking
69. It tastes bad
70. It smells good
71. It has little to no withdrawal effects
72. There are no benefits to using it
73. It was created by God for us to use
74. It is sinful to use
75. It is morally wrong to use
76. It enhances spiritual experiences
77. It's expensive
78. It can be beneficial depending on how it's used
79. It can be harmful depending on how it's used

Table 3. Sample 2 Demographics

| Ethnicity (N = 610)           |      |       |
|-------------------------------|------|-------|
|                               | N    | %     |
| White                         | 99   | 13.2% |
| Hispanic                      | 192  | 31.5% |
| Black                         | 86   | 14.1% |
| Asian                         | 126  | 20.7% |
| South Asian                   | 64   | 10.5% |
| Native American               | 2    | 0.3%  |
| Middle Eastern                | 40   | 6.6%  |
| Pacific Islander              | 1    | 0.2%  |
| Age (N = 612)                 |      |       |
|                               | M    | SD    |
|                               | 20.9 | 3.4   |
| Sex (N = 612)                 |      |       |
|                               | N    | %     |
| Male                          | 128  | 20.9% |
| Female                        | 482  | 78.8% |
| Intersex                      | 1    | 0.2%  |
| Declined to Respond           | 1    | 0.2%  |
| Gender (N = 606)              |      |       |
|                               | N    | %     |
| Man                           | 124  | 20.5% |
| Woman                         | 459  | 75.7% |
| Non-Binary                    | 23   | 3.8%  |
| Degree (N = 611)              |      |       |
|                               | N    | %     |
| High-School                   | 163  | 26.7% |
| Some College                  | 311  | 50.9% |
| Associate's Degree            | 110  | 18.0% |
| Bachelor's Degree             | 24   | 3.9%  |
| Other                         | 2    | 0.3%  |
| Declined to Respond           | 1    | 0.2%  |
| Income (N = 611)              |      |       |
|                               | N    | %     |
| \$0-\$14,999                  | 55   | 9.0%  |
| \$15,000-\$24,999             | 40   | 6.6%  |
| \$25,000-\$34,999             | 58   | 9.5%  |
| \$35,000-\$49,999             | 78   | 12.8% |
| \$50,000-\$74,999             | 100  | 16.4% |
| \$75,000-\$99,999             | 60   | 9.8%  |
| \$100,000-\$149,999           | 86   | 14.1% |
| \$150,000-\$199,999           | 33   | 5.4%  |
| \$200,000 or More             | 55   | 9.0%  |
| Declined to Respond           | 46   | 7.5%  |
| 30-day Cannabis Use (N = 612) |      |       |
|                               | N    | %     |
| Any Use                       | 237  | 38.7% |
| No Use                        | 375  | 61.3% |
| User Status (N = 610)         |      |       |
|                               | N    | %     |
| Non-User                      | 258  | 42.3% |
| Quitter                       | 44   | 7.2%  |
| Potential User                | 71   | 11.6% |
| User                          | 237  | 38.9% |

Table 4. Exploratory Factor Eigenvalues

| Factor   | Eigenvalue | Difference | Proportion | Cumulative |
|----------|------------|------------|------------|------------|
| Factor1  | 19.78243   | 8.61258    | 0.4388     | 0.4388     |
| Factor2  | 11.16985   | 6.62908    | 0.2478     | 0.6865     |
| Factor3  | 4.54078    | 2.54586    | 0.1007     | 0.7873     |
| Factor4  | 1.99492    | 0.68677    | 0.0442     | 0.8315     |
| Factor5  | 1.30815    | 0.27471    | 0.029      | 0.8605     |
| Factor6  | 1.03344    | 0.19849    | 0.0229     | 0.8834     |
| Factor7  | 0.83495    | 0.04427    | 0.0185     | 0.902      |
| Factor8  | 0.79068    | 0.12413    | 0.0175     | 0.9195     |
| Factor9  | 0.66655    | 0.07165    | 0.0148     | 0.9343     |
| Factor10 | 0.5949     | 0.0736     | 0.0132     | 0.9475     |
| Factor11 | 0.5213     | 0.03568    | 0.0116     | 0.959      |
| Factor12 | 0.48562    | 0.05351    | 0.0108     | 0.9698     |
| Factor13 | 0.43211    | 0.02656    | 0.0096     | 0.9794     |
| Factor14 | 0.40555    | 0.01993    | 0.009      | 0.9884     |
| Factor15 | 0.38562    | 0.04888    | 0.0086     | 0.9969     |



