Protective behavioral strategies for cannabis use: findings from a web-based Intervention

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PROTECTIVE BEHAVIORAL STRATEGIES FOR CANNABIS USE: FINDINGS FROM A WEB-BASED INTERVENTION

by

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Abstract

Cannabis is one of the most commonly used psychoactive substances in the United States. Perceived risks of cannabis appear to be declining, while use rates continue to rise, especially for adolescents. Heavy, frequent cannabis use is associated with negative outcomes. Efforts have emerged to identify effective harm-reduction strategies, with a recent emphasis on protective behavioral strategies (PBS). PBS emphasize straightforward cognitive and behavioral strategies that can help cannabis users develop less heavy, more planful use of the plant. Previous findings suggest that PBS for marijuana (PBSM) are negatively associated with frequency of use, quantity of use, and cannabis-associated problems.

The present study measured cannabis use, PBSM use and cannabis-associated problems in a sample of cannabis users (n=410). Participants were randomized to receive a brief, web-based intervention describing and encouraging use of PBSM or to receive information on stress and coping. We hypothesized that participants in the former condition would demonstrate increased PBSM use, decreased cannabis use, and decreased cannabis-associated problems at follow up. We also anticipated that PBSM would be protective at baseline and follow up. Contrary to hypotheses, treatment outcome did not significantly predict changes in these variables. However, participants in both groups demonstrated significant increases in PBSM use, and significant decreases in frequency of cannabis use over time. Findings do appear somewhat consistent with previous work suggesting a buffering effect of PBSM, though further work is needed in developing effective PBSM interventions.
Chapter 1: Introduction

Cannabis is the most commonly used psychoactive substance in the United States. The 2016 National Survey of Drug Use and Health found that 24 million Americans aged 12 or over identified as current cannabis users (Ahrnsbrak, Bose, Hedden, Lipari & Park-Lee, 2017). The same survey estimated that 4 million Americans aged 12 or older met criteria for cannabis use disorder. Though legislation and attitudes towards the medical and recreational availability of cannabis are shifting, cannabis remains problematic for many users. In 2015, 138,000 individuals sought treatment for cannabis use (CBHSQ, 2015). Heavy, frequent cannabis use, especially use that begins in adolescence, is linked to respiratory problems, cognitive impairment, educational deficits, and memory impairment (Volkow, Baler, Compton & Weiss, 2014). Thus, effective, empirically supported treatments for cannabis abuse and dependence are needed.

Cannabis use is especially prevalent in adolescent samples. In adolescents aged 12-17 cannabis is the second-most commonly used illicit substance, with 13% endorsing past-year use (Johnston, O’Malley, Bachman, Schulenberg & Miech, 2016). In college samples, cannabis remains the most commonly used substance, with 38% reporting use in the past month and 1 in 22 college students identifying as daily or near daily cannabis users. While cannabis use in high school has decreased somewhat over the past several years, cannabis use in college remains quite common, with prevalence rates actually increasing between 2001 and 2017 (Johnston et al., 2016). Identified risks of heavy adolescent cannabis use include: less frequent condom use, higher rates of sexually transmitted diseases, early school drop out, delinquency, legal problems, and reduced educational and occupational achievements (Brook, Adams, Balka & Johnson, 2002; Brook, Balka & Whiteman, 1999; Lynskey, Coffey, Degenhardt, Carlin & Patton, 2003; Tapert,
Aarons, Sedlar & Brown, 2001). Similarly, earlier and more regular cannabis use increases the risk for persistent drug problems as an adult (Substance Abuse and Mental Health Services Administration Office of Applied Studies, 2002).

Chapter 2: Background

Understanding Problematic Cannabis Use

In a shifting legal, social, and medical landscape, current definitions of cannabis problems are varied. Though there is consistent evidence that frequent, heavy cannabis use increases the risk of problems, “frequent” and “heavy” remain somewhat ill defined. As attitudes towards the risks of cannabis shift, medicinal use continues to grow, and legislation allows more liberal use of the plant, understanding what exactly constitutes problematic use becomes increasingly difficult. Similarly, the patterns of cannabis use associated with cannabis dependence and the stages of use prior to the development of problems remains somewhat unclear.

