

DISSERTATION

CANNABIS USE CONSEQUENCES: A MULTI-ETHNIC SITE INVESTIGATION OF RISK  
AND PROTECTIVE FACTORS

Submitted by

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## ABSTRACT

### CANNABIS USE CONSEQUENCES: A MULTI-ETHNIC SITE INVESTIGATION OF RISK AND PROTECTIVE FACTORS

Cannabis is the most popular regulated drug in the world and use rates continue to increase as legalization becomes more prevalent. Heavy cannabis use has been associated with a variety of mental health concerns and psychological distress has been observed to be a risk factor for the development of Cannabis Use Disorder. The current study examines how psychological distress relates to cannabis use consequences across sites in the United States, the Netherlands, Uruguay, Spain, and Argentina. Additionally, this study also explores protective coping strategies that users employ that may reduce the incidence of negative cannabis use consequences. Participants were recruited from university research pools and given surveys that assessed the individual's cannabis use behavior, possible risk and protective strategies, and problematic use outcomes. Results from this study may inform clinical interventions for the treatment and prevention of cannabis use disorder and make suggestions about ways to alter these interventions based on the location of services provided.

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## INTRODUCTION

The interplay between substance use and mental health is an important area for research as the number of individuals who endorse co-occurring substance use and mental health diagnoses grows (National Academies of Sciences [NAS], 2017). For cannabis use specifically, as it grows in popularity, so do the rates at which psychological disorders co-occur among heavy and chronic users (NAS, 2017; Satre et al., 2018). Consistent findings support a bi-directional relationship, i.e., that cannabis use can be a risk factor for developing a psychological disorder and that psychological disorders can be risk factors for increased rates of cannabis use (Satre et al., 2018). Rates of cannabis use are increasing around the world as the social and legal landscape surrounding use is changing. About 3.9% of the global population used cannabis in the past year, a notable increase of about 28% compared to historical trends of use rates increasing by about 1.4% each year (United Nations Office on Drugs and Crime [UNODC], 2018). In the United States, the number of daily or nearly daily users has increased by 67% from 2007-2015 (UNODC, 2017), indicating that more people are using cannabis overall and an increasing number of people are using heavily. As cannabis use increases around the globe, increased attention is being paid to the potential beneficial and adverse mental and physical health outcomes of consumers.

Measuring frequency of cannabis use, amount used, and potency of what is used is difficult to measure, due to lack of standard measures of quantity and potency across countries (Hall, 2015). Concentration of tetrahydrocannabinol (THC), the primary psychoactive agent in cannabis, has increased over years and methods of use (e.g., smoking, vaping, dabbing, edibles, drinkables) have broadened, leading to increased challenges in measuring rates of use globally

(NAS, 2017). Increased rates of use of and increased concentration of THC in cannabis products contribute to the rise in cannabis related mental health disorders, such as cannabis use disorder (CUD) in certain groups of consumers (UNODC, 2017). Factors such as psychological distress, emotion dysregulation, and cultural norms have been found to relate to CUD and problematic use of cannabis (Bonn Miller et al., 2011; Dvorak & Day, 2014; Farris et al., 2016; Hall & Weier, 2015). Despite growing research about these relationships, there is a need for more research on factors that may prevent and be utilized in treatment of negative consequences that are specific to cannabis use.

This study examines psychological distress, its relationship to cannabis use consequences, and the differences in this relationship across site by conducting a secondary data analysis of an international data set from universities in the United States, the Netherlands, Uruguay, Spain and Argentina. Sites were sorted into groups based on a number of factors, including region, policy status, and primary language spoken at the site to explore the effect of these groupings on the relationship between psychological distress and cannabis use consequences. For grouping by region, sites were split into three groups, United States sites, South American sites, and European sites in order to explore how the relationship between psychological distress and cannabis use consequences may differ in each region. Policy status was used as a second grouping category to examine how this relationship may differ as a function of the cannabis policies of each site. Policy was conceptualized on two continuums, regulation and access. Though many sites have nuanced policies regarding cannabis access and regulation, sites were sorted into groups depending on where they fell on these dimensions, with low access and high regulation sites grouped together (Spain, Argentina, New Mexico, New York, and Virginia) and high access and low regulation sites grouped together (Uruguay, the

Netherlands, and Colorado). To categorize by language, three primary language groups were utilized for analyses, Spanish, English, and Dutch.

The study also included a number of other variables as risk and protective factors to negative cannabis use consequences, based on Acceptance and Commitment Therapy (ACT) as a conceptual model. These additional variables were only explored in data from the United States, as the corresponding measures were only given to respondents from sites in the United States. Affective lability was modeled as a mediator of the relationship between psychological distress and cannabis use consequences. Emotion, cognitive, and behavioral coping, were explored as moderators of the relationship between psychological distress and cannabis use consequences through affective lability.

### **Cannabis Use Rates**

Cannabis laws in the locations for the study range from legalization of medical use only for specific conditions (low access, high regulation), to legal and available cannabis for recreational use (high access, low regulation). Laws regarding cannabis can impact the social norms and perceptions of the drug and its users (Hasin et al., 2017), though research is mixed on the extent to which these changes in perceptions and norms impact use rates (Blevins, et al. 2018). Studies comparing perceived risk of use before and after legalization indicate that legalization leads to lower perceived risk of use, higher rates of use particularly in adolescents, and increased use in those who have never used cannabis before as well as those who use daily (Okaneku et al., 2015; UNODC, 2017). This study investigated differences in the relationship between psychological distress and cannabis use consequences in sites where the policies regarding access and regulation of cannabis use varied by location.

**Cannabis use in the United States.** In the United States, 22.2 million Americans over the age of 12 endorsed cannabis use in the past month (NAS, 2017). These rates of use have increased from 6.2% in 2002 to 8.3% in 2016 and reflect the largest increases in use reported globally (Center for Behavioral Health Statistics and Quality [CBHSQ], 2016; UNODC, 2018). The biggest increases in use in the United States have been observed in those populations who are of low socioeconomic status, educated with high school diploma or less, and are unemployed or self-identify as having a disability (UNODC, 2018). Additionally, individuals between ages 18-25 are the largest cannabis consuming group by age in the United States, with 19.8% of individuals surveyed reporting use within the past 6 months (CBHSQ, 2016).

Medical cannabis use is legal in 29 states and recreational cannabis use is legal in eight states and the District of Columbia (CBHSQ, 2016; Marijuana Policy Project, 2016). Legislation approving the de-criminalization and legalization of cannabis is associated with less perceived risk and lower perceived consequences among current and potential users (Amirav, 2011). Laws determining legal status of cannabis, availability of cannabis, and acceptability of use vary from state to state, leading to differences in use and consequences (Hasin et al., 2017). In Colorado recreational cannabis is legal for those aged 21+ and can be purchased at registered dispensaries throughout the state. People can purchase up to 28 grams of cannabis flower per transaction and can legally possess up to one ounce. In New Mexico and New York, medical cannabis has been legalized and can be purchased from registered dispensaries with a recommendation from a medical doctor, though the consequences for possession of non. In New Mexico, those with “debilitating medical conditions” can purchase up to 8 ounces of cannabis over a 90-day period and in New York, only individuals who have documentation of approved medical conditions can obtain a 30-day supply of cannabis. Medical cannabis use is also legal in Virginia, but only in

cases where the individual is significantly impaired by symptoms of cancer, glaucoma, or epilepsy and use is heavily regulated and restricted to low THC oils (Marijuana Policy Project, 2016).

**Cannabis use in the Netherlands.** Cannabis use rates have remained largely stable in Europe following a brief rise in use following the decriminalization of use in 1976 (UNDOC, 2017). Following this change, rates of cannabis use increased across all age groups surveyed, from young adolescents to older adults (Macoun & Router, 1997). Increases in cannabis related car accidents and middle school and high school dropout rates were also observed in the Netherlands following the 1976 changes in law, however, no causality could be established and these relationships are purely correlational (Hall, 2015; Joffe & Yancy, 2004).

Cannabis was decriminalized for personal use in 1976 and permitted for personal use and sold in coffeeshops. There is no penalty for possession if amount is less than 5 grams of cannabis plant throughout the Netherlands, though it cannot be bought in large quantities from dispensaries throughout the country. In the Netherlands coffeeshops are allowed to sell cannabis over the counter in small amounts to those persons who are over the age of 18 (Hall & Weier, 2015). Though cannabis tourism is popular in the Netherlands due to cannabis sales in “coffeeshops” in Amsterdam, possession and distribution still carry legal penalties. Current use rates are comparable to those in the United States with 7.7% of adolescents aged 12-18 reporting cannabis use in the past month. Interestingly, many of these users are from vulnerable populations such as high school drop outs, transient youth, and those from low income backgrounds indicating that rates of use may vary based on factors beyond the legal policy of the country (Dupont et al., 2016).

**Cannabis use in Uruguay.** Uruguay was the first country to legalize recreational cannabis use and allow citizens to either home grow plants or purchase cannabis from pharmacies and cannabis clubs. In 2013 legislation passed to legalize cannabis under prescribed rules intended to regulate users. Individuals are supposed register with the government in order to cultivate cannabis at home or purchase from the pharmacy or club, though few people have registered in comparison to the number of suspected users, thus the impact of these laws on rates of use and mental health outcomes is unclear as of now (UNDOC, 2017).

**Cannabis use in Spain.** Laws in Spain regarding buying, selling, and use of cannabis regard cannabis as illegal in public settings and decriminalized for personal use. Buying or selling cannabis is illegal in any commercial capacity and selling or importation is punishable with jail time. However, cannabis is decriminalized for private growing and use. Due to this distinction between the public and private sphere, non-profit groups that sell to members only in a private setting called ‘cannabis clubs’ are common, with loophole in the law allowing “private” sale and consumption.

In Spain, 17.1% of young adults (age 15-34) used cannabis in the past year. Cannabis users accounted for 34% of entrants in to drug treatment in Spain (as the stated primary drug of choice) (EMCDDA, 2017).

**Cannabis use in Argentina.** Argentina legalized medical cannabis use throughout the country in 2017, though the law continues to prohibit personal cultivation. 28% of people surveyed in a study of college freshmen in Argentina used cannabis in last month and 59% of ‘young adults’ in the study reported cannabis use in past year, demonstrating that cannabis use is prevalent among college aged individuals. Heavy alcohol use and binge drinking behavior were also reported in this population of young adult users, indicating that normative rates of substance

use are high (Pilatti, Read, & Pautassi, 2017). Perceived risk of alcohol and cannabis were also reported to be low in this population, with students citing this as reason for high levels of use.

### **Health Impacts of Cannabis Use**

Though the perceived negative effects of cannabis use are decreasing, there is evidence that indicates the presence of health effects among short- and long-term users (NAS, 2017). As the number of reported cannabis users increases with legal changes, more and more individuals will be impacted by these health effects. To elucidate the effects of cannabis use on consumers and to stress the need for ongoing research on cannabis use consequences, research on the physical and mental health effects are outlined below.

**Physical health effects.** Sufficient medical evidence exists to show respiratory issues cardiovascular disease, and increased susceptibility to infections have been observed in chronic users (Dupont, 2015; NAS, 2017). However, for health issues such as cardiovascular disease and respiratory issues, it is challenging to establish origin of illness due to high overlap with those who use tobacco in addition to cannabis (Hall, 2014). Pregnancy complications for the mother and impacts on fetal growth and development, cancer, cardiometabolic risks (dysregulation, diabetes), and immune competence decline are all cited as potential health risks following regular cannabis use, though there is insufficient evidence to implicate cannabis use as the sole cause of these issues (NAS, 2017).

Therapeutic cannabis use has been suggested as treatment for a variety of illnesses and conditions with scientific support ranging from minimal to moderate. Medical use of cannabis for chronic pain, chemotherapy related nausea, and multiple sclerosis related spasticity has modest support from the National Academy of Science indicating that there is some indication of success in treatment or symptom reduction for these disorders. Treatment for individuals who

suffer from epilepsy, Tourette Syndrome, Parkinson's, dementia, glaucoma, schizophrenia, traumatic brain injury, and addiction have been suggested and reported, however very minimal support of efficaciousness exists at the current time (NAS, 2017).

**Mental health effects.** Cannabis use has been linked to mental health changes both acutely and with chronic use. Attention and memory impairment have been observed during times of use, sometimes resulting in negative academic and occupational outcomes (Solowj et al., 2011). Cognitive issues such as processing speed delays, memory deficits, and challenges in executive functioning have also been observed in chronic users (Shrivastava, Johnston, & Tsuang, 2011). Psychomotor impairment during use, leading to adverse outcomes, i.e. driving related accidents, have also been observed (NAS, 2017; Hall, 2014). Chronic and heavy use have been associated with mental health outcomes such as schizophrenia; strong evidence found for an increase in schizophrenic symptoms in heavy users (Giordano et al., 2014; NAS, 2017). Strong evidence also links increased psychotic symptoms, increased general and social anxiety symptoms, and worsening manic symptoms in users with Bipolar disorder (Gibbs et al., 2014; Kedzior et al., 2016; NAS, 2017). Many users endorse using cannabis to reduce psychological distress and to cope with negative affect (Wyckoff, Metrick, & Trull, 2018). Increased depressive symptoms have been linked to heavy cannabis use and a dose response has been found relating to suicidality, wherein heavier use is linked to higher rates of suicidal ideation, attempts, and completion (Lev-Ran et al., 2014; NAS, 2017). Euphoria, decreased anxiety, and increased sociability are cited as positive mental health effects in some users (Hall, 2014) though not much is known about how to determine those it will improve symptoms versus exacerbate them. Support is also present for mental health disorders leading to the use of cannabis, with many studies highlighting depression, anxiety, stress related disorders, and psychotic disorders as risk

factors for increased use of cannabis and problematic cannabis use (CBHSQ, 2016; Cornelius et al., 2014)

### **Negative Cannabis Use Consequences**

Though correlated with the health effects detailed above, negative cannabis use consequences present unique challenges to sufferers and treatment providers. Background on the prevalence and risk factors related to problem use are discussed to outline the importance of studying problematic cannabis use consequences, psychological distress, and emotional lability variables included in the study.