Table 5. Cannabis Beliefs Standardized Factor Loadings

| Theme               | Item | Factor 1 | Factor 2 | Factor 3 |
|---------------------|------|----------|----------|----------|
| Culturally Positive | 14   | 0.784    |          |          |
| Culturally Positive | 37   | 0.776    |          |          |
| Culturally Positive | 78   | 0.774    |          |          |
| Culturally Positive | 35   | 0.724    |          |          |
| Culturally Positive | 41   | 0.714    |          |          |
| Culturally Positive | 24   | 0.689    |          |          |
| Culturally Positive | 2    | 0.680    |          |          |
| Culturally Positive | 20   | 0.646    |          |          |
| Culturally Positive | 9    | 0.630    |          |          |
| Culturally Positive | 57   | 0.623    |          |          |
| Culturally Positive | 1    | 0.620    |          |          |
| Culturally Positive | 48   | 0.606    |          |          |
| Culturally Positive | 28   | 0.589    |          |          |
| Culturally Positive | 50   | 0.585    |          |          |
| Culturally Positive | 34   | 0.558    |          |          |
| Culturally Positive | 3    | 0.555    |          |          |
| Culturally Positive | 23   | 0.554    |          |          |
| Culturally Positive | 43   | 0.522    |          |          |
| Culturally Positive | 30   | 0.514    |          |          |
| Culturally Positive | 8    | 0.496    |          |          |
| Culturally Positive | 42   | 0.439    |          |          |
| Culturally Positive | 33   | 0.390    |          |          |
| Culturally Negative | 27   |          | 0.726    |          |
| Culturally Negative | 51   |          | 0.718    |          |
| Culturally Negative | 44   |          | 0.710    |          |
| Culturally Negative | 63   |          | 0.692    |          |
| Culturally Negative | 26   |          | 0.691    |          |
| Culturally Negative | 25   |          | 0.690    |          |
| Culturally Negative | 54   |          | 0.684    |          |
| Culturally Negative | 38   |          | 0.666    |          |
| Culturally Negative | 40   |          | 0.665    |          |
| Culturally Negative | 52   |          | 0.664    |          |
| Culturally Negative | 66   |          | 0.655    |          |
| Culturally Negative | 32   |          | 0.651    |          |
| Culturally Negative | 64   |          | 0.645    |          |
| Culturally Negative | 61   |          | 0.639    |          |
| Culturally Negative | 58   |          | 0.608    |          |
| Culturally Negative | 55   |          | 0.603    |          |
| Culturally Negative | 13   |          | 0.576    |          |
| Culturally Negative | 5    |          | 0.559    |          |
| Culturally Negative | 12   |          | 0.553    |          |
| Culturally Negative | 69   |          | 0.515    |          |

|                     |    |        |       |       |
|---------------------|----|--------|-------|-------|
| Culturally Negative | 17 |        | 0.511 |       |
| Culturally Negative | 53 |        | 0.500 |       |
| Culturally Negative | 10 |        | 0.489 |       |
| Culturally Negative | 77 |        | 0.484 |       |
| Culturally Negative | 47 |        | 0.449 |       |
| Culturally Negative | 4  |        | 0.367 |       |
| <hr/>               |    |        |       |       |
| Cannabis Advocacy   | 7  |        |       | 0.669 |
| Cannabis Advocacy   | 45 |        |       | 0.617 |
| Cannabis Advocacy   | 70 |        |       | 0.598 |
| Cannabis Advocacy   | 39 |        |       | 0.594 |
| Cannabis Advocacy   | 19 |        |       | 0.592 |
| Cannabis Advocacy   | 6  |        |       | 0.579 |
| Cannabis Advocacy   | 46 |        |       | 0.570 |
| Cannabis Advocacy   | 16 |        |       | 0.565 |
| Cannabis Advocacy   | 59 |        |       | 0.555 |
| Cannabis Advocacy   | 11 |        |       | 0.504 |
| Cannabis Advocacy   | 73 |        |       | 0.494 |
| Cannabis Advocacy   | 71 |        |       | 0.490 |
| Cannabis Advocacy   | 56 |        |       | 0.437 |
| Cannabis Advocacy   | 65 |        |       | 0.432 |
| Cannabis Advocacy   | 15 |        |       | 0.368 |
| Cannabis Advocacy   | 18 |        |       | 0.364 |
| <hr/>               |    |        |       |       |
| Excluded            | 21 | 0.457  | 0.396 |       |
| Excluded            | 22 |        |       |       |
| Excluded            | 29 | 0.358  |       | 0.481 |
| Excluded            | 31 | 0.352  | 0.519 |       |
| Excluded            | 36 | 0.408  |       | 0.508 |
| Excluded            | 49 | 0.503  | 0.493 |       |
| Excluded            | 60 | 0.514  |       | 0.379 |
| Excluded            | 62 | -0.404 | 0.704 |       |
| Excluded            | 67 | 0.594  | 0.361 |       |
| Excluded            | 68 | 0.531  |       | 0.409 |
| Excluded            | 72 | -0.472 | 0.550 |       |
| Excluded            | 74 | -0.438 | 0.565 |       |
| Excluded            | 75 | -0.494 | 0.613 |       |
| Excluded            | 76 | 0.464  |       | 0.360 |
| Excluded            | 79 | 0.393  | 0.558 |       |