In a recent systematic review of 49 articles and websites defining problematic cannabis use, authors note discrepancies in measuring, assessing, and defining problematic cannabis use (Casajuana et al., 2016). Frequency of use and cutoff scores on screening instruments are the most common measures of risky or problematic cannabis use. Of the 49 studies examined, 21 utilized frequency of use to define “hazardous” (n=14) or “problematic” (n=7) use. While variations emerged with regards to frequency, most defined daily or near daily use as the most hazardous or problematic pattern of use, with weekly use considered “at risk” or “moderate risk”. This definition emerged from cross-sectional and longitudinal data as well as empirically determined terminology. Twenty-four of the included studies used cutoff scores on screening instru-
ments to determine problematic cannabis use. Again, measures were variable, with authors using 5 different measures and several cutoff scores throughout.

The DSM-V defines Cannabis User Disorder (CUD) as the use of cannabis for at least one year with significant impairment or distress associated with use as well as two or more of the following symptoms: use of larger amounts or over a longer period than intended, repeated failed efforts to discontinue or reduce use, increased amount of time spent acquiring, using or recovering from use of cannabis, symptoms of craving, continued use despite adverse effects from use, desire to use that supersedes other important activities or obligations, use in contexts that are potentially dangerous, symptoms of tolerance, and symptoms of withdrawal (APA, 2013). The American Psychiatric Association (APA) has identified family history of chemical dependence, personal history of conduct disorder, unstable family history, and familial cannabis use as potential risk factors for CUD. Still, it remains unclear whether these factors are simply correlated with CUD rather than predictive of its development (APA, 2013). Examining the factors associated with seeking treatment for cannabis-related problems is also useful in understanding problematic cannabis use. Early onset of cannabis use, previous treatment, comorbid mental illness, and other substance use are associated with greater treatment utilization (Agosti & Levin, 2004; Arendt and Munk-Jorgenson, 2004; Copeland, Swift & Ress, 2001; Gates et al. 2012).

A consensus report published by the National Academies of Sciences, Engineering and Medicine (2017) dedicates one chapter to existing research on the development of problematic cannabis use. This report, titled “The Health Effects of Cannabis and Cannabinoids: The Current State of Evidence and Recommendations for Research” offers a comprehensive overview of existing research on the health effects and potential therapeutic uses of cannabis. In examining
problematic cannabis use, authors focused on two systematic reviews and 26 primary literature articles. Their search criteria included only studies that incorporated the most relevant risk factors and excluded studies with fewer than 500 participants. As observed in earlier studies, history of psychiatric treatment and early initiation of use were associated with increased risk for problems. Male gender and cigarette use also increased the likelihood of progression to CUD. In adolescents, frequency of use, parental substance abuse and oppositional behaviors moderately increased the risks for CUD. Using data from two large U.S. surveys with nearly 86,000 participants, authors note a significant increase in DSM-IV cannabis abuse and dependence between 1991 and 2001. However, this increase was observed in the absence of self-reported increases in frequency or quantity of use. The report suggests that increased potency of cannabis may help explain these observed increases in cannabis abuse and dependence.

Another way of understanding problems associated with cannabis use is to consider individual symptoms or problems most commonly reported. Unfortunately, many existing studies present composite scores for problems scales. Available data suggests that for individuals seeking treatment for cannabis use, feeling bad about use, procrastination, decreased energy, low self-esteem, decreased self-confidence and loss of productivity are most common, with 74-95% of treatment seekers endorsing these symptoms on the Cannabis Problems Scale (MPS; Stephens et al., 2000). Among individuals with previous diagnoses of cannabis use disorder, individuals endorsed lower productivity (36%), feeling bad about use (38%), missed appointments or obligations (39%), problems with family or partner (39%), and memory loss (45%) as the most common symptoms on the Cannabis Problems Scale-Lifetime (MPS-L; Hodgins & Stea, 2018).
Symptoms of withdrawal also appear useful in understanding cannabis problems. In a sample of 496 non-treatment seeking cannabis users, 42.4% of participants reported cannabis withdrawal during their “most difficult” quit attempt (Levin et al., 2010). Symptoms of withdrawal were associated with increased frequency and quantity of use prior to quit attempt, and greater lifetime use. Approximately 70% of participants reported use or relapse in response to withdrawal symptoms. Interestingly, a majority of participants denied withdrawal symptoms in spite of endorsing a difficult quit attempt. This suggests that many users are able to reduce use on their own without experiencing bothersome withdrawal symptoms. However, the authors provide little information on the characteristics of participants who denied lifetime experience of cannabis withdrawal. Further work of this nature would likely contribute to better understanding of the precise factors predicting problematic use as well as potential protective factors.