**Substance use disorders.** Substance Use Disorders (SUDs) are characterized by clinical impairment in functioning across domains due to use of alcohol and other drugs. (CBHSQ, 2016) approximately 20.8 million people over 12 years met criteria for a SUD in the past year. Of those, 4 million endorsed cannabis use within the past month. Cannabis Use Disorder (CUD) is a specific SUD for cannabis and is included in the Diagnostic and Statistical Manual of Mental Disorders 5<sup>th</sup> edition (DSM-5). Individuals aged 18-25 have the highest reported incidence of CUD compared to other age groups (CBHSQ, 2016). Frequency of use and early age of first use are implicated as risk factors for developing CUD and there is moderate evidence that depression, being male, combined use of other abused drugs plus cannabis, smoking cigarettes, early age of onset for alcohol and cannabis use, oppositional behavior patterns in adolescence, poor school performance, antisocial thinking are other risk factors for problem use (NAS, 2017).

Lack of official distinction between “risky” use and “problem” use exists, as different instruments and different cut-offs are used across studies. Though CUD has clinical criteria for diagnosis, it is unclear what frequency and amount of use constitute problematic use (NAS, 2017). Problem users can be considered as individuals who meet clinical criteria as defined by

DSM-5 criteria for CUD (APA, 2013) or who meet cutoff scores indicated in Marijuana Consequences Questionnaire (MACQ) (Simons et al., 2012). Problems outlined in the MACQ include issues relating to socio-occupational functioning, increased risk-taking behavior, interpersonal challenges, and levels of motivation and apathy. It is important to note that problematic use is not dictated by the amount of cannabis consumed, but rather by the consequences experienced by the user. In the current study, scores on the MACQ will be used to determine presence of negative cannabis use consequences.

**Risk factors.** The likelihood that a person develops a SUD is attributable to a wide variety of factors. There is strong evidence for a genetic and heritable risk of developing a SUD, in addition to a wealth of evidence suggesting that family, school, and community environments impact substance use behavior (Arthur et al., 2002; Belcher et al., 2014). While there are many different factors at play, the current study focused on those factors that are particularly salient in the population of interest, young adults: psychological distress, and affective lability.

Heavy users, typically defined as those who use daily, seem to be at the most risk for developing CUD and other negative consequences. Trends showing increase in problematic use over past few years are primarily found in those who identify as “heavy and consistent” users who report daily or near daily use. This group has grown from 1.9% of the population to 3.5% in the United States from 2007-2015 (UNODC, 2017). Heavy users have been found to be more at risk due to factors such as the chronic and habitual nature of their use, the ease at which they can access cannabis, and the social reinforcement gained from other peers who are also heavy users (Von Sydow et al., 2002).

Those who indicate psychological distress have also been found to be more likely to develop cannabis use issues. High co-occurrence of other mental illness and SUDs has been observed,

and in the 2015 National Survey of Drug Use and Health, 42% of those surveyed with SUDs also reported some form of mental illness (CBHSQ, 2016; Somers, et al., 2015). Presence of depression symptoms has been found to be correlated with problematic cannabis and alcohol use behavior (Keough et al., 2007) and public health data has indicated that cannabis use has been associated with increase of depressive symptoms during the course of the diagnosis (NAS, 2017). These findings indicate a strong relationship between the amount of psychological distress a person is experiencing and their cannabis use behavior.

In studies of those with affective psychopathology (depression, anxiety, mania), increases in cannabis use have been observed along with increased motivation to use cannabis to cope with negative emotionality (Osborn et al., 2015; Wycoff, Metrick, & Trull, 2018). This demonstrates that individuals with affective symptoms view cannabis as a way to reduce symptoms, leading them to use the substance at higher rates. A survey of regular users in the United States found that the “self-medication” of anxiety and depression symptoms was cited as the most common motivation to use cannabis (Osborn et al., 2015). This relationship has been found to be negatively reinforcing, meaning that users associate cannabis intake with removal of negative symptoms (Wycoff, Metrick, & Trull, 2018). However, individuals who endorse using cannabis to cope with negative emotions also report problem use more often than individuals who use for other reasons (Bonn Miller et al., 2011 & 2008), indicating that the use of cannabis to treat mental health symptoms is associated with increased mental health concerns.

Understanding the rationale for why those in psychological distress utilize cannabis in a problematic way is important for development of interventions that improve both the symptoms of distress and CUD. Psychological distress is inherently a negative experience associated with symptoms that are unpleasant for the individual, and consequently people are motivated to

reduce those feelings. However, some people engage in healthy coping skills while others turn to substances like cannabis to mitigate these negative feelings (Simons & Gaher, 2005). Distress tolerance, or the ability to withstand the experience of negative emotion, is a coping skill that allows an individual to endure emotional discomfort until either it subsides, or they find a way to mitigate the experience (Simons & Gaher, 2005).

The expression or tolerance of emotion is contingent upon a variety of factors, including emotion regulation skills and cultural expectations for emotional expression (Butler, Lee, & Gross, 2007; Mesquita & Walker, 2003). Individuals who have low distress tolerance have been observed to utilize substances to deal with unpleasant emotions at higher rates than individuals who have other strategies for coping with negative affect (Simons & Gaher, 2005). Labile affect, or emotions that are changing rapidly and difficult for the individual to regulate, has also been found to be a risk factor for problematic substance use behavior (Dorard et al., 2008). Those who demonstrate affective lability are likely to experience more intense emotional experiences, which is correlated with increased rates of reported distress (Jazaieri, Urry, & Gross, 2013). Research has proposed that the affective lability may be the core of many psychological disorders and that psychological distress arises from affective lability and the inability of an individual to engage in regulatory strategies (Jazaieri, Urry, & Gross, 2013). Those who self-report affective lability have also reported cannabis use to cope with emotion at similar rates of those who indicated coping motives for psychological distress symptoms (Bonn Miller, 2008; Simons et al., 2005). Adolescents and young adults who endorsed high affective lability were also found to endorse higher levels of substance use behavior compared to peers who reported more emotional stability (Wills et al., 2006). This emotional dysregulation is hypothesized to be related to coping motives beyond what could be attributed to negative emotionality, sensitivity, anxiety, and other mood

factors in a sample of users in the United States (Bonn Miller et al., 2011). Like findings about psychological distress, little research has focused on the ways that the relationship between affective lability and cannabis use consequences may be different across countries, states, cultures, and locations. The proposed study hypothesizes that the relationship between psychological distress and problematic cannabis use will be mediated by affective lability, and that this relationship will change based on the coping strategies employed by the individual.

**Protective factors and strategies.** Some characteristics and behaviors, referred to as protective factors, serve as buffers for the development of CUD and other SUDs. Positive community engagement and strong family support have been cited as important protective factors in adolescence and young adulthood that prevent individuals from engaging in risky behavior such as substance use (Cleveland et al., 2008). In young adulthood, some factors that have been shown to mitigate problematic substance use include: late onset of use, peer groups that do not use substances, and distress tolerance (Arthur et al., 2002).

Behavioral strategies to reduce risk and distress employed by cannabis users can also be protective factors against the development of CUD. Behavioral strategies for reducing cannabis use risk are often taught in harm reduction models of SUD treatment (Marlatt & Witkiewitz, 2010). Similar to findings from alcohol use research, protective behavioral strategies are related to lower consequences associated with use and less use overall (Kenney et al., 2014; Borden et al., 2011). Examples of these strategies may include: avoiding use in situations where one might get in trouble, not operating a motor vehicle while using, limiting use to certain times of the day, restricting use to a set amount to be consumed, avoiding use when feeling upset, and taking breaks from use to avoid tolerance (Bravo et al. 2017; Pederson et al., 2016). Individuals who engage in these protective behaviors regularly are expected to experience fewer negative

consequences associated with their use. It was hypothesized the number of protective behavioral strategies a person utilizes would moderate the relationship between psychological distress and negative cannabis use consequences in the study, such that the more protective behavioral strategies the individual engaged in, the less negative consequences they would experience.

In addition to behavioral protective factors, there are also emotion focused coping strategies, that are directed at reducing emotional distress or negative affect (Lazarus & Folkman, 1984). Many of these emotion-related coping strategies fall into two categories, reappraisal or suppression (Gross & John, 2003). Cognitive reappraisal strategies are those that allow an individual to reinterpret a situation in a way that is less emotionally charged, where as suppression strategies are focused on limiting emotionally expressive responses (Gross, 1998). Cognitive coping strategies, such as evaluating and replacing negative thought patterns, are hypothesized to moderate the relationship between psychological distress and cannabis use consequences, such that at higher levels of cognitive coping strategies endorsed, the less negative cannabis use consequences will be experienced.

Emotion focused coping strategies are often a focus of psychotherapy and treatment for SUDs and are emphasized in many mindfulness-based programs (Bowen et al., 2014). Some examples of emotion focused coping are: deep breathing exercises, meditation, re-framing the problem, identifying cravings, and reaching out for support. Cannabis users who frequently engage emotion focused coping strategies are predicted to experience less psychological distress and challenges associated with affective lability. It is hypothesized the more emotion-focused coping skills a person endorses will moderate the relationship between psychological distress and negative cannabis use consequences, such that the more emotion coping skills the individual uses in, the less negative consequences they will experience.

## **Theoretical and Conceptual Considerations in Model Building and Hypothesis Testing**

Acceptance and Commitment Therapy (ACT) is a therapeutic modality that seeks to reduce psychological inflexibility, cognitive fusion, and experiential avoidance that contribute to psychopathology. ACT is an empirically supported treatment for a number of disorders (chronic pain, depression, anxiety, psychosis, and obsessive-compulsive disorder) and has been found efficacious in the treatment of some SUDs as well (Serfaty et al., 2018). The six core processes in ACT (acceptance, cognitive defusion, being present, self as context, values, and committed action) fall into two categories, acceptance/mindfulness and commitment/behavior change (Hayes et al., 2005). ACT also places emphasis on the use of language and verbal connections to emotions as a way to understand the strong link between thoughts and feelings. Interventions then are aimed to change the relationship between language, thoughts, feelings, and overt behavior, leading to decreased psychological distress and increased values-driven action (Luomo et al., 2008).

By using the ACT framework as a conceptual model, the current study hypothesizes that the links between psychological distress, affective lability, and negative cannabis use outcomes will differ based on the emotional, cognitive, and behavioral coping strategies employed by the individual. Additionally, because of the importance of language and its impact on mental wellbeing in ACT conceptualizations, the current study also included language as a moderator for the primary relationship between psychological distress and cannabis use consequences. The following section describes basic tenets of ACT, highlighting the ways the ACT framework conceptualizes the aforementioned variables in relation to cannabis use consequences.

Cognitive fusion or becoming enmeshed with one's inner experience (thoughts) to the detriment of engagement with the outer world, is identified in ACT as a major contributor to

psychological distress (Hayes et al., 2005). As an example, if a person is feeling anxious about a job interview and having thoughts that they are unqualified and then they decide to cancel the interview because they are convinced that they will not perform well, this person is so fused with their anxiety that they choose not to interact with the world in a way that benefits them. Fusion with negative thoughts and emotions in ACT is conceptualized as a correlate of psychological distress. Interventions that target this fusion include cognitive strategies such as thought distancing that allow a person to evaluate their thoughts as outside information rather than as “truth” (Hayes, Stroschal, & Wilson, 2011). For the current study, it is hypothesized that higher psychological distress and affective lability predict cannabis use consequences. Incorporating ACT framework, efforts to mitigate this cognitive fusion through cognitive coping strategies are hypothesized to lessen the relationship between psychological distress and negative cannabis use consequences.

For substance users, the act of drug use can often be related to the urge to move away from feelings or situations that feel distressing (Bujarski, Norberg, & Copeland, 2012). Individuals who utilize cannabis to cope with distress are engaging in use to distance themselves from negative emotionality. Those individuals with affective lability are at higher risk for negative emotionality and cannabis use consequences such as the development of CUD (Simons et al., 2002). As mentioned, coping motives for cannabis use are strongly linked to negative use consequences (Bonn Miller, 2008; Buckner, 2014). From an ACT framework, increased efforts to avoid negative emotionality only increase the suffering and detrimental impacts of those negative experiences (Hayes et al., 2005). ACT mindfulness interventions, examples of emotional coping, work to connect a person to their emotions so that they allow emotions to arise and pass naturally and feel each emotion more fully in the moment. This connection to the

present moment reduces the that reduce cannabis as experiential avoidance is hypothesized to be associated with lower negative consequences to use.

Another important aspect of ACT interventions is increasing value-driven action. Values may include concepts such as honesty, independence, compassion, or integrity. Psychological distress and cognitive fusion can interrupt the pathway from intention to behavioral action. For example, if a person is experiencing psychological distress, they may utilize cannabis to reduce this distress and distract from negative emotions, even though they might believe that using substances when in a bad mood is harmful. Despite their intention to use in a way is non-harmful, those experiencing distress may engage in riskier cannabis use practices. Behavioral strategies that move towards an individual's value set, such as using cannabis only when in a social setting or only when the individual has completed their work for the day, are conceptualized to reduce psychological distress and align one's behavior with their values.

Relational Frame Theory (RFT), one of the theoretical bases for ACT, asserts that one of the building blocks of language is how we relate language to internal concepts and react to those concepts (Hayes, 2005). ACT interventions draw on RFT and often include language-based skills, such as changing the way we react to certain words or phrases (Bunting & Hayes, 2008). Though no research has been conducted examining how ACT/RFT theory may differ by language spoken, studies investigating how language shapes thought and emotional processing have found that different languages produce different conceptual links and reactions (Casasanto, 2008). For the current study, there were three primary languages spoken among the sites, English, Spanish, and Dutch. Based on the literature suggesting that language may impact concepts and emotional reactions, language was tested as moderator to explore the possible

impact of language spoken on the relationship between psychological distress and cannabis use consequences.