*Note. Blank cells represent a standardized factor loading less than |0.35|*

Table 6. Mean differences in beliefs as a function of use-status

| Belief Category             | Group             | Mean | SE   |    |
|-----------------------------|-------------------|------|------|----|
| Culturally Positive Beliefs | Non-Users         | 2.87 | 0.05 | A  |
|                             | Quitters          | 3.59 | 0.10 | BC |
|                             | Non-Current Users | 3.49 | 0.12 | B  |
|                             | Current Users     | 3.76 | 0.05 | C  |
| Culturally Negative Beliefs | Non-Users         | 3.03 | 0.05 | A  |
|                             | Quitters          | 2.92 | 0.09 | B  |
|                             | Non-Current Users | 2.96 | 0.12 | B  |
|                             | Current Users     | 2.81 | 0.05 | B  |
| Cannabis Advocacy Beliefs   | Non-Users         | 1.90 | 0.04 | A  |
|                             | Quitters          | 2.35 | 0.08 | B  |
|                             | Non-Current Users | 2.17 | 0.10 | B  |
|                             | Current Users     | 2.61 | 0.04 | C  |

Note. Cells sharing a letter indicate no significant differences

Table 7. Correlations among outcomes and belief measures

|                 | 1       | 2        | 3       | 4       | 5       | 6       | 7       | 8       |
|-----------------|---------|----------|---------|---------|---------|---------|---------|---------|
| 1. CPB          | -       |          |         |         |         |         |         |         |
| 2. CNB          | 0.29*** | -        |         |         |         |         |         |         |
| 3. CAB          | 0.64*** | 0.17***  | -       |         |         |         |         |         |
| 4. Frequency    | 0.30*** | -0.10*   | 0.36*** | -       |         |         |         |         |
| 5. Quantity     | 0.26*** | -0.04    | 0.28*** | 0.62*** | -       |         |         |         |
| 6. Consequences | 0.23*** | 0.02     | 0.25*** | 0.56*** | 0.47*** | -       |         |         |
| 7. PBS          | 0.37*** | -0.07    | 0.30*** | 0.25*** | 0.16*** | 0.23*** | -       |         |
| 8. Intent       | 0.43*** | -0.14*** | 0.42*** | 0.67*** | 0.48*** | 0.46*** | 0.46*** | -       |
| 9. CUDIT        | 0.36*** | -0.05    | 0.41*** | 0.75*** | 0.61*** | 0.75*** | 0.39*** | 0.68*** |

Note. \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 9. Correlations among MMM subscales and cannabis beliefs

|               | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      |
|---------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. CPB        | -       |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2. CNB        | 0.29*** | -       |         |         |         |         |         |         |         |         |         |         |         |         |
| 3. CAB        | 0.64*** | 0.17*** | -       |         |         |         |         |         |         |         |         |         |         |         |
| 4. Enjoy      | 0.52*** | -0.11** | 0.45*** | -       |         |         |         |         |         |         |         |         |         |         |
| 5. Conform    | 0.07    | 0.07    | 0.27*** | 0.35*** | -       |         |         |         |         |         |         |         |         |         |
| 6. Coping     | 0.38*** | -0.01   | 0.44*** | 0.69*** | 0.53*** | -       |         |         |         |         |         |         |         |         |
| 7. Expand     | 0.37*** | 0.00    | 0.34*** | 0.72*** | 0.49*** | 0.57*** | -       |         |         |         |         |         |         |         |
| 8. Boredom    | 0.37*** | 0.00    | 0.40*** | 0.71*** | 0.53*** | 0.73*** | 0.65*** | -       |         |         |         |         |         |         |
| 9. Alcohol    | 0.19*** | 0.01    | 0.37*** | 0.47*** | 0.61*** | 0.55*** | 0.50*** | 0.60*** | -       |         |         |         |         |         |
| 10. Celebrate | 0.44*** | -0.08*  | 0.48*** | 0.76*** | 0.35*** | 0.64*** | 0.59*** | 0.65*** | 0.53*** | -       |         |         |         |         |
| 11. Alter     | 0.39*** | -0.06   | 0.49*** | 0.70*** | 0.43*** | 0.70*** | 0.58*** | 0.68*** | 0.53*** | 0.75*** | -       |         |         |         |
| 12. Anxiety   | 0.41*** | -0.05   | 0.48*** | 0.69*** | 0.43*** | 0.71*** | 0.52*** | 0.68*** | 0.58*** | 0.77*** | 0.78*** | -       |         |         |
| 13. Risk      | 0.44*** | -0.12** | 0.52*** | 0.73*** | 0.40*** | 0.68*** | 0.59*** | 0.69*** | 0.56*** | 0.75*** | 0.78*** | 0.77*** | -       |         |
| 14. Sleep     | 0.44*** | -0.09*  | 0.49*** | 0.69*** | 0.36*** | 0.70*** | 0.50*** | 0.65*** | 0.51*** | 0.67*** | 0.70*** | 0.75*** | 0.77*** | -       |
| 15. Available | 0.35*** | 0.03    | 0.44*** | 0.64*** | 0.55*** | 0.66*** | 0.58*** | 0.74*** | 0.63*** | 0.65*** | 0.71*** | 0.74*** | 0.71*** | 0.70*** |