Together, these findings suggest that earlier onset of cannabis use, daily or near daily use, comorbid mental illness, male gender, increased potency of cannabis, and comorbid nicotine use increase the risk of developing CUD, treatment utilization, and problematic cannabis use more generally. Additionally, problematic cannabis use often manifests through feeling bad about use, procrastination or low productivity, problems with family or partner, decreased self-esteem, withdrawal symptoms, and memory loss. Finally, heavy and frequent use appears to increase the likelihood of tolerance and withdrawal, perhaps contributing to more chronic use. Future efforts to treat or prevent problematic cannabis use should thus take into account these salient risk factors and common problems in developing targeted, effective interventions.
**Existing Interventions**

In light of the legal, health and psychological risks associated with frequent, heavy and early cannabis use, efforts to develop interventions are valuable. To date, empirically supported treatments range in focus and goal, with small to moderate treatment effect sizes most common. Motivational Interviewing (MI) approaches aim to strengthen motivation for change among drug users by encouraging reflection on the risks and problems associated with drug use (Miller & Rollnick, 2002). MI interventions demonstrate efficacy in reducing cannabis use and cannabis-related consequences in adolescents (Stewart, Siebert, Arlt, Moise-Campbell & Lehinger, 2016; Erickson, Gerstle & Feldstein, 2005) and in reducing alcohol and drug use in adults (Burke, Arkowitz & Menchola, 2003; Hettema, Steele & Miller, 2005; Rubak, Sandbaek, Lauritzen & Christensen, 2005). A meta-analysis of 21 studies on the effects of MI interventions for adolescent substance use found a small but significant effect (d=0.17). In adults, MI interventions for alcohol, tobacco and cannabis use appear similarly effective (d= 0.15 to d=0.26; Lundahl, Kunz, Brownell, Tollefson, 2010).

Family-based interventions emphasize the developmental context of substance use and recognize the potential leverage of the family unit in offering support and encouraging positive change (Rowe, 2012). Such approaches appear particularly useful in the context of adolescent substance use. Family-based interventions appear effective in preventing cannabis use initiation (Vermeulen-Smit, Verdummen & Engels, 2015), among adolescents at-risk for comorbid mental health conditions (Piehler & Winters, 2015) and among juvenile offenders (Vaughn & Howard, 2004). Adolescents enrolled in a family-based intervention appeared more likely to be abstinent from cannabis at 12-month follow up than those enrolled in Cognitive Behavioral therapy (Lid-
dle, Rowe, Dakof, Henderson & Greenbaum, 2008). Across family-based interventions, effect size estimates are quite variable, with most reported effect size estimates small to moderate (Vaughn & Howard, 2004).

Cognitive Behavioral Therapy (CBT) is an evidence-based psychotherapy indicated for a range of psychological disorders. Broadly, CBT aims to decrease the frequency of maladaptive thoughts and behaviors that contribute to distress and impairment. By identifying and modifying the antecedents and consequences of maladaptive behaviors, clinicians and clients work to identify opportunities for new learning and behaviors. Cognitive interventions propose that individuals experiencing emotional distress often hold distorted cognitions or beliefs. Therefore, CBT interventions aim to address and restructure these cognitive biases (Arch & Craske, 2009). CBT has a strong empirical base for the treatment of mood and anxiety disorders, and has demonstrated some efficacy in treating CUD.

Many existing interventions have combined CBT with MI or other treatments, making it difficult to quantify the effects of CBT on CUD. However, three randomized controlled trials (RCT) examined the use of CBT for CUD. While CBTs for CUD appear to reduce cannabis use and problems (Stephens, Roffman & Simpson, 1994; Stephens et al., 2000), and promote abstinence (Copeland, Swift, Roffman & Stephens, 2001), these effects are not superior to other active treatments. Combined MI and CBT treatment appear more effective and have broader empirical support but reported effect sizes are small to moderate (Budney et al., 2007; Sherman & McRae-Clark, 2016).