ACT interventions that incorporate cognitive, emotional, and behavioral coping skills are designed to reduce psychological distress and increase cognitive flexibility among patients. Based on this framework, it is hypothesized that individuals with psychological distress and affective lability who endorse utilizing these coping skills will report lower cannabis use consequences than those with mental health risk factors who do not utilize these skills. Additionally, ACT incorporates RFT in its approach to conceptualization and treatment, focusing on language and the relationship between language, cognition, and emotional reactions. As such, language was explored as a moderator of the primary relationship between psychological distress and cannabis use consequences.

### **Current Treatment Options for Problematic Cannabis Use**

Considering the ACT framework and the above research into correlates of CUD, cannabis use behavior stems from many factors from the individual and the greater culture at large. Working to change this behavior has been the focus of research for the treatment of SUDs. By describing the state of the science on treatment for cannabis use, the following section will provide information about current treatment and highlight that more research is needed to improve the effectiveness of existing treatments and develop new interventions for CUD. Additionally, the following section will discuss the value of including coping strategies in the current study to inform clinicians treating CUD.

Though CUD is the most commonly reported SUDs after alcohol use disorder (AUD), rates of treatment utilization are low in CUD sufferers in comparison to those who have AUD (Gates, et al. 2016). Treatments for CUD are similar in practice to those offered for other

substance related disorders and include individual and group therapy as well as community-based interventions. Cognitive behavioral therapy (CBT) and motivational enhancement therapies (MET) are most common for treatment of CUD with some success in use reduction and or abstinence from use in the short term. In follow-up surveys post-treatment, however, many individuals who had undergone treatment returned to pre-treatment levels of use (Budney et al., 2006; Davis et al., 2015; Gates et al., 2016). About one quarter of individuals seeking treatment reported abstinence from cannabis following treatment that combined CBT and MET (Gates et al., 2016). A review of literature by Barnett et al (2012) found that MET are most efficacious in reducing cannabis use in samples of adolescent users. Budney et al (2006) reported that cannabis use treatment outcomes overall are comparable to other substance use treatments in that success is variable and relapse rates are high.

As with the treatment of other SUDs, cannabis treatment choices fall into two groups: abstinence from use or a harm reduction approach. Abstinence in relation to SUDs is the cessation of drug or alcohol use (SAMHSA, 2015). Abstinence approaches emphasize that end goal is zero use of the target substance for a period of time. Programs such as the Minnesota Model, Alcoholics Anonymous (AA), and 12-step programs are based on the supposition that abstinence is required for recovery from SUDs. Harm reduction is a “yellow light approach” in which users are encouraged to slow down, take note of consequences to use that are both positive and negative and make informed decisions about their use that are individualized rather than zero tolerance for use. Treatment that is harm reduction focused prides itself on being collaborative between therapist and client (Marlatt & Witkiewitz, 2010). Harm reduction compared to other substance use interventions (AA, disease model, moral model) most closely resembles CBT, as the focus for both is on coping skill development.

CBT has research support for the treatment of CUD with users reporting lower rates of use, less negative outcomes, and less concerns regarding cannabis use following treatment (Copeland et al., 2001; Gates et al., 2016). The cognitive model is based on the premise that cognitive activity, or thoughts, impacts behavior, cognitive activity can be monitored and changed, and desired change in behaviors, emotion, or physiology can be accomplished through changing cognitions (Butler et al., 2006). The typical course of therapy for CBT is usually 12-16 sessions, though many shorter-term CBT interventions have been developed for SUDs (McHugh, Hearon, & Otto, 2010). Because CBT is goal oriented, problem focused, and based on the client's own thoughts, it allows flexibility and individualized treatment which has been found to be effective for treating SUDs (Copeland et al., 2001; Gates et al., 2006).

ACT is a third wave CBT approach that has a mindfulness-based focus which incorporates attention to internal and external experiences and an attitude of non-judgement (Chiesa & Serretti, 2014). The ACT model is consistent with harm-reduction approaches and includes interventions that target behavior change (value driven action) and internal strategies (de-fusion, acceptance).

Mindfulness based relapse prevention programs, like those focused on ACT, have been shown to have good outcomes with those clients who have dual diagnosis or co-occurring SUD and other mental health concerns (Bowen et al., 2009). Mindfulness programs encourage monitoring internal phenomenon (thoughts, feelings, urges to use) and teach skillful coping for moments of cravings or psychological distress, leading to longer term success when compared to 12-step abstinence-based interventions (Bowen et al., 2014). Many of the coping strategies that can be learned through ACT and mindfulness-based treatments relate to the behavioral strategies and emotion focused coping skills discussed previously. By examining the impact of coping

behavior on the relationship between psychological distress and problematic cannabis use, the current study seeks to inform clinicians in successfully treating symptoms of CUD and associated psychological distress.

### **Prevention Efforts**

Systematic reviews have indicated that primary and secondary prevention efforts yield few positive results, often lead to iatrogenic effects, usually in the form of increased consumption rates. These prevention efforts are typically conducted as part of school programs. Typical modalities include skills training, informational campaigns, normative interventions and psycho-education. Components found to increase things negative effects included sessions focused on polysubstance use and those interventions that involved peer teachers. (De Cock, Bekkering, & Hannes 2017). Currently existing prevention efforts only found to be effective if participants are screened and placed in intervention groups based on screenings, in other words, prevention efforts targeted towards vulnerable individuals. These screenings need to take in to account individual's use as well as cultural and family use habits and norms. A significant challenge of prevention efforts is intervention before drug use becomes an issue (Dupont et al., 2015). The goal of the current study is guide future research of prevention and treatment efforts for CUD using clinically informed interventions. This study seeks to guide these efforts by identifying individual factors that contribute to problematic cannabis use, identifying coping strategies that best mitigate negative consequences associated with cannabis use, and understanding the differences in the relationship between individual factors and problematic cannabis use across multi-ethnic sites and cannabis policy status.

## **Current Study**

This study seeks to understand the differences in the relationship between psychological distress and cannabis use consequences across sites that have varying cultural and legal expectations regarding the use of cannabis. Additionally, by examining psychological distress, affective lability, and coping strategies the current study seeks to inform prevention and intervention efforts and add to the literature on what steps can be taken by cannabis users to avoid negative consequences associated with use.

## **Hypotheses**

The following hypotheses were proposed from data collected in the United States, the Netherlands, Uruguay, Spain, and Argentina:

- 1) Primary hypothesis 1: There is a positive relationship between psychological distress and cannabis use problems in college aged users.
  - a. Exploratory hypothesis 1: The positive relationship between psychological distress and cannabis use problems will be moderated by location. In order to test this moderation, location will be categorized in a variety of different ways (e.g. cannabis policy type, region, language spoken) to explore this relationship.

The next group of hypotheses will be tested from data collected across sites in four states in the United States; Colorado, New Mexico, New York, and Virginia:

- 2) The relationship between psychological distress and negative use consequences will be mediated by affective lability.

3) The extent to which the relationship between psychological distress and negative use consequences is mediated by affective lability will be moderated by the level of coping strategies employed by the individual. Three distinct coping strategies will be investigated as moderators: emotional, cognitive, and behavioral coping strategies.

## METHODS

### Participants

College students ( $n=3,482$ , 67.9% females) were recruited from universities across the United States, the Netherlands, Uruguay, Spain, and Argentina to participate in an online survey regarding cannabis use behavior, mental health, and personality traits. The average age of respondent was 21.07 ( $SD = 4.61$ ). Students were recruited from the research pools at universities in Colorado ( $n = 848$ ), New Mexico ( $n = 413$ ), New York ( $n = 297$ ), Virginia ( $n = 360$ ), the Netherlands ( $n = 302$ ), Uruguay ( $n = 133$ ), Spain ( $n = 754$ ), and Argentina ( $n = 375$ ) (See Table 1). Of the participants, 33.8% ( $n = 1,183$ ) endorsed cannabis use in the past 30 days (See Table 2). For all sites, students were administered the surveys using Qualtrics software. Study procedures were approved by the institutional review board or the international equivalent at each of the participating universities.

### Measures

Cannabis use was assessed first by a question reading “In your lifetime, have you ever used marijuana in any form?”. Participants who responded “yes” were branched to two additional questions: “How old were you the first time you used marijuana?” and “On how many days during the last 30 days did you use marijuana?”. Participants who indicated use in the past 30 days were administered the remainder of the cannabis use questions.

Cannabis use was determined by a set of questions that survey use across categories such as: frequency of use, amount of use, financial investment, method of use, amount of time spent high on average, and approximate schedules of use. Participants are asked to indicate answers based on the past month of use for all categories. A visual guide was utilized in the survey to

help responders answer questions about quantity accurately and consistently across individuals and locations (See Appendix B). Use quantity and frequency was also assessed using the Marijuana Use Grid (MUG) which asks participants to indicate the frequency and quantity of cannabis use during a typical week (Pearson & Marijuana Outcomes Study Team, 2018).

Indicators of problematic use was assessed using the Brief Marijuana Consequences Questionnaire (B-MACQ), a 21 item dichotomously scored measure that assesses consequences to cannabis use over the past 30 days. The full version of this scale is the Marijuana Consequences Questionnaire (MACQ) and is a 50 item dichotomously scored measure that looks at 8 dimensions of marijuana consequences over the past 6 months (Simons et al. 2012). Test-retest correlations were strong ( $\alpha = .75$ ) demonstrating good test-retest reliability over a brief interval of about 20 days as well as high convergent validity and good internal consistency. This was paired down to 21 items and found to have high correlation with the full scale ( $\alpha = .95$ ) indicating no loss of criterion validity with less items (Simons et al. 2012). Both the MACQ and the B-MACQ indicate high ability to discriminate between levels of severity of problematic use (Simons et al., 2012).

To capture psychological distress, the DSM-5 Cross Cutting Symptoms Measure was utilized. It is a 23-item measure that asks participants to indicate how much or how often they are impacted by mental health symptoms. Developed by the APA, the DSM-5 Cross Cutting Symptoms Measure assesses symptoms across 13 psychological domains (Clark & Kuhl, 2014; Narrow et al., 2012). The measure is not intended to be utilized for diagnosis of disorders, rather it provides an overview of symptomology using clinical criteria from the DSM-5 to give a picture of respondent's psychological profile.

The Affective Lability Scale—Short Form (ALS-18) is an 18-item scale designed to evaluate the extent to which a person experiences rapid changes in mood. The ALS-18 has been found to be correlated highly with the 54-item original Affective Lability Scale ( $r = .97$ ) and was used to capture self-reported emotional lability in participants at the sites in the United States (Look et al., 2011). The ALS-18 has three subscales relating to anxiety, elation, and anger; and it has been found to correlate with symptoms of depression, bipolar disorder, borderline personality disorder, and intermittent explosive disorder (Look et al., 2011). Total scores (ALS-tot) and individual anxiety, elation, and anger subscale scores (ALS-anx, ALS-ela, and ALS-ang, respectively) were explored as mediators of the relationship between psychological distress and cannabis use consequences.

Behavioral methods of coping were measured by participant responses to the Protective Behavioral Strategies for Marijuana – Short form (PBSM). The PBSM short form includes 17 items that assess strategies that cannabis users enact before, during, after, or instead of using cannabis (Pederson et al. 2017). Responders indicate which strategies they use and how helpful those strategies are in helping moderate use of cannabis. Higher number of protective strategies indicated on the PBSM has been correlated with less negative consequences and lower reported cannabis use, suggesting that those who engage in protective strategies experience fewer negative effects of their use (Pederson et al. 2016).

Cognitive coping methods were measured by participant responses to the Emotion Regulation Questionnaire (ERQ). The ERQ includes two scales, Suppression and Reappraisal, that examine respondent's emotion regulation strategies (Gross & John, 2003). Emotional coping strategies were measured utilizing the Distress Tolerance Scale (DTS). The DTS includes 15

items on a 5-point Likert scale ranging from strongly agree to strongly disagree that assesses respondents' beliefs about being distressed or upset (Simons & Gaher, 2005).

Measures were translated from English into Spanish and Dutch by bicultural and multi-lingual researchers from the Cross-cultural Addictions Study Team (CAST) with expertise in test adaptation and addictive behaviors.

## **Procedures**

This is a secondary data analysis of responses collected by CAST researchers from sites in the United States, the Netherlands, Uruguay, Spain, and Argentina. The number of respondents ( $n = 3,482$ ) provided sufficient power for the most complex analysis proposed, i.e., a multi-group moderated mediation path analysis. Prior to analysis, the data was checked to determine whether it met the assumptions of normality as it is common for substance use behavior data to violate the assumptions of normality and skew positively (Neal & Simons, 2007). The data was determined to be non-normal, thus count regression methods (e.g., negative binomial regression) were used as they are designed to appropriately model highly skewed data (Hilbe, 2011). Analyses with count data was conducted using Mplus 8.1 (Muthén & Muthén, 1998-2017) using maximum likelihood estimator with robust standard errors (MLR). For count data, the Sobel test was utilized to establish significance. Though the Sobel test has known limits, it is unlikely to deviate greatly from significance established by confidence intervals. For any effects less than 0.2, 95% Monte Carlo confidence intervals not containing 0 were used to establish significance.