Note. \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 8. Correlations among cannabis beliefs, cannabis expectancies, college cannabis beliefs, cannabis descriptive norms, and DASS-21

|                 | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14    |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| 1. CPB          | -       |         |         |         |         |         |         |         |         |         |         |         |         |       |
| 2. CNB          | 0.29*** | -       |         |         |         |         |         |         |         |         |         |         |         |       |
| 3. CAB          | 0.64*** | 0.17*** | -       |         |         |         |         |         |         |         |         |         |         |       |
| 4. CBIMP        | 0.34*** | 0.37*** | 0.06    | -       |         |         |         |         |         |         |         |         |         |       |
| 5. RTR          | 0.60*** | 0.08*   | 0.37*** | 0.50*** | -       |         |         |         |         |         |         |         |         |       |
| 6. SSF          | 0.50*** | 0.09*   | 0.38*** | 0.39*** | 0.76*** | -       |         |         |         |         |         |         |         |       |
| 7. PCE          | 0.61*** | 0.13**  | 0.43*** | 0.60*** | 0.85*** | 0.75*** | -       |         |         |         |         |         |         |       |
| 8. GNE          | -0.01   | 0.39*** | -0.04   | 0.59*** | 0.25*** | 0.31*** | 0.36*** | -       |         |         |         |         |         |       |
| 9. CPE          | 0.61*** | 0.14*** | 0.32*** | 0.62*** | 0.79*** | 0.63*** | 0.81*** | 0.26*** | -       |         |         |         |         |       |
| 10. CLASS       | 0.33*** | 0.04    | 0.37*** | 0.17*** | 0.31*** | 0.31*** | 0.35*** | 0.07    | 0.33*** | -       |         |         |         |       |
| 11. PIMCES      | 0.38*** | 0.06    | 0.47*** | 0.18*** | 0.35*** | 0.38*** | 0.39*** | 0.06    | 0.32*** | 0.67*** | -       |         |         |       |
| 12. Stress      | 0.26*** | 0.17*** | 0.20*** | 0.22*** | 0.13*** | 0.15*** | 0.22*** | 0.12**  | 0.18*** | 0.13**  | 0.15*** | -       |         |       |
| 13. Depression  | 0.21*** | 0.16*** | 0.21*** | 0.18*** | 0.13**  | 0.13**  | 0.18*** | 0.13*** | 0.15*** | 0.12**  | 0.16*** | 0.83*** | -       |       |
| 14. Anxiety     | 0.23*** | 0.12**  | 0.30*** | 0.16*** | 0.13**  | 0.14*** | 0.20*** | 0.09*   | 0.17*** | 0.16*** | 0.20*** | 0.84*** | 0.78*** | -     |
| 15. Social Norm | 0.28*** | 0.05    | 0.20*** | 0.05    | 0.19*** | 0.12**  | 0.19*** | -0.09*  | 0.19*** | 0.15*** | 0.11**  | 0.08    | 0.01    | 0.09* |

Note. \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 10. Correlations among cannabis beliefs and basic psychological needs satisfaction and frustration scales

|                      | 1       | 2       | 3       | 4        | 5       | 6        | 7        | 8        |
|----------------------|---------|---------|---------|----------|---------|----------|----------|----------|
| 1. CPB               | -       |         |         |          |         |          |          |          |
| 2. CNB               | 0.29*** | -       |         |          |         |          |          |          |
| 3. CAB               | 0.64*** | 0.17*** | -       |          |         |          |          |          |
| 4. Autonomy Sat.     | 0.24*** | 0.14*** | 0.06    | -        |         |          |          |          |
| 5. Autonomy Frus.    | 0.16*** | 0.19*** | 0.09*   | -0.11**  | -       |          |          |          |
| 6. Relatedness Sat.  | 0.28*** | 0.16*** | 0.01    | 0.71***  | -0.05   | -        |          |          |
| 7. Relatedness Frus. | 0.03    | 0.15*** | 0.19*** | -0.21*** | 0.56*** | -0.34*** | -        |          |
| 8. Competence Sat.   | 0.23*** | 0.09*   | 0.08*   | 0.76***  | -0.12** | 0.67***  | -0.20*** | -        |
| 9. Competence Frus.  | 0.15*** | 0.19*** | 0.08*   | -0.17*** | 0.66*** | -0.14*** | 0.59***  | -0.33*** |