Hypothesis 1 was tested using a path analysis model, with psychological distress being related to cannabis use consequences (Figure 1). Next, a multigroup path analysis was used to test the exploratory hypothesis that the relationship between psychological distress and cannabis

use consequences would vary by site location (Figure 2). Location groups were created on three different criteria, region, cannabis policy, and primary language spoke. All paths were allowed to freely vary across groups. For Hypothesis 2, a mediation model was built in which psychological distress was modeled as a predictor of cannabis use consequences via affective lability (Figure 3). Because the Affective Lability Scale (ALS) includes three individual subscale scores and a total score, this model was run four times with each individual score as the mediator to investigate the unique contribution of each score. To test Hypothesis 3, sixteen moderated mediation models were built using the state of the science methodology for testing conditional indirect effects (Stride, Gardner, Catley, & Thomas, 2015) to explore the three types of coping strategies (emotional, cognitive, behavioral) as the moderator for the mediation model from Hypothesis 2 (Figure 4).

## **Results**

Models using MLR estimation with count data do not allow for typical model fit estimations (Muthén & Muthén, 1998-2017) and thus, overall model fit is not available for the models presented.

### *Hypothesis 1 Results*

Results from Hypothesis 1 are presented in Table 3. Among participants for all sites, psychological distress significantly predicted cannabis use consequences. The exploratory moderation hypothesis was tested using multi-group analysis by location, and multiple models were constructed to test this hypothesis using location groupings described above. When separated into two groups based on access and regulation, recreational (Colorado, Uruguay, the Netherlands) and medical sites (Virginia, New York, New Mexico, Argentina, Spain), the relationship between psychological distress and cannabis use consequences was positive and

significant, however the interaction term was nonsignificant, indicating policy is not a moderator of this relationship. The relationship between psychological distress and cannabis use consequences did not differ significantly at sites with varied cannabis regulation and access policies. When countries were separated into 3 groups based on region (USA, South America, and Europe), the relationship between psychological distress and cannabis use consequences was positive and significant only the United States, demonstrating a moderating effect when grouped by region. Sites were then separated into 3 groups by primary language spoken (English, Spanish, and Dutch). Psychological distress significantly predicted cannabis use consequences in sites that primarily spoke English, but not at those sites where participants primarily spoke Spanish or Dutch, indicating a moderating effect when grouped by language.

### *Hypothesis 2 Results*

Psychological distress significantly and positively predicted cannabis use consequences and scores on ALS-tot, ALS-anx, ALS-ang, and ALS-ela (See Tables 4-7). Neither ALS-tot nor the ALS subscales significantly predicted cannabis use consequences. The indirect effect was nonsignificant for all ALS subscales. The results do not support the mediation hypothesis, rather they suggest that higher values of psychological distress were associated with higher cannabis use consequences and higher ALS total scores, but that ALS scores were not predictive of cannabis use consequences. Thus, ALS is not a mechanism by which psychological distress results in cannabis use consequences in the current sample.

### *Hypothesis 3 Results*

*Cognitive Coping.* Results for Hypothesis 3 with cognitive coping strategies as the moderator are presented in Tables 8-11. With ALS-tot modeled as the mediating variable (Table

8), a significant direct effect was detected between ERQ reappraisal scores and total ALS score and ERQ suppression scores and total ALS score. A significant effect was also detected between psychological distress and ALS-tot. Additionally, a significant interaction was observed, such that the relationship between psychological distress and total ALS score varied at different levels of ERQ reappraisal scores (See Figure 5). All other paths were nonsignificant. With ALS-anx modeled as the mediating variable (Table 7), a significant effect was detected between psychological distress and ALS-anx scores, and between ERQ subscales and ALS-anx scores. A significant interaction was observed between psychological distress and ALS-anx at varying levels of ERQ reappraisal (See Figure 6). All other effects were nonsignificant. With ALS-ela modeled as the mediator (Table 9), a direct effect was observed between psychological distress, ALS-ela, and ERQ subscales. A significant interaction was observed between psychological distress and ALS-ela at varying levels of ERQ reappraisal (See Figure 7). All other effects were nonsignificant. With ALS-ang modeled as the mediator (Table 10), a direct effect was observed between psychological distress, ALS-ang, and ERQ subscales. A significant interaction was observed between psychological distress and ALS-ang at varying levels of ERQ reappraisal (See Figure 8). All other effects were nonsignificant.

*Emotional Coping.* Results for Hypothesis 3 with emotional coping strategies as the moderator are presented in Tables 10-13. With ALS-tot modeled as the mediator (Table 10), significant direct effects were observed between psychological distress and ALS-tot, and ALS-tot and DTS scores. A significant interaction was detected, such that the relationship between psychological distress and ALS-tot varied at different levels of DTS scores (See Figure 9). All other effects were nonsignificant. With ALS-anx modeled as the mediator (Table 11), a significant effect was observed between DTS scores and ALS-anx scores. A significant

interaction was observed such that the relationship between psychological distress and ALS-anx varied at different levels of DTS scores (See Figure 10). All other effects were nonsignificant. With ALS-ela modeled as the mediator (Table 12), significant direct effects were observed between psychological distress and ALS-ela, and ALS-ela and DTS scores. A significant interaction was detected, such that the relationship between psychological distress and ALS-ela varied at different levels of DTS scores (See Figure 11). All other effects were nonsignificant. With ALS-ang modeled as the mediator (Table 13), a significant direct effect was found between ALS-ang and DTS scores, and DTS and cannabis use consequences. A significant interaction was observed, such that the relationship between psychological distress and ALS-ang varied at different levels of DTS scores (See Figure 12). All other effects were nonsignificant.

*Behavioral Coping.* Results for Hypothesis 3 with behavioral coping strategies as the moderator are presented in Tables 14-17. With ALS-tot modeled as the mediator (Table 14), a significant direct effect was observed between psychological distress and ALS-tot. All other effects were nonsignificant. With ALS-anx modeled as the mediator (Table 15), a significant direct effect was observed between psychological distress and ALS-anx, and between PBSM scores and cannabis use consequences. All other effects were nonsignificant. With ALS-ela modeled as the mediator (Table 16), a significant effect was observed between ALS-ela and cannabis use consequences. No other significant effects were observed. With ALS-ang modeled as the mediator (Table 17), a significant effect was detected between PBSM scores and cannabis use consequences. No other significant effects were observed.

## DISCUSSION

The current study investigated the relationship between individual's psychological distress, cannabis use consequences, and risk and protective factors that may impact this connection. Data was collected from college aged students at four sites in the United States, as well as at single sites in Uruguay, Spain, Argentina, and the Netherlands. Responses regarding risk and protective factors from each participant were used to explore how these concepts relate to cannabis use consequences across sites. Results from this study may inform how clinicians can work to prevent and treat negative cannabis use consequences, such as the development of CUD.

To test Hypothesis 1, the relationship between psychological distress and cannabis use consequences was tested across multi-ethnic site locations. A significant and positive relationship was observed between psychological distress and cannabis use consequences when data was aggregated for all sites, indicating that users who endorsed higher rates of psychological distress also reported higher cannabis use consequences. To understand how this relationship might differ across sites, three exploratory models were run that grouped each site by three criteria—cannabis policy, region, and primary language spoken. Groupings by cannabis policy indicated that cannabis policy of the site did not significantly predict cannabis use consequences. A nonsignificant moderation by policy is notable in that it suggests that the cannabis policies of the country/state for each site did not change the relationship between psychological distress and cannabis use consequences. Those sites with higher access and lower regulation of cannabis did not demonstrate statistically significant differences from those sites where cannabis has low access and high regulation, in the strength of relationship between

psychological distress and cannabis use consequences. This does not indicate that policy has no impact on cannabis users at all, but rather that the link between psychological distress and use consequences is not contingent on cannabis policy type. It is likely that another variable or group of variables accounts for the differences in use consequences that occur in sites with varying policy types. These findings may suggest that prevention and treatment targeted towards those with mental health symptoms should not focus on the impact that cannabis policy changes may have on use consequences or be modified for implementation at sites with differing cannabis policies.

Regional groupings revealed that the primary relationship was only found to be significant in United States sites, demonstrating a significant moderating effect. This moderating relationship suggests that in regions outside of the United States, psychological distress does not predict cannabis use consequences. Though rates of CUD and other negative impacts of cannabis use continue to rise globally (UNDOC, 2017), it seems that psychological distress does not account for the increase in consequences in the Netherlands, Uruguay, Spain, or Argentina. In the United States, however, psychological distress significantly and positively predicted cannabis use consequences.

Similarly, groupings by primary language spoken indicated that the strong, positive relationship between psychological distress and cannabis use consequences was detected only at sites where the primary language spoken was English. No significant moderation was detected in Spanish speaking countries (Spain, Uruguay, and Argentina) or Dutch speaking countries (the Netherlands). Again, this points to a difference in the way that individuals in the United States experience cannabis use consequences, specifically as consequences relate to psychological distress. Several explanations for this pattern are explored below.

The differences in effect of psychological distress on consequences across locations can likely be attributed to many variables. It may be that sample size for each location, as number of participants larger in the United States ( $n = 1,918$ ) was larger than the sample in South America ( $n = 508$ ) and Europe ( $n = 1,056$ ), however, all locations were adequately powered to detect the effects. Further, when comparing rate ratios for the relationship between psychological distress and cannabis use consequences, the effect is much larger in the United States than in South America and Europe (3.4% increase in consequences for every unit increase in distress in the United States, compared to a 0.09% increase in South America and Europe). This suggests that other explanations beyond sample size likely explain the differences in this relationship.

It may be that other policies that impact the study sites, beyond regulation of cannabis, may account for this pattern of results. For example, access to mental health care may impact this relationship, such that regions with increased rates of mental health treatment exhibit a weaker link between psychological distress and negative cannabis use consequences. As users learn more protective coping strategies through treatment, the negative use consequences decrease. Another explanation could be that other substances are more heavily utilized than cannabis in these regions, such that cannabis is not a primary coping method, decreasing the strength of the connection between psychological distress and use consequences.

Because the current study was based in a harm reductionist approach, focusing on consequence of use rather than use itself, e.g., the amount and frequency of cannabis used was not included in the models. It may be that levels of use differ across sites and may impact the primary relationship between psychological distress and cannabis use consequences to varying degrees. It should be noted that indicators of cannabis use frequency and quantity have been found to explain only a small amount of the variance of cannabis use consequences (Pearson,

2019), and there remains a significant association between frequency and quantity of cannabis use and the consequences experienced. Future studies could include use indicators in models to compare the impacts of use frequency and quantity across site location to explore the possible impacts of use on this relationship.

Another possible explanation for the differences in the moderation by location may be related to the instruments used to measure the variables of interest. To measure cannabis use consequences the B-MACQ was utilized. The B-MACQ is the 21-item short form of a larger instrument, the MACQ, both of which capture information regarding negative consequences of cannabis use (Simons et al., 2012). Items tap 8 factors, such as social/interpersonal consequences, physical dependence symptoms, and academic/occupational consequences. This measure was constructed and validated utilizing a sample from the United States, though has been translated to other languages and used in other locations. A possible explanation for the moderation in English speaking/United States sites may be that users in the United States experience the specific consequences measured by the B-MACQ, but that users in other sites experience unique consequences not included in the measure. From an ACT perspective, which emphasizes that language greatly impacts mental health and behavior, nonsignificant moderation effects by language may also reflect differences in the way other languages explain and talk about psychological health or a breakdown in understanding the questions or concepts presented in the study materials.

Based on these results, more information regarding correlates of cannabis use consequences is needed in order understand ongoing global patterns of rising negative use outcomes. Additionally, more work is needed to understand the cultural differences regarding cannabis use, psychological distress, and experiencing and reporting negative use consequences.

The pattern of results in this study indicate that the relationship between psychological distress and negative use consequences is salient only for those sites in the United States. A deeper exploration of how cultural factors have influenced these results is required.

Overall, efforts to increase protective factors, including coping skills and protective behavioral interventions, are indicated for substance users, regardless of psychological distress. Findings from this study suggest that interventions addressing psychological distress symptoms are indicated for the prevention of negative cannabis use consequences for English speaking individuals. Clinicians working towards prevention of negative use outcomes should implement screening for psychological distress symptoms in order to identify those users who would benefit most from these interventions. For non-English speakers, continued exploration of risk factors for negative cannabis use consequences is indicated. Focus groups and qualitative surveys may be utilized to understand how additional influences impact cannabis use consequences, in order to inform and direct future intervention and prevention efforts.

The focus of Hypothesis 2 was examining affective lability as a mediator of psychological distress and cannabis use consequences. Affective lability was measured using the Affective Lability Scale which is comprised of three subscales and mediation models were built using each subscale score, as well as the total score. When affective lability was added to the primary model, the direct effect of psychological distress associated with cannabis use consequences continued to be positive and significant. The direct effect of psychological distress associated with affective lability was also positive and significant, consistent with literature on this relationship (Jazaieri, Urry, & Gross, 2013). The direct effect of affective lability predicting cannabis use consequences was nonsignificant and the indirect effect of psychological distress being associated with consequences through affective lability was also nonsignificant. This is

inconsistent with previous research that detected significant relationships between affective lability and increased risk for negative substance use consequences (Kassel et al., 2010; Simons & Carey 2002). It may be that affective lability is not significantly linked to cannabis use consequences in this sample. Based on this assumption, interventions for affective lability would not likely impact negative cannabis use consequences. Interventions aimed at reducing negative cannabis use consequences may not need to screen for or address affective lability directly, but rather should focus on identifying other correlates of negative use consequences and developing interventions that target those more salient factors.

Another explanation could be that the consequences experienced by those with labile affect may be distinct from the consequences captured by the BMACQ. Affective lability is linked highly with impulsive behavior, interpersonal challenges, and unstable and distressing mood (Henry et al., 2001), which from a clinical perspective, seems likely to impact use consequences. Few items on the BMACQ address these constructs directly, and thus, may not capture the consequences specifically experienced by those users with labile affect. To determine what consequences may occur for these users, future studies should incorporate the perspective of users with labile affect through qualitative methods in order to understand how labile affect may impact the relationship between psychological distress and use consequences.

The next step in the study was to examine the role of emotional, cognitive, and behavioral coping strategies in moderating the mediation model described above. Though no mediation was detected in Hypothesis 2, the moderated mediation model examined impacts of coping strategies on all paths of the mediation model, and thus allowed exploration of whether or not affective lability would emerge as a significant mediator at varied levels coping strategies employed. Regarding cognitive coping strategies, coping strategies moderated the relationship

between psychological distress and affective lability scores. No significant direct effects or indirect effects were observed related to cannabis use consequences. Significant interactions were observed demonstrating that at low psychological distress, increased cognitive coping predicted lower affective lability, but that at high levels of psychological distress, the amount of coping no longer moderated this relationship. This indicates that cognitive coping impacts the relationship between psychological distress and affective lability at low levels of cognitive coping but is not significantly associated with cannabis use consequences. Similarly, the model utilizing emotion coping strategies as a moderator detected significant interactions between psychological distress and affective lability scores, but not for any interactions associated with cannabis use consequences. Behavioral coping strategies were observed to have a direct effect on cannabis use consequences; however, no significant interaction effects were noted, and no conditional indirect effects were observed. This suggests that behavioral coping strategies are protective factors against negative cannabis use consequences, though these coping strategies do not influence rates of psychological distress or affective lability. These results from the moderated mediation models demonstrate the effectiveness of coping strategies on reduction of affective symptoms (psychological distress such as depression and anxiety, and emotional lability), and for behavioral coping, the effectiveness of behavioral coping on reducing negative use consequences. Behavioral coping strategies were the only group of coping strategies that significantly impacted cannabis use consequences in this sample. Overall, this demonstrates that internal coping strategies (cognitive and emotional) do impact mental wellbeing and attenuate the link between psychological distress and affective lability. However, as noted in the mediation model, the changes in reported affective lability do not predict changes in cannabis use

consequences. Only changes in use behavior, the protective behavioral strategies reported by the user, impacted cannabis use consequences in this sample.

From a clinical perspective, these findings indicate a number of future directions for intervention. Because cognitive and emotional coping strategies were found to moderate the relationship between psychological distress and affective lability, techniques such as mindfulness, thought distancing, and emotional acceptance are indicated as useful for reducing the negative impacts of affective lability. ACT interventions targeted towards those individuals who endorsed psychological distress and affective lability would likely be helpful in mitigating potential risk factors related to mental health. Increasing education about the link between these two concepts may also be useful for individuals to better identify and change negative emotional and cognitive patterns. For cannabis use consequences, interventions aimed at increasing protective factors for cannabis users should focus on behavioral coping strategies, regardless of mental health status or other individual factors of the user. As such, prevention tools providing all potential users with multiple behavioral coping strategies and skills are suggested.

The findings of this study should be interpreted with consideration of its limitations. First, the data was collected exclusively from college undergraduates and should not be interpreted as generalizable to the population in its entirety. Second, the data from this study was cross-sectional, which does not allow for causal inferences to be made about the presented relationships.

Several future directions should be considered based on the results of this study. First, the results of the moderation by location point to differences in the relationship between psychological distress and cannabis use consequences across study sites. Given that the primary relationship between psychological distress and cannabis use consequences was only found to be

significant in sites in the United States, future studies should investigate what prominent risk factors exist for cannabis users in other locations to inform prevention and treatment of negative cannabis use consequences internationally. Additionally, measures constructed and tested in the countries and languages of interest should be utilized to accurately capture the experiences of individuals in sites beyond English speaking sites and those sites in the United States and to determine if the hypothesized relationships exist when alternate measures are given.

Intervention and prevention efforts should highlight symptoms of psychological distress in addition to symptoms of negative cannabis use outcomes as a way to educate users of possible risk factors. For those in the United States, more specific interventions to identify and provide resources to users experiencing psychological distress are indicated.

Next, future studies should continue to explore possible risk and protective factors for cannabis use consequences across sites. The current study identified psychological distress and affective lability as primary risk factors for the development of negative use consequences. Psychological distress emerged as a significant risk factor, though affective lability was not found to be a significant mediator of this relationship. Continued understanding of how affective lability may impact other use consequences is indicated, as well as continued exploration into other variables that may explain the variance in cannabis use consequences.

Regarding coping, this study hypothesized that coping strategies would moderate the relationship between psychological distress and cannabis use consequences via affective lability and coping strategies did not moderate this relationship. Future studies should examine how to target psychological distress utilizing coping strategies beyond distress tolerance and emotion regulation in order to mitigate the negative impact of psychological distress on cannabis use consequences. By combining ACT interventions and protective behavioral strategies for

substance use, clinicians will be better able to address negative psychological consequences associated with cannabis use. Exploring these additional strategies beyond protective behavioral interventions will better bolster intervention efforts seeking to reduce negative use consequences, beyond addressing mental health.

This study contributes to the current literature on risk and protective factors of cannabis use consequences by adding a multi-ethnic, multilingual, and multi-policy perspective. A strength of this study is the clinical implications that can be extrapolated from the results. As cannabis policies continue to change and use continues to increase across the world, the comparisons in the relationship between psychological distress and cannabis use consequences across sites illuminated findings that will be useful in addressing this global health issue. Broadly, the recommendations based on this study's findings would be to create an intervention with content that did not differ based on cannabis access/regulation, incorporate information about treating mental health concurrently with substance use issues in the United States, and to teach protective behavioral strategies to users to reduce cannabis use consequences. Overall, this study provided clinical recommendations for understanding risk factors and increasing protective factors for a harm reductionist approach to preventing negative cannabis use consequences.



## TABLES

Table 1

*Demographics for site locations*

	Total Sample ( <i>n</i> = 3482)	United States ( <i>n</i> = 1918)	Argentina ( <i>n</i> = 375)	Uruguay ( <i>n</i> = 133)	Spain ( <i>n</i> = 754)	Netherlands ( <i>n</i> = 302)
Sex	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Men	1105 (31.7)	623 (32.5)	125 (33.3)	26 (19.5)	253 (33.6)	78 (25.8)
Women	2363 (67.9)	1283 (66.9)	250 (66.7)	107 (81)	501 (66.4)	222 (73)
Missing	14 (0.4)	12 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Age <i>M</i> ( <i>SD</i> )	21.07 (4.61)	19.95 (4.16)	24.16 (5.38)	26.56 (6.21)	21.44 (3.99)	20.87 (2.96)

Table 2

*Descriptive statistics of cannabis use across countries*

	United States (USA) ( <i>n</i> = 1918)	Argentina (AR) ( <i>n</i> = 375)	Uruguay (UY) ( <i>n</i> = 133)	Spain (ES) ( <i>n</i> = 754)	Netherlands (NL) ( <i>n</i> = 302)
<b>Lifetime Use</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
No	672 (35.0)	104 (27.7)	20 (15.0)	265 (35.1)	137 (45.4)
Yes	1246 (65.0)	271 (72.3)	113 (85.0)	489 (64.9)	165 (54.6)
<b>Last 30-day Use</b>					
No	548 (44.0)	118 (43.5)	34 (30.1)	311 (63.6)	98 (59.4)
Yes	698 (56.0)	153 (56.5)	79 (69.9)	178 (36.4)	67 (22.2)

Table 3

*Model Results for Cannabis Use Consequences on Psychological Distress*

Location Group	RR	S.E.	<i>p</i> -value
All sites	5.54%	0.007	$p < 0.05$
Recreation Policy	0.1%	0.002	$p = 0.45$
Medical Policy	0.1%	0.002	$p = 0.54$
United States	3.45%	0.01	$p < 0.05$
South America	0.1%	0.002	$p = 0.63$
Europe	0.1%	0.002	$p = 0.69$
English	3.45%	0.001	$p < 0.05$
Spanish	0.1%	0.001	$p = 0.56$
Dutch	0.9%	0.01	$p = 0.15$

Table 4

*Model Results for Variables Predicting Cannabis Use Consequences via ALS-tot*

Variables	RR/b	S.E.	<i>p</i> -value
Use Consequences on			
Psych Distress	4.81%	0.01	$p < 0.05$
ALS-tot	0.3%	0.08	$p = 0.97$
ALS-tot on			
Psychological Distress	0.05	0.003	$p < 0.05$
Indirect Effect	0.00	0.003	$p = 0.97$

Table 5

*Model Results for Variables Predicting Cannabis Use Consequences via ALS-anxiety*

Variables	RR/b	S.E.	<i>p</i> -value
Use Consequences on			
Psych Distress	4.71%	0.01	$p < 0.05$
ALS-anx	2.1%	0.06	$p = 0.75$
ALS-anx on			
Psychological Distress	1.747	0.02	$p < 0.05$
Indirect Effect	0.001	0.003	$p = 0.75$

Table 6

*Model Results for Variables Predicting Cannabis Use Consequences via ALS-elation*

Variables	RR/b	S.E.	95% CI
Use Consequences on			
Psych Distress	4.71%	0.01	$p < 0.05$
ALS-ela	1.8%	0.07	$p = 0.80$
ALS-ela on			
Psychological Distress	0.05	0.02	$p < 0.05$
Indirect Effect	0.001	0.003	$p = 0.79$

Table 7

*Model Results for Variables Predicting Cannabis Use Consequences via ALS-anger*

Variables	RR/b	S.E.	95% CI
Use Consequences on			
Psych Distress	5.02%	0.01	$p < 0.05$
ALS-ang	- 4.3%	0.06	$p = 0.49$
ALS-ang on			
Psychological Distress	0.045	0.003	$p < 0.05$
Indirect Effect	-0.002	0.003	$p = 0.49$

Table 8

*Model Results for Moderated Mediation via ALS-tot, by Cognitive Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	2.1%	0.03	<i>p</i> = 0.49
ALS-tot	13%	0.33	<i>p</i> = 0.65
ERQ-supp	10.6%	0.24	<i>p</i> = 0.67
ERQ-reapp	8.5%	0.15	<i>p</i> = 0.56
ERQ-supp x Psych Distress			
ERQ-reapp x Psych Distress	0.6%	0.01	<i>p</i> = 0.37
ALS-tot on			
Psychological Distress	0.02	0.01	<i>p</i> = 0.15
ERQ-supp			
ERQ-reapp	-0.06	0.02	<i>p</i> < 0.05
ERQ-supp x Psych Distress			
ERQ-reapp x Psych Distress	0.01	0.002	<i>p</i> < 0.05
Indirect Effect			
Low ERQ-supp	0.002	0.005	<i>p</i> = 0.73
Med ERQ-supp	0.00	0.004	<i>p</i> = 0.91
High ERQ-supp	-0.001	0.005	<i>p</i> = 0.84
Low ERQ-reapp	-0.001	0.01	<i>p</i> = 0.79
Med ERQ-reapp	0.048	0.01	<i>p</i> = 0.94
High ERQ-reapp	0.003	0.006	<i>p</i> = 0.66

Table 9

*Model Results for Moderated Mediation via ALS-anx, by Cognitive Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	0.9%	0.04	<i>p</i> = 0.81
ALS-anx	4.7%	0.27	<i>p</i> = 0.86
ERQ-supp	1.3%	0.12	<i>p</i> = 0.91
ERQ-reapp	2.76%	0.13	<i>p</i> = 0.83
ERQ-supp x Psych Distress	0.3%	0.01	<i>p</i> = 0.57
ERQ-reapp x Psych Distress	0.8%	0.01	<i>p</i> = 0.27
ALS-anx on			
Psychological Distress	0.03	0.013	<i>p</i> < 0.05
ERQ-supp	0.10	0.02	<i>p</i> < 0.05
ERQ-reapp	-0.08	0.02	<i>p</i> < 0.05
ERQ-supp x Psych Distress	0.00	0.002	<i>p</i> = 0.85
ERQ-reapp x Psych Distress	0.01	0.003	<i>p</i> < 0.05
Indirect Effect			
Low ERQ-supp	0.002	0.01	<i>p</i> = 0.73
Med ERQ-supp	0.00	0.004	<i>p</i> = 0.91
High ERQ-supp	-0.001	0.01	<i>p</i> = 0.84
Low ERQ-reapp	0.002	0.01	<i>p</i> = 0.73
Med ERQ-reapp	0.002	0.004	<i>p</i> = 0.66
High ERQ-reapp	0.002	0.01	<i>p</i> = 0.77

Table 10

*Model Results for Moderated Mediation via ALS-ela, by Cognitive Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	2.8%	0.028	<i>p</i> = 0.31
ALS-ela	23.6%	0.22	<i>p</i> = 0.33
ERQ-supp	5.9%	0.12	<i>p</i> = 0.64
ERQ-reapp	8.2%	0.16	<i>p</i> = 0.58
ERQ-supp x Psych Distress	0.5%	0.01	<i>p</i> = 0.45
ERQ-reapp x Psych Distress	0.6%	0.01	<i>p</i> = 0.33
ALS-ela on			
Psychological Distress	0.05	0.01	<i>p</i> < 0.05
ERQ-supp	0.1	0.02	<i>p</i> < 0.05
ERQ-reapp	-0.04	0.02	<i>p</i> < 0.05
ERQ-supp x Psych Distress	-0.001	0.002	<i>p</i> = 0.59
ERQ-reapp x Psych Distress	0.01	0.002	<i>p</i> < 0.05
Indirect Effect			
Low ERQ-supp	0.004	0.004	<i>p</i> = 0.41
Med ERQ-supp	0.001	0.003	<i>p</i> = 0.76
High ERQ-supp	-0.002	0.004	<i>p</i> = 0.68
Low ERQ-reapp	-0.001	0.004	<i>p</i> = 0.89
Med ERQ-reapp	0.001	0.003	<i>p</i> = 0.79
High ERQ-reapp	0.003	0.005	<i>p</i> = 0.57