Note. \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 11. Hurdle model of all cannabis beliefs without controlling for covariates

Logistic Regression

|               | CPB         |             |             |             | CNB         |             |              |              | CAB         |             |             |             |
|---------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|-------------|-------------|-------------|-------------|
|               | OR          | SE          | Z           | ES (d)      | OR          | SE          | Z            | ES (d)       | OR          | SE          | Z           | ES (d)      |
| Use Frequency | <b>2.39</b> | <b>0.15</b> | <b>5.75</b> | <b>0.46</b> | <b>0.38</b> | <b>0.16</b> | <b>-6.12</b> | <b>-0.49</b> | <b>2.62</b> | <b>0.17</b> | <b>5.63</b> | <b>0.46</b> |
| Use Quantity  | <b>2.82</b> | <b>0.16</b> | <b>6.63</b> | <b>0.54</b> | <b>0.35</b> | <b>0.16</b> | <b>-6.40</b> | <b>-0.52</b> | <b>2.16</b> | <b>0.17</b> | <b>4.52</b> | <b>0.37</b> |
| Consequences  | <b>2.69</b> | <b>0.15</b> | <b>6.44</b> | <b>0.52</b> | <b>0.52</b> | <b>0.15</b> | <b>-4.42</b> | <b>-0.36</b> | <b>1.53</b> | <b>0.16</b> | <b>2.60</b> | <b>0.21</b> |
| PBS Use       | <b>2.80</b> | <b>0.15</b> | <b>6.69</b> | <b>0.54</b> | <b>0.35</b> | <b>0.15</b> | <b>-6.70</b> | <b>-0.54</b> | <b>2.16</b> | <b>0.17</b> | <b>4.48</b> | <b>0.36</b> |
| CUDIT         | <b>2.75</b> | <b>0.15</b> | <b>6.64</b> | <b>0.54</b> | <b>0.37</b> | <b>0.16</b> | <b>-6.29</b> | <b>-0.51</b> | <b>2.44</b> | <b>0.17</b> | <b>5.24</b> | <b>0.42</b> |

Truncated Negative Binomial Regression

|               | CPB         |             |              | CNB         |             |              | CAB         |             |             |
|---------------|-------------|-------------|--------------|-------------|-------------|--------------|-------------|-------------|-------------|
|               | IRR         | SE          | Z            | IRR         | SE          | Z            | IRR         | SE          | Z           |
| Use Frequency | 1.31        | 0.16        | 1.66         | <b>0.68</b> | <b>0.17</b> | <b>-2.28</b> | <b>1.80</b> | <b>0.19</b> | <b>3.12</b> |
| Use Quantity  | 1.24        | 0.13        | 1.74         | 0.94        | 0.13        | -0.39        | <b>1.63</b> | <b>0.14</b> | <b>3.46</b> |
| Consequences  | <b>0.73</b> | <b>0.12</b> | <b>-2.70</b> | <b>1.59</b> | <b>0.13</b> | <b>3.65</b>  | <b>1.38</b> | <b>0.14</b> | <b>2.36</b> |
| PBS Use       | <b>1.10</b> | <b>0.05</b> | <b>2.06</b>  | 1.07        | 0.04        | 1.48         | 0.91        | 0.05        | -1.91       |
| CUDIT         | 1.11        | 0.08        | 1.41         | 1.00        | 0.08        | -0.03        | <b>1.41</b> | <b>0.08</b> | <b>4.03</b> |

Note. ORs and IRRs in bold were significant at  $p < 0.05$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs; IRRs can be interpreted similar to an effect size; ES (d) = Effect Size in Cohen's d calculated by the equation:  $d = \frac{2 * Z}{\sqrt{qr * (n)}}$  (see Rosenthal & Rosnow, 2008); Hurdle models were based on an analytic sample of 612