Table 11

*Model Results for Moderated Mediation via ALS-ang, by Cognitive Coping*

Variables	RR/b	SE	p-value
Use Consequences on			
Psych Distress	1.8%	0.03	$p = 0.54$
ALS-ang	22.5%	0.23	$p = 0.27$
ERQ-supp	5.98%	0.12	$p = 0.64$
ERQ-reapp	10.4%	0.12	$p = 0.35$
ERQ-supp x Psych Distress	0.5%	0.01	$p = 0.46$
ERQ-reapp x Psych Distress	0.7%	0.01	$p = 0.28$
ALS-ang on			
Psychological Distress	0.01	0.01	$p = 0.36$
ERQ-supp	0.1	0.02	$p < 0.05$
ERQ-reapp	-0.08	0.02	$p < 0.05$
ERQ-supp x Psych Distress			
ERQ-reapp x Psych Distress	0.01	0.003	$p < 0.05$
Indirect Effect			
Low ERQ-supp	0.004	0.004	$p = 0.41$
Med ERQ-supp	0.001	0.003	$p = 0.77$
High ERQ-supp	-0.002	0.004	$p = 0.68$
Low ERQ-reapp	-0.003	0.003	$p = 0.27$
Med ERQ-reapp	-0.002	0.003	$p = 0.53$
High ERQ-reapp	0.001	0.004	$p = 0.88$

Table 12

*Model Results for Moderated Mediation via ALS-tot, by Emotional Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	0.5%	0.03	<i>p</i> = 0.87
ALS-tot	4.9%	0.321	<i>p</i> = 0.87
DTS	19.4%	0.19	<i>p</i> = 0.26
DTS x Psych Distress	1.7%	0.01	<i>p</i> = 0.14
ALS-tot on			
Psychological Distress	-0.03	0.01	<i>p</i> < 0.05
DTS	-0.33	0.03	<i>p</i> < 0.05
DTS x Psych Distress	0.02	0.004	<i>p</i> < 0.05
Indirect Effect			
Low DTS	-0.001	0.003	<i>p</i> = 0.84
Med DTS	-0.001	0.004	<i>p</i> = 0.86
High DTS	0.000	0.007	<i>p</i> = 0.96

Table 13

*Model Results for Moderated Mediation via ALS-anx, by Emotional Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	2.37%	0.04	<i>p</i> = 0.57
ALS-anx	13.9%	0.28	<i>p</i> = 0.64
DTS	12.8%	0.17	<i>p</i> = 0.41
DTS x Psych Distress	2.22%	0.01	<i>p</i> = 0.09
ALS-anx on			
Psychological Distress	-0.01	0.02	<i>p</i> = 0.63
DTS	-0.38	0.04	<i>p</i> < 0.05
DTS x Psych Distress	0.02	0.005	<i>p</i> < 0.05
Indirect Effect			
Low DTS	0.001	0.003	<i>p</i> = 0.68
Med DTS	0.001	0.003	<i>p</i> = 0.88
High DTS	-0.001	0.006	<i>p</i> = 0.85

Table 14

*Model Results for Moderated Mediation via ALS-ela, by Emotional Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	1.19%	0.04	<i>p</i> = 0.73
ALS-ela	4.81%	0.29	<i>p</i> = 0.87
DTS	15.9%	0.19	<i>p</i> = 0.35
DTS x Psych Distress	1.9%	0.01	<i>p</i> = 0.09
ALS-ela on			
Psychological Distress	-0.04	0.01	<i>p</i> < 0.05
DTS	-0.31	0.03	<i>p</i> < 0.05
DTS x Psych Distress	0.03	0.004	<i>p</i> < 0.05
Indirect Effect			
Low DTS	0.00	0.002	<i>p</i> = 0.87
Med DTS	0.00	0.003	<i>p</i> = 0.93
High DTS	0.00	0.01	<i>p</i> = 0.97

Table 15

*Model Results for Moderated Mediation via ALS-ang, by Emotional Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	0.09%	0.03	<i>p</i> = 0.97
ALS-ang	22.2%	0.21	<i>p</i> = 0.23
DTS	25.9%	0.14	<i>p</i> < 0.05
DTS x Psych Distress	1.61%	0.01	<i>p</i> = 0.1
ALS-ang on			
Psychological Distress	-0.03	0.01	<i>p</i> = 0.06
DTS	-0.29	0.03	<i>p</i> < 0.05
DTS x Psych Distress	0.02	0.004	<i>p</i> < 0.05
Indirect Effect			
Low DTS	-0.002	0.002	<i>p</i> = 0.19
Med DTS	-0.002	0.003	<i>p</i> = 0.47
High DTS	0.00	0.005	<i>p</i> = 0.97

Table 16

*Model Results for Moderated Mediation via ALS-tot, by Behavioral Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	0.79%	0.03	<i>p</i> = 0.79
ALS-tot	71.7%	0.30	<i>p</i> = 0.07
PBSM	20%	0.13	<i>p</i> = 0.09
PBSM x Psych Distress	1.0%	0.01	<i>p</i> = 0.16
ALS-tot on			
Psychological Distress	0.03	0.02	<i>p</i> = 0.05
PBSM	0.001	0.03	<i>p</i> = 0.98
PBSM x Psych Distress	0.003	0.003	<i>p</i> = 0.30
Indirect Effect			
Low PBSM	0.006	0.004	<i>p</i> = 0.12
Med PBSM	0.00	0.003	<i>p</i> = 0.93
High PBSM	-0.01	0.006	<i>p</i> = 0.33

Table 17

*Model Results for Moderated Mediation via ALS-anx, by Behavioral Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	0.79%	0.03	<i>p</i> = 0.79
ALS-anx	57.4%	0.24	<i>p</i> = 0.07
PBSM	23.4%	0.12	<i>p</i> < 0.05
PBSM x Psych Distress	1.05%	0.01	<i>p</i> = 0.16
ALS-anx on			
Psychological Distress	0.04	0.02	<i>p</i> = 0.03
PBSM	0.003	0.04	<i>p</i> = 0.93
PBSM x Psych Distress	0.004	0.004	<i>p</i> = 0.29
Indirect Effect			
Low PBSM	0.007	0.004	<i>p</i> = 0.07
Med PBSM	0.001	0.004	<i>p</i> = 0.71
High PBSM	-0.01	0.01	<i>p</i> = 0.46

Table 18

*Model Results for Moderated Mediation via ALS-ela, by Behavioral Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	0.69%	0.03	<i>p</i> = 0.82
ALS-ela	73.1%	0.55	<i>p</i> = 0.05
PBSM	19.5%	0.13	<i>p</i> = 0.10
PBSM x Psych Distress	1.0%	0.007	<i>p</i> = 0.15
ALS-ela on			
Psychological Distress	0.03	0.02	<i>p</i> = 0.09
PBSM	0.00	0.03	<i>p</i> = 0.99
PBSM x Psych Distress	0.004	0.004	<i>p</i> = 0.32
Indirect Effect			
Low PBSM	0.01	0.003	<i>p</i> = 0.07
Med PBSM	0.001	0.003	<i>p</i> = 0.75
High PBSM	-0.01	0.005	<i>p</i> = 0.35

Table 19

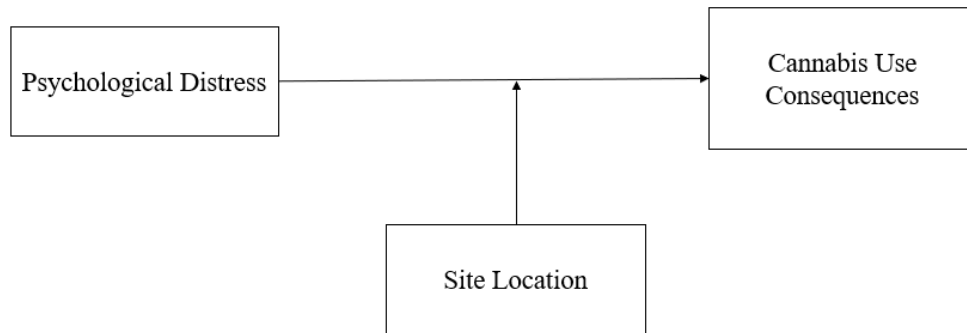
*Model Results for Moderated Mediation via ALS-ang, by Behavioral Coping*

Variables	RR/b	SE	<i>p</i> -value
Use Consequences on			
Psych Distress	0.3%	0.03	<i>p</i> = 0.92
ALS-ang	33.9%	0.27	<i>p</i> = 0.28
PBSM	26.9%	0.11	<i>p</i> < 0.05
PBSM x Psych Distress	0.8%	0.01	<i>p</i> = 0.25
ALS-ang on			
Psychological Distress	0.03	0.02	<i>p</i> = 0.11
PBSM	0.001	0.03	<i>p</i> = 0.97
PBSM x Psych Distress	0.003	0.003	<i>p</i> = 0.39
Indirect Effect			
Low PBSM	0.001	0.003	<i>p</i> = 0.63
Med PBSM	-0.002	0.002	<i>p</i> = 0.46
High PBSM	-0.01	0.01	<i>p</i> = 0.23

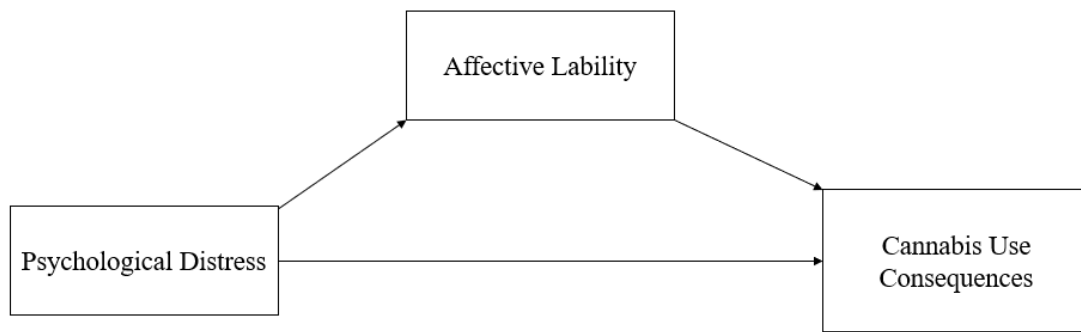
## FIGURES



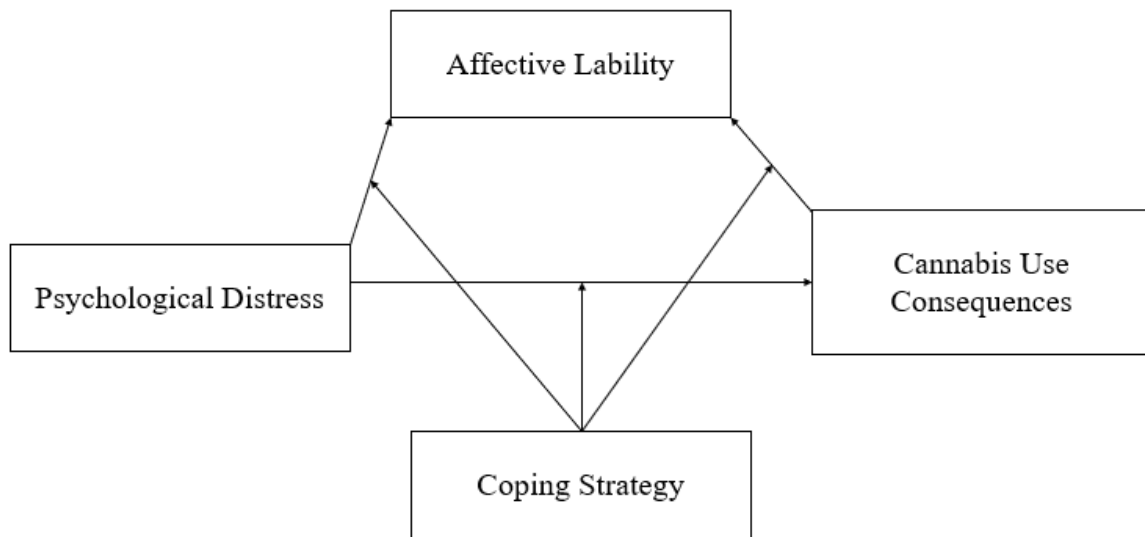
*Figure 1.* Hypothesized relationship between psychological distress and cannabis use consequences.



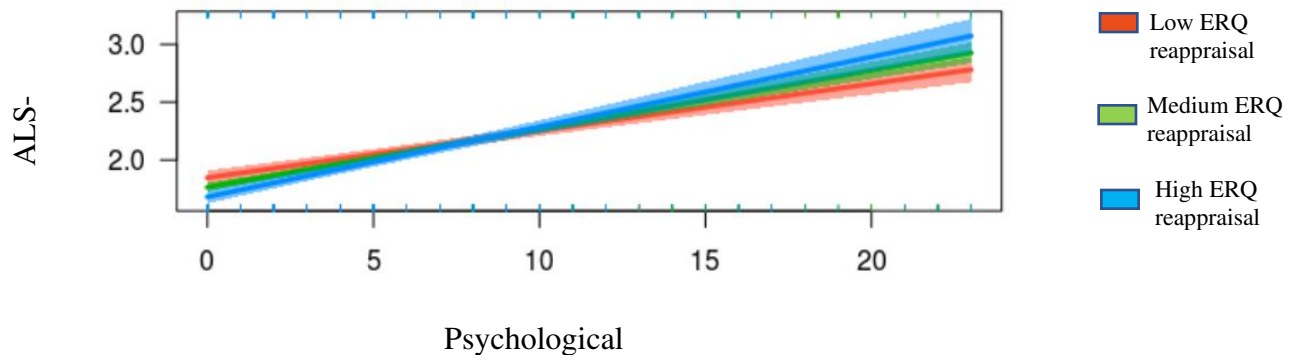
*Figure 2.* Exploratory moderation model of psychological distress and cannabis use consequences by site location. Site locations were grouped according to region, cannabis policy, and primary language spoken.