Table 12. Hurdle models for cannabis beliefs controlling for covariates

| Logistic Regression |                   |             |             |      |      |             |      |             |             |              |             |             |                    |             |             |
|---------------------|-------------------|-------------|-------------|------|------|-------------|------|-------------|-------------|--------------|-------------|-------------|--------------------|-------------|-------------|
| OR                  | Descriptive Norms |             |             | MMM  |      |             | MMQ  |             |             | Expectancies |             |             | College Experience |             |             |
|                     | CPB               | CNB         | CAB         | CPB  | CNB  | CAB         | CPB  | CNB         | CAB         | CPB          | CNB         | CAB         | CPB                | CNB         | CAB         |
| Use Frequency       | <b>2.26</b>       | <b>0.38</b> | <b>2.61</b> | 0.70 | 0.78 | <b>1.97</b> | 0.84 | <b>0.69</b> | <b>2.02</b> | 0.72         | 0.75        | <b>3.38</b> | <b>2.30</b>        | <b>0.38</b> | <b>2.01</b> |
| Use Quantity        | <b>2.69</b>       | <b>0.35</b> | <b>2.15</b> | 0.82 | 0.78 | 1.54        | 1.07 | <b>0.61</b> | 1.50        | 0.98         | <b>0.63</b> | <b>2.74</b> | <b>2.75</b>        | <b>0.35</b> | <b>1.72</b> |
| Consequences        | <b>2.55</b>       | <b>0.53</b> | <b>1.51</b> | 1.10 | 1.00 | 0.83        | 1.13 | 0.90        | 0.93        | 1.19         | 0.75        | <b>1.90</b> | <b>2.64</b>        | <b>0.52</b> | 1.19        |
| PBS Use             | <b>2.61</b>       | <b>0.35</b> | <b>2.16</b> | 1.16 | 0.67 | 1.23        | 1.33 | <b>0.62</b> | 1.27        | 1.28         | <b>0.53</b> | <b>3.59</b> | <b>2.63</b>        | <b>0.37</b> | <b>1.78</b> |
| CUDIT               | <b>2.55</b>       | <b>0.37</b> | <b>2.44</b> | 0.91 | 0.79 | <b>1.82</b> | 1.06 | <b>0.67</b> | <b>1.97</b> | 1.00         | <b>0.62</b> | <b>4.13</b> | <b>2.64</b>        | <b>0.38</b> | <b>2.14</b> |

| Truncated Negative Binomial Regression |                   |             |             |             |             |             |             |             |             |              |      |             |                    |             |             |
|--|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|------|-------------|--------------------|-------------|-------------|
| IRR                                    | Descriptive Norms |             |             | MMM         |             |             | MMQ         |             |             | Expectancies |      |             | College Experience |             |             |
|  | CPB               | CNB         | CAB         | CPB         | CNB         | CAB         | CPB         | CNB         | CAB         | CPB          | CNB  | CAB         | CPB                | CNB         | CAB         |
| Use Frequency                          | 1.28              | <b>0.69</b> | <b>1.78</b> | 0.71        | 0.98        | 1.23        | 1.02        | <b>0.67</b> | 1.31        | 1.14         | 0.84 | 1.48        | 1.29               | <b>0.69</b> | <b>1.55</b> |
| Use Quantity                           | 1.23              | 0.96        | <b>1.63</b> | 0.82        | 0.96        | <b>1.54</b> | 0.92        | 0.86        | <b>1.61</b> | 0.98         | 1.07 | <b>1.64</b> | 1.24               | 0.91        | <b>1.55</b> |
| Consequences                           | <b>0.73</b>       | <b>1.59</b> | <b>1.38</b> | <b>0.69</b> | <b>1.61</b> | 1.04        | <b>0.73</b> | <b>1.45</b> | 1.09        | 0.78         | 1.38 | 1.28        | <b>0.72</b>        | <b>1.55</b> | 1.21        |
| PBS Use                                | <b>1.10</b>       | 1.07        | 0.91        | 1.03        | 1.08        | 0.93        | 1.09        | 1.08        | 0.91        | 1.07         | 1.05 | 0.95        | <b>1.10</b>        | 1.07        | 0.94        |
| CUDIT                                  | 1.11              | 1.00        | <b>1.41</b> | 0.85        | 1.01        | 1.09        | 0.89        | 0.88        | 1.07        | 0.94         | 0.96 | <b>1.30</b> | 1.08               | 0.97        | <b>1.24</b> |

Note. ORs and IRRs in bold were significant at  $p < 0.05$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 13. OLS regression models of intent to use cannabis onto cannabis beliefs