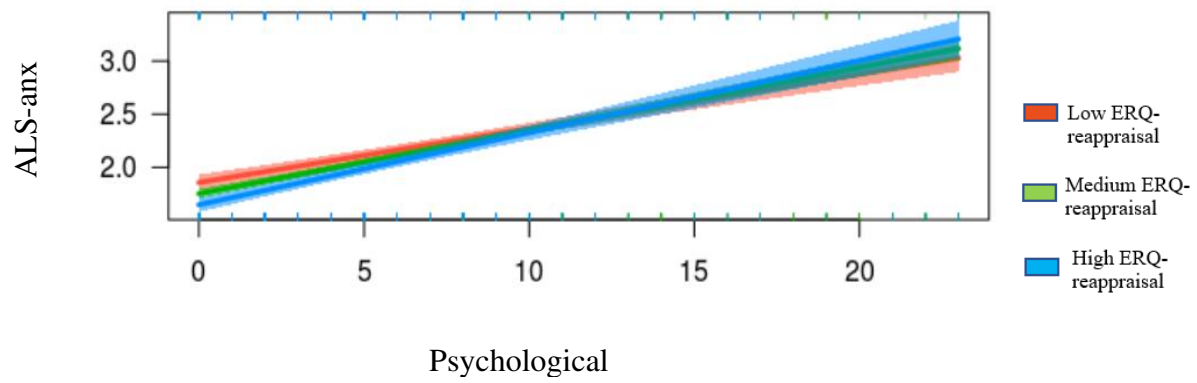
*Figure 3.* Hypothesized mediation model of psychological distress to cannabis use consequences by affective lability. The above model was run four separate times with each affective lability subscale score and the overall score as moderators.



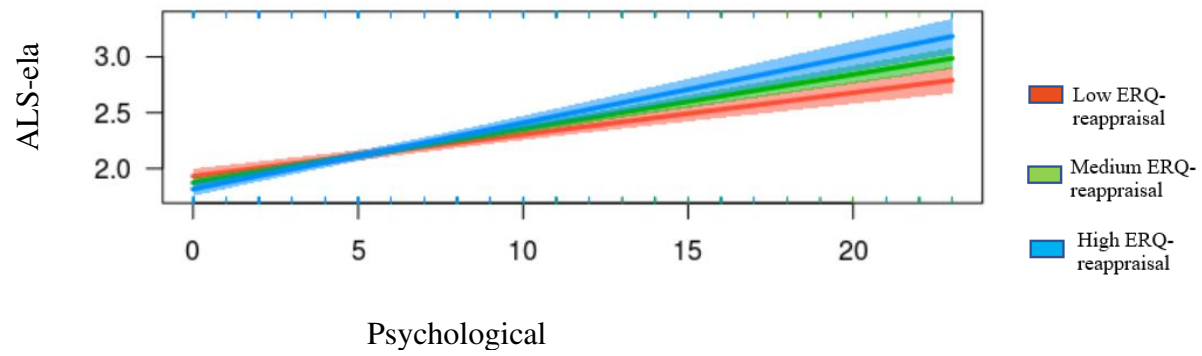
*Figure 4.* Hypothesized moderated mediation of psychological distress to cannabis use consequences through affective lability, moderated by coping strategy. Sixteen models were run using the each of the four affective lability scores and three distinct coping strategies, cognitive, emotional, and behavioral.



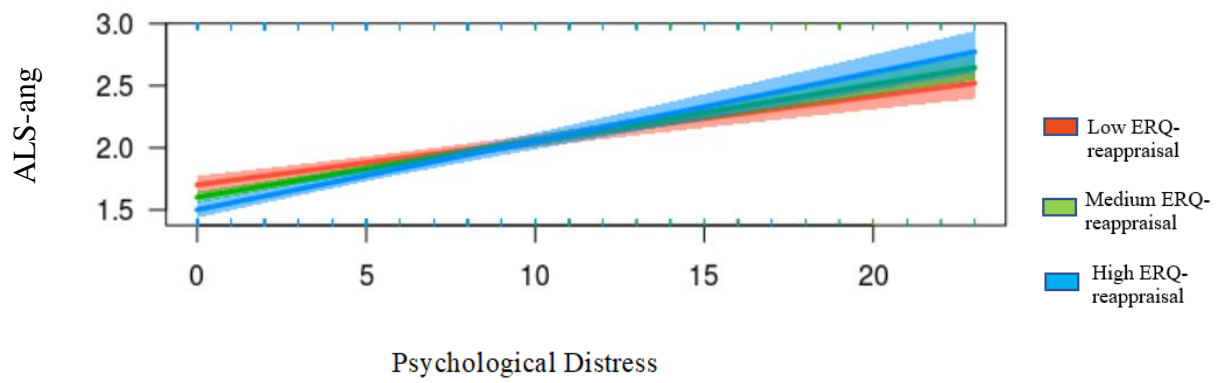
*Figure 5.* A representation of the significant interaction in the moderated mediation model, such that the relationship between psychological distress and total ALS score varied at different levels of ERQ reappraisal scores.



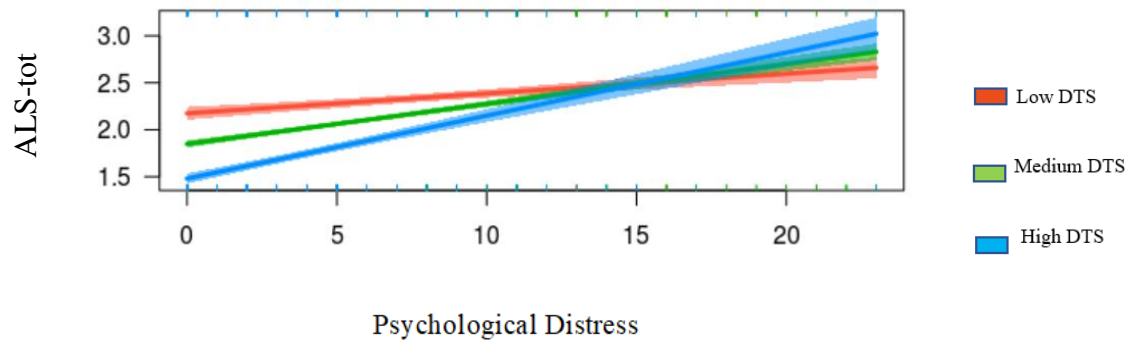
*Figure 6.* A representation of the significant interaction between psychological distress and ALS-anx at varying levels of ERQ reappraisal.



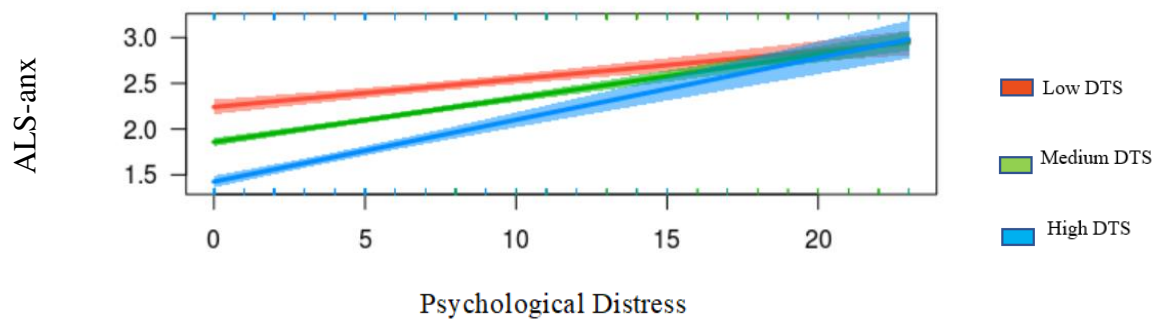
*Figure 7.* A representation of the significant interaction between psychological distress and ALS-ela at varying levels of ERQ reappraisal.



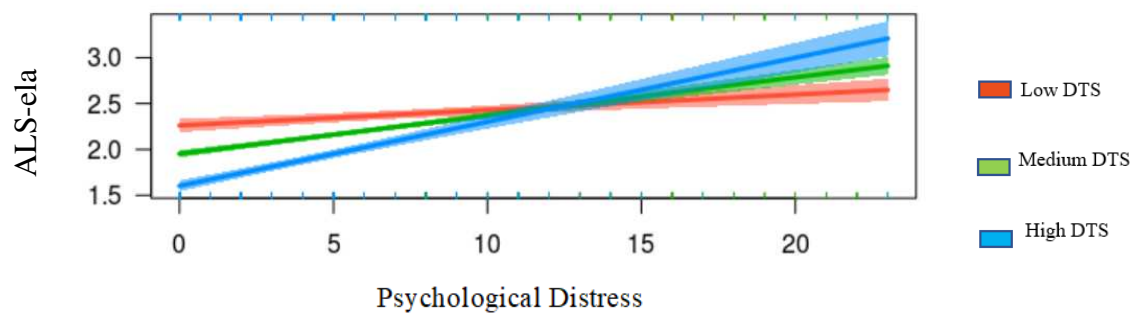
*Figure 8.* A representation of the significant interaction between psychological distress and ALS-ang at varying levels of ERQ reappraisal.



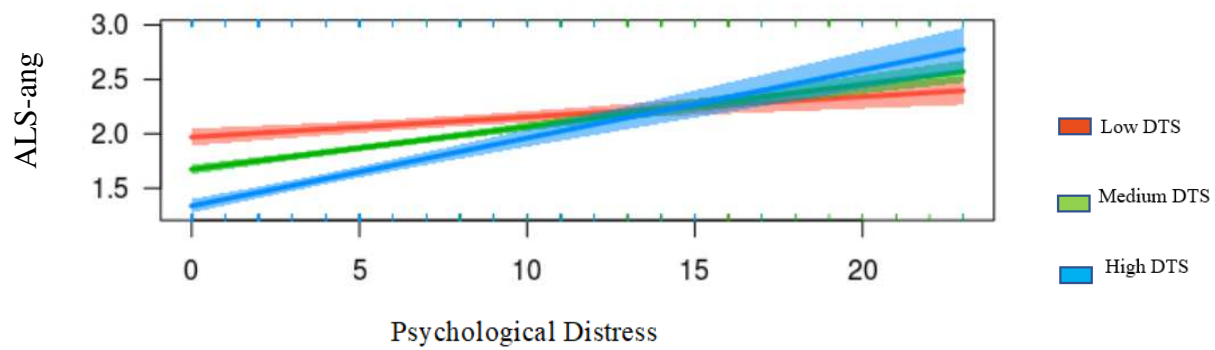
*Figure 9.* A representation of the significant interaction between psychological distress and ALS-tot at different levels of DTS scores.



*Figure 10.* A representation of the significant interaction between psychological distress and ALS-anx at different levels of DTS.



*Figure 11.* A representation of the significant interaction between psychological distress and ALS-ela at different levels of DTS scores.



*Figure 12.* A representation of the significant interaction between psychological distress and ALS-ang at different levels of DTS scores.

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## APPENDICES

### Appendix A

#### Consent and Demographic Information

Your age: [                      ]

Your sex: {Choose one}

☐ Male                      ☐ Female                      ☐ Transgender                      ☐ Other \_\_\_\_\_

Year in school: {Choose one}

☐ Freshman    ☐ Sophomore    ☐ Junior                      ☐ Senior                      ☐ Graduate

Your Race: {Choose multiple}

☐ American Indian or Alaska Native ☐ Asian                      ☐ Black or African American  
☐ Native Hawaiian or Pacific Islander                      ☐ White                      ☐ Other [                      ]

Are you Hispanic, Latino, or of Spanish origin? {Choose multiple}

☐ No    ☐ Yes, Mexican or Mexican American                      ☐ Yes, Cuban    ☐ Yes, Puerto Rican  
☐ Yes, Other \_\_\_\_\_

Your marital status:

{Choose one}

☐ Never Married                      ☐ Married                      ☐ Separated                      ☐ Divorced                      ☐ Widowed

Your sexual orientation:

{Choose one}

☐ Exclusively heterosexual  
☐ Mostly heterosexual  
☐ Equally heterosexual and homosexual  
☐ Mostly homosexual  
☐ Exclusively homosexual

Your political views:

{Choose one}

☐ Strongly Conservative  
☐ Moderately Conservative  
☐ Somewhat Conservative  
☐ Moderate (middle-of-the-road)  
☐ Somewhat Liberal  
☐ Moderately Liberal  
☐ Strongly Liberal

Your parents' political view:

{Choose one}

☐ Strongly Conservative

- ☐ Moderately Conservative
- ☐ Somewhat Conservative
- ☐ Moderate (middle-of-the-road)
- ☐ Somewhat Liberal
- ☐ Moderately Liberal
- ☐ Strongly Liberal

How would you describe your socioeconomic status when you were growing up?

- ☐ Poor or just barely making it
- ☐ Working or labor class
- ☐ Middle class
- ☐ Upper middle class
- ☐ Wealthy

In 10 years, which of the following SES categories do you aspire to?

- ☐ Poor or just barely making it
- ☐ Working or labor class
- ☐ Middle class
- ☐ Upper middle class
- ☐ Wealthy
- ☐ I really don't care about my social status

Which political party do you most strongly identify with?

- ☐ Democratic
- ☐ Republican
- ☐ Green party
- ☐ Libertarian
- ☐ Independent
- ☐ Other \_\_\_\_\_

Which of the following is the best estimate of your GPA (for all courses) right now?

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ F

How much importance do you place on doing well in school (academically)?

- ☐ Extremely unimportant
- ☐ Very unimportant
- ☐ Somewhat unimportant
- ☐ Neither unimportant or important
- ☐ Somewhat important
- ☐ Very important
- ☐ Extremely important

Do you have any previous or current experience with mindfulness meditation?

Yes

No

If yes: How often do you practice mindfulness meditation currently?