| Intentions to use |                     |              |                     |              |                     |              |                     |              |                     |              |                     |              |
|-------------------|---------------------|--------------|---------------------|--------------|---------------------|--------------|---------------------|--------------|---------------------|--------------|---------------------|--------------|
| OLS               | Beliefs Only        |              | Descriptive Norms   |              | MMM                 |              | MMQ                 |              | Expectancies        |              | College Experience  |              |
|                   | $\beta$ (SE)        | t            | $\beta$ (SE)        | t            | $\beta$ (SE)        | t            | $\beta$ (SE)        | t            | $\beta$ (SE)        | t            | $\beta$ (SE)        | t            |
| CPB               | <b>0.36 (0.07)</b>  | <b>7.76</b>  | <b>0.34 (0.07)</b>  | <b>7.19</b>  | 0.05 (0.07)         | 1.05         | 0.07 (0.07)         | 1.59         | 0.03 (0.09)         | 0.61         | <b>0.32 (0.07)</b>  | <b>7.08</b>  |
| CNB               | <b>-0.29 (0.06)</b> | <b>-8.05</b> | <b>-0.28 (0.06)</b> | <b>-8.00</b> | <b>-0.08 (0.06)</b> | <b>-2.44</b> | <b>-0.12 (0.06)</b> | <b>-3.82</b> | <b>-0.11 (0.07)</b> | <b>-2.69</b> | <b>-0.27 (0.06)</b> | <b>-7.90</b> |
| CAB               | <b>0.24 (0.09)</b>  | <b>5.46</b>  | <b>0.24 (0.09)</b>  | <b>5.41</b>  | <b>0.10 (0.08)</b>  | <b>2.45</b>  | <b>0.13 (0.08)</b>  | <b>3.2</b>   | <b>0.25 (0.09)</b>  | <b>5.53</b>  | <b>0.15 (0.09)</b>  | <b>3.40</b>  |

Note. Regression weights in bold were significant at  $p < 0.05$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 14. Cannabis beliefs predicted from the DASS-21 controlling for cannabis use frequency

| Cannabis Beliefs |                    |             |              |       |                    |             |                        |              |
|------------------|--------------------|-------------|--------------|-------|--------------------|-------------|------------------------|--------------|
| OLS              | Stress             |             | Depression   |       | Anxiety            |             | Cannabis use Frequency |              |
|                  | $\beta$ (SE)       | t           | $\beta$ (SE) | t     | $\beta$ (SE)       | t           | $\beta$ (SE)           | t            |
| CPB              | <b>0.32 (0.07)</b> | <b>3.90</b> | -0.07 (0.06) | -0.94 | -0.04 (0.07)       | 0.57        | <b>0.28 (0.00)</b>     | <b>7.25</b>  |
| CNB              | 0.15 (0.07)        | 1.78        | 0.10 (0.06)  | 1.29  | -0.06 (0.07)       | -0.73       | <b>-0.12 (0.00)</b>    | <b>-3.01</b> |
| CAB              | -0.12 (0.06)       | -1.57       | -0.01 (0.05) | -0.16 | <b>0.35 (0.06)</b> | <b>4.93</b> | <b>0.30 (0.00)</b>     | <b>8.07</b>  |

Note. Regression weights in bold were significant at  $p < 0.05$ ; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 15. Cannabis beliefs predicted from the basic psychological needs satisfaction and frustration scales controlling for cannabis use frequency

| Cannabis Beliefs |                          |                         |                             |                            |                            |                           |                           |
|------------------|--------------------------|-------------------------|-----------------------------|----------------------------|----------------------------|---------------------------|---------------------------|
| OLS<br>β (SE)    | Autonomy<br>Satisfaction | Autonomy<br>Frustration | Relatedness<br>Satisfaction | Relatedness<br>Frustration | Competence<br>Satisfaction | Competence<br>Frustration | Cannabis use<br>Frequency |
| CPB              | 0.02 (0.06)              | 0.06 (0.05)             | <b>0.18 (0.05)</b>          | -0.05 (0.05)               | <b>0.16 (0.06)</b>         | <b>0.21 (0.05)</b>        | <b>0.30 (0.00)</b>        |
| CNB              | 0.11 (0.06)              | 0.08 (0.05)             | <b>0.16 (0.05)</b>          | <b>0.14 (0.05)</b>         | -0.02 (0.05)               | 0.09 (0.04)               | <b>-0.12 (0.00)</b>       |
| CAB              | 0.01 (0.05)              | -0.06 (0.04)            | 0.03 (0.04)                 | <b>0.22 (0.04)</b>         | 0.09 (0.05)                | 0.01 (0.04)               | <b>0.34 (0.00)</b>        |

Note. Regression weights in bold were significant at  $p < 0.05$ ; Each cannabis beliefs subscale was set as the dependent variable; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs

Table 16. T-tests of differential beliefs between hazardous users versus others

| Cannabis Beliefs |                    |             |              |                  |
|------------------|--------------------|-------------|--------------|------------------|
| Scale<br>Item    | Hazardous<br>Users | Others      | t            | p                |
| <b>CPB</b>       | <b>3.83</b>        | <b>3.20</b> | <b>7.47</b>  | <b>&lt;0.000</b> |
| <b>14</b>        | <b>4.17</b>        | <b>3.61</b> | <b>5.01</b>  | <b>&lt;0.000</b> |
| <b>37</b>        | <b>4.24</b>        | <b>3.61</b> | <b>6.51</b>  | <b>&lt;0.000</b> |
| <b>78</b>        | <b>4.22</b>        | <b>3.64</b> | <b>4.53</b>  | <b>&lt;0.000</b> |
| <b>35</b>        | <b>3.92</b>        | <b>3.45</b> | <b>3.92</b>  | <b>&lt;0.000</b> |
| <b>41</b>        | <b>4.22</b>        | <b>3.18</b> | <b>8.77</b>  | <b>&lt;0.000</b> |
| CNB              | 2.88               | 2.95        | -0.87        | 0.386            |
| <b>27</b>        | <b>2.86</b>        | <b>3.12</b> | <b>-2.20</b> | <b>&lt;0.050</b> |
| 51               | 3.13               | 3.32        | -1.67        | 0.095            |
| 44               | 2.85               | 2.87        | 0.19         | 0.846            |
| 63               | 2.96               | 3.05        | 0.76         | 0.446            |
| <b>26</b>        | <b>2.78</b>        | <b>3.02</b> | <b>1.99</b>  | <b>&lt;0.050</b> |
| <b>CAB</b>       | <b>2.72</b>        | <b>2.10</b> | <b>9.53</b>  | <b>&lt;0.000</b> |
| <b>15</b>        | <b>3.40</b>        | <b>2.37</b> | <b>7.55</b>  | <b>&lt;0.000</b> |
| <b>18</b>        | <b>3.11</b>        | <b>2.44</b> | <b>5.32</b>  | <b>&lt;0.000</b> |
| <b>46</b>        | <b>2.93</b>        | <b>2.41</b> | <b>4.50</b>  | <b>&lt;0.000</b> |
| <b>56</b>        | <b>3.27</b>        | <b>2.59</b> | <b>6.02</b>  | <b>&lt;0.000</b> |
| <b>59</b>        | <b>2.86</b>        | <b>2.36</b> | <b>4.48</b>  | <b>&lt;0.000</b> |

Note. Ttest significance was determined by the twotailed test; CPB = Culturally Positive Beliefs, CNB = Culturally negative Beliefs, CAB = Cannabis Advocacy Beliefs; CUDIT scores were cutoff at 8 to generate a dummy variable such that 1 = hazardous use

## FIGURES

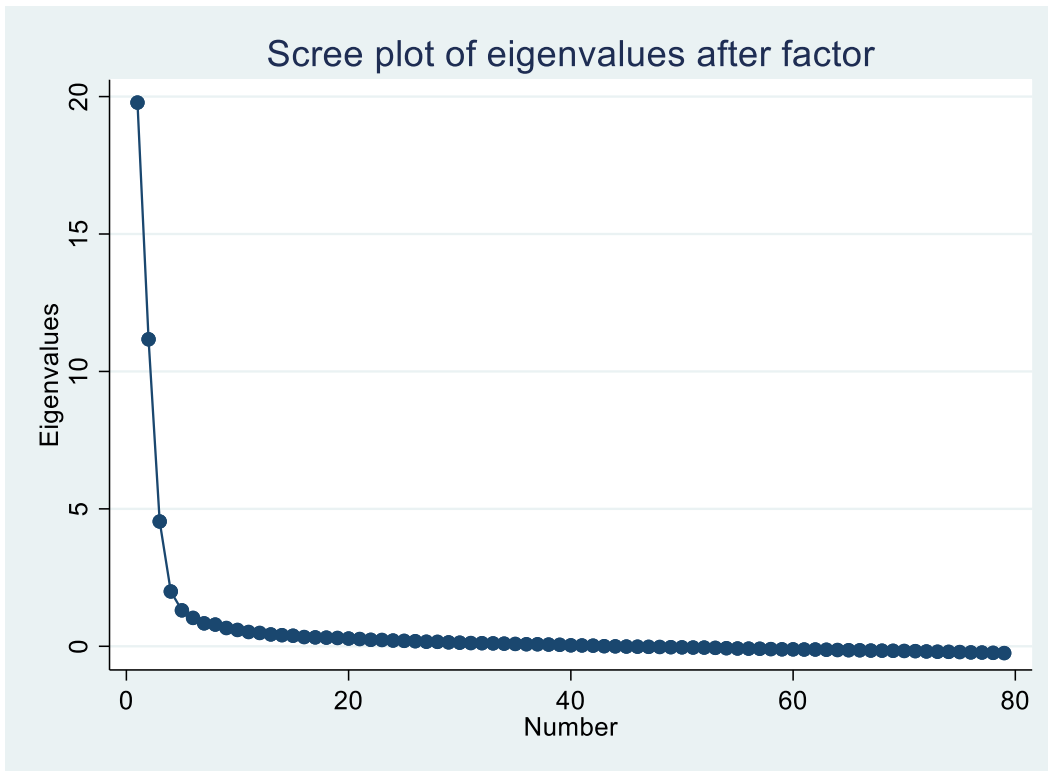


Figure 1. Exploratory analysis scree plot.