☐ Daily

☐ 3-5 times a week

☐ Weekly

☐ Monthly

☐ A few times a year

☐ Once a year

☐ Longer than a year since I last meditated

How long have you been practicing mindfulness meditation?

1. 1-6 months

2. 7-12 months

3. 1-2 years

4. 3 years or more

Do you have experience with any other forms of meditation?

Yes

No

If yes: Please describe:

To be contacted for the follow-up, please provide an email below:

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## Appendix B

### Cannabis Use Measures

#### Marijuana Use Measures

For the following set of items, we ask about “using marijuana” to indicate the use of marijuana in any form (i.e., smoking, consuming edibles, etc.)

In your lifetime, have you ever used marijuana in any form? ( ) yes ( ) no

[Branches to next two items]

Approximately how many days in your lifetime have you used marijuana? \_\_\_ years \_\_\_ days

On how many days during the last 30 days did you use marijuana? [0-30]

[if greater than 0, branches to items below and measures 3-8]

How old were you the first time you used marijuana? [0-30]

In the past month, please report the percentage of marijuana that you used from the following sources:

I bought it from a legal marijuana shop (i.e., dispensary) in the country (*state in U.S.*) where I attend college \_\_\_%

I bought it from a legal marijuana shop (i.e., dispensary) in a country (*state in U.S.*) where I do not attend college \_\_\_%

I bought it, but not from a legal marijuana shop (i.e., dispensary) \_\_\_%

I did not buy it \_\_\_%

Please estimate how much money you have spent on marijuana in the past month. \$\_\_\_

On a typical marijuana use day in the past 30 days, please indicate how high you get from using marijuana. [0=not at all, 100=completely]

Please indicate the highest you have been from marijuana in the past month? [0=not at all, 100=completely]

What percentage of the time do you get this high from using marijuana? [0-100%]

On a typical marijuana use day in the past 30 days, how long do you stay high from using marijuana? \_\_\_ hours

In the past month, please report the percentage of marijuana you consumed in each the following ways (must total to 100%):

Plant (i.e., bud, flower) \_\_\_%

Edibles (i.e., brownie, chocolate) \_\_\_%

Concentrates (i.e., hash, dabs) \_\_\_%

Other \_\_\_%

In the past month, please report the percentage of marijuana you consumed in each the following ways (must total to 100%):

Smoked in joint/blunt without tobacco \_\_\_\_%

Smoked in joint/blunt with tobacco \_\_\_\_%

Smoked in bong/water pipe without tobacco \_\_\_\_%

Smoked in bong/water pipe with tobacco \_\_\_\_%

Eaten/cooked \_\_\_\_%

Used in a vaporizer \_\_\_\_%

In the past month, please report the percentage of times that you used marijuana in each the following ways (must total to 100%):

At my home \_\_\_\_%

At a friend's home \_\_\_\_%

At a stranger's home \_\_\_\_%

Outside \_\_\_\_%

In a car \_\_\_\_%

At a party \_\_\_\_%

Other \_\_\_\_%

In the past month, please report the percentage of times that you used marijuana in each the following ways (must total to 100%):

Alone \_\_\_\_%

With friends \_\_\_\_%

With family \_\_\_\_%

With people I don't know \_\_\_\_%

Other \_\_\_\_%

Do you have a medical marijuana card? yes no

If yes, for what condition(s) have you been provided with a medical marijuana card? (list all)

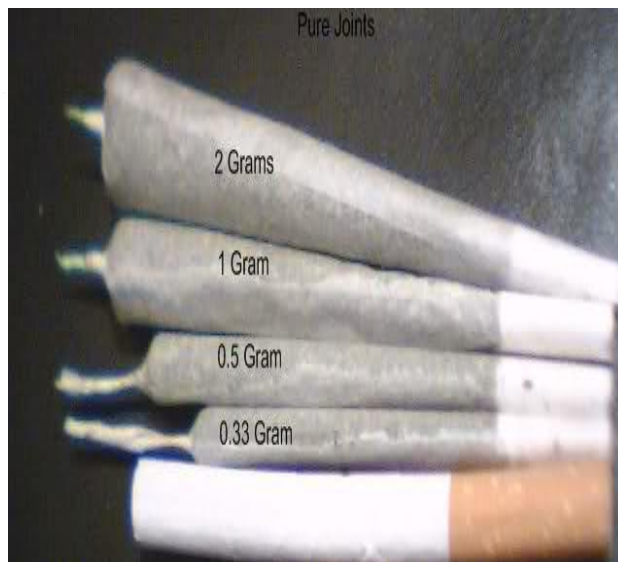
\_\_\_\_\_

In the past month, please report the percentage of marijuana that you used in the following ways:

I made a plan to use marijuana \_\_\_\_%

I did not make a plan to use marijuana \_\_\_\_%

Please review the next page carefully as it will help you understand what exactly counts as a gram of marijuana.



During a week of typical marijuana use in the past 30 days, please indicate times, days, and approximate number of grams of marijuana that you used.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
12a-4a							
4a-8a							
8a-12p							
12p-4p							
4p-8p							
8p-12a							

## Appendix C

### Brief Marijuana Consequences Questionnaire

Below is a list of things that sometimes happen to people either during, or after they have used marijuana. Next to each item below, please indicate whether that item describes something that has happened to you in the PAST 30 days.

Response scale: ( ) yes            ( ) no

In the past 30 days...

1. The quality of my work or schoolwork has suffered because of my marijuana use.
2. I have driven a car when I was high.
3. I have felt in a fog, sluggish, tired, or dazed the morning after using marijuana.
4. I have been unhappy because of my marijuana use.
5. I have gotten into physical fights because of my marijuana use.
6. I have spent too much time using marijuana.
7. I have felt like I needed a hit of marijuana after I'd gotten up (that is, before breakfast).
8. I have become very rude, obnoxious, or insulting after using marijuana.
9. I have been less physically active because of my marijuana use.
10. I have had trouble sleeping after stopping or cutting down on marijuana use.
11. I have neglected obligations to family, work, or school because of my marijuana use.
12. When using marijuana I have done impulsive things that I regretted later.
13. I have awakened the day after using marijuana and found I could not remember a part of the evening before.
14. I have been overweight because of my marijuana use.
15. I haven't been as sharp mentally because of my marijuana use.
16. I have received a lower grade on an exam or paper than I ordinarily would have because of marijuana use.
17. I have tried to quit using marijuana because I thought I was using too much.
18. I have felt anxious, irritable, lost my appetite or had stomach pains after stopping or cutting down on marijuana use.
19. I often have thought about needing to cut down or to stop using marijuana.
20. I have had less energy or felt tired because of my marijuana use.
21. I have lost motivation to do things because of my marijuana use.

## Appendix D

### DSM 5 Cross Cutting Symptoms Measure

Response scale:

- 1 = None, not at all
- 2 = Slight, rare, less than a day or two
- 3 = Mild, several days
- 4 = Moderate, more than half the days
- 5 = Severe, nearly every day

During the past TWO (2) WEEKS, how much (or how often) have you been bothered by the following problems?

- 1. Little interest or pleasure in doing things?
- 2. Feeling down, depressed, or hopeless?
- 3. Feeling more irritated, grouchy, or angry than usual?
- 4. Sleeping less than usual, but still have a lot of energy?
- 5. Starting lots more projects than usual or doing more risky things than usual?
- 6. Feeling nervous, anxious, frightened, worried, or on edge?
- 7. Feeling panic or being frightened?
- 8. Avoiding situations that make you anxious?
- 9. Unexplained aches and pains (e.g., head, back, joints, abdomen, legs)?
- 10. Feeling that your illnesses are not being taken seriously enough?
- 11. Thoughts of actually hurting yourself?
- 12. Hearing things other people couldn't hear, such as voices even when no one was around?
- 13. Feeling that someone could hear your thoughts, or that you could hear what another person was thinking?
- 14. Problems with sleep that affected your sleep quality over all?
- 15. Problems with memory (e.g., learning new information) or with location (e.g., finding your way home)?
- 16. Unpleasant thoughts, urges, or images that repeatedly enter your mind?

17. Feeling driven to perform certain behaviors or mental acts over and over again?
18. Feeling detached or distant from yourself, your body, your physical surroundings, or your memories?
19. Not knowing who you really are or what you want out of life?
20. Not feeling close to other people or enjoying your relationships with them?
21. Drinking at least 4 drinks of any kind of alcohol in a single day?
22. Smoking any cigarettes, a cigar, or pipe, or using snuff or chewing tobacco?
23. Using any of the following medicines ON YOUR OWN, that is, without a doctor's prescription, in greater amounts or longer than prescribed [e.g., painkillers (like Vicodin), stimulants (like Ritalin or Adderall), sedatives or tranquilizers (like sleeping pills or Valium), or drugs like marijuana, cocaine or crack, club drugs (like ecstasy), hallucinogens (like LSD), heroin, inhalants or solvents (like glue), or methamphetamine (like speed)]?

## Appendix E

### Affect Lability Scale

Please read the following statements and rate how descriptive each statement is of you.

Participants use the following response scale.

- (1) Very undescriptive
- (2) Undescriptive
- (3) Descriptive
- (4) Very descriptive

1. At times I feel just as relaxed as everyone else and then within minutes I become so nervous that I feel light-headed and dizzy
2. There are times when I have very little energy and then just afterwards I have about the same energy level as most people.
3. One minute I can be feeling OK and then the next minute I'm tense, jittery, and nervous.
4. I frequently switch from being able to control my temper very well to not being able to control it very well at all.
5. Many times I feel nervous and tense and then I suddenly feel very sad and down.
6. Sometimes I go from feeling extremely anxious about something to feeling very down about it.
7. I shift back and forth from feeling perfectly calm to feeling uptight and nervous.
8. There are times when I feel perfectly calm one minute and then the next minute the least little thing makes me furious.
9. Frequently, I will be feeling OK but suddenly get so mad that I could hit something.
10. Sometimes I can think clearly and concentrate well one minute and then the next minute I have a great deal of difficulty concentrating and thinking clearly.
11. There are times when I am so mad that I can barely stop yelling and other times shortly afterwards when I wouldn't think of yelling at all.
12. I switch back and forth between being extremely energetic and having so little energy that it's a huge effort just to get where I am going.
13. There are times when I feel absolutely wonderful about myself but soon afterwards I often feel that I am just about the same as everyone else.
14. There are times when I'm so mad that my heart starts pounding and/or I start shaking and then shortly afterwards I feel quite relaxed.
15. I shift back and forth between being very unproductive and being just as productive as everyone else.

16. Sometimes I feel extremely energetic one minute and then the next minute I might have so little energy that I can barely do anything.

17. There are times when I have more energy than usual and more than most people and then soon afterwards I have about the same energy level as everyone else.

18. At times I feel that I'm doing everything at a very slow pace but then soon afterwards I feel that I'm no more slowed down than anyone else.

## Appendix F

### Protective Behavioral Strategies for Marijuana (Short Form)

Within the past 30 days, please indicate the degree to which you engage in the following behaviors when using marijuana/cannabis.

#### **Response scale:**

- ☐ Never
- ☐ Rarely
- ☐ Occasionally
- ☐ Sometimes
- ☐ Usually
- ☐ Always

Within the past 30 days, please indicate how helpful each behavior has been in helping you to moderate your use of marijuana/cannabis.

#### **Response scale:**

- ☐ Not at all helpful
- ☐ Slightly helpful
- ☐ Somewhat helpful
- ☐ Moderately helpful
- ☐ Very helpful
- ☐ Extremely helpful

#### **Write-in items:**

Please describe a strategy you have used to cut down/moderate your marijuana use

Please describe a second strategy you have used to cut down/moderate your marijuana use

Please describe a third strategy you have used to cut down/moderate your marijuana use

#### **PBSM-17 items:**

Use marijuana only among trusted peers

Avoid use while spending time with family

Avoid using marijuana before work or school

Avoid using marijuana to cope with emotions such as sadness or depression

Limit use to weekends

Only purchase marijuana from a trusted source

Avoid using marijuana habitually (that is, every day or multiple times a week)

Use a little and then wait to see how you feel before using more

Avoid mixing marijuana with other drugs

Avoid using marijuana in public places

Take periodic breaks if it feels like you are using marijuana too frequently

Buy less marijuana at a time so you smoke less

Have a set amount of “times” you take a hit (e.g., passing on a shared joint if you have already hit that limit)

Avoid methods of using marijuana that can make you more intoxicated than you would like (e.g., using large bongs, volcano, 'edibles,' etc.)

Only use one time during a day/night

Limit the amount of marijuana you smoke in one sitting

Avoid using marijuana before engaging in physical activity (i.e., exercise, hiking)



## Appendix H

### Distress Tolerance Scale

Think of times that you feel distressed or upset. Select the item from the menu that describes your beliefs about feeling distressed or upset.

Participants use the following response scale.

- (1) Strongly agree
- (2) Mildly agree
- (3) Agree and disagree equally
- (4) Mildly disagree
- (5) Strongly disagree

- 1. Feeling distressed or upset is unbearable to me
- 2. When I feel distressed or upset, all I can think about is how bad I feel
- 3. I can't handle feeling distressed or upset
- 4. My feeling of distress are so intense that they completely take over.
- 5. There is nothing worse than feeling distressed or upset.
- 6. I can tolerate being distressed or upset as well as most people.
- 7. My feeling of distress or being upset are not acceptable
- 8. I'll do anything to avoid feeling distressed or upset.
- 9. Other people seem to be able to tolerate feeling distressed or upset better than I can.
- 10. Being distressed or upset is always a major ordeal for me.
- 11. I am ashamed of myself when I feel distressed or upset.
- 12. My feelings of distress or being upset scare me.
- 13. I'll do anything to stop feeling distressed or upset.
- 14. When I feel distressed or upset, I must do something about it immediately.
- 15. When I feel distressed or upset, I cannot help but concentrate on how bad the distress actually feels.