While many intervention approaches for problematic cannabis use have garnered empirical support, they are not without limitations. As noted, existing treatments have small to moder-
ate effects. Further work is needed to examine factors predicting response to treatments and treatment moderators and mediators. Additionally, many strategies aim to prevent substance use entirely or promote abstinence in current users. While such approaches are valuable especially in younger users, or for cannabis-dependent individuals, many cannabis users are interested neither in formal treatment nor complete abstinence (Van der Pol, 2013; Ellingstad et al., 2006; Gates et al., 2012). Similarly, there is some evidence that many daily users quit or cut down on cannabis use without formal treatment (Swift et al., 2000). As research continues to legitimize cannabis in a medical context and many states opt for recreational and medicinal legalization, intervention priorities may thus need to shift. Similarly, as cannabis use prevalence rates continue to rise, interventions that aim to primarily prevent or eliminate cannabis use or engage users in formal treatment appear incompatible.

**Harm Reduction Approaches**

A somewhat new approach, takes a harm reduction perspective. To date, few studies have directly examined harm reduction approaches for cannabis users. However, there is reason to believe that findings observed with other psychoactive substances may generalize to cannabis users. Broadly, harm reduction strategies aim to reduce the likelihood of problematic outcomes associated with substance use. Thus, unlike strategies that encourage abstinence or aim to prevent initiation of use, these approaches aim to identify and develop approaches that mitigate harms associated with drug use.

Harm reduction can be broadly defined as a set of “policies and programs which attempt primarily to reduce the adverse health, social and economic consequences of mood altering substances to individual drug users, their families, and their communities” (International Harm Re-
duction Association, 2002). Harm reduction approaches have a prolonged history, with some efforts dating back to the suggestion in 1926 that opiate dependence be medically managed (Rolloston Report, 1926). Similarly, drug policy in the 1970s Netherlands considered the pragmatism and utility of strict law enforcement for minor drug offenses. This “balance of harms” approach sought to weigh the risks of drug use against the risks and costs of wide scale drug enforcement, especially as drug use was increasingly apparent across social and economic strata (Roe, 2005).

Harm reduction approaches gained additional traction with the HIV/AIDS epidemic, as public health experts recognized the role of intravenous drug use in transmission risk. This epidemic led to recognition that the threats posed by HIV and AIDS transmission far outweighed the threats posed by drug use alone (Hunt et al., 2003). Broadly, harm reduction approaches create a hierarchy of goals to be pursued, with abstinence from psychoactive substances often at the bottom, if present at all. During the HIV epidemic, the primary goal was to reduce the incidence of shared injecting equipment. Efforts to provide users with clean needles through needle exchange programs followed. Efforts to reduce the incidence of injection drug use, street drug use, prescription drug use and finally increasing abstinence from all drug use were subsequent goals (Hunt et al., 2003).

Harm reduction principles include: 1) Pragmatism, 2) Humanistic values, 3) A focus on harms, 4) Balancing costs and benefits and 5) Prioritization of immediate goals. Pragmatism acknowledges that use of psychoactive substances is a common feature of human experience, and that a focus on drug related harms is more pragmatic than efforts to eliminate drug use entirely. Humanistic aspects of harm reduction recognize the autonomy of drug users and seek to avoid both condemnation of and sweeping support of drug use, instead focusing on the rights and dig-
nity of drug users. Focus on harms implies that the focus of intervention efforts should be related to the harms or consequences associated with drug use, rather than on reducing drug use itself. Balancing costs and benefits emphasizes a need to consider the costs and benefits of interventions and the use of resources on priority issues. Finally, most harm-reduction efforts recognize the practical need for interventions to create a hierarchy of goals based on the most pressing needs and the most meaningful impacts for individuals and society (Hunt, 2003).

Efforts to implement harm reduction models often meet criticism. Critics argue that in providing drug users with safer recommendations for or means of using drugs, harm reduction efforts condone or encourage drug use. However, harm reduction models have been successfully applied with a range of psychoactive substances and health-related behaviors. Among injection drug users, harm reduction strategies focus on increasing the number of clean syringes in circulation while encouraging users to return and safely dispose of used syringes, reducing the chances of viral transmission to other drug users as well as the general public. Such programs not only provide users with means for reducing their risk of transmitting or contracting HIV and Hepatitis C, but also increase access to healthcare, social services and even addiction treatment (Hunt, 2003). A review of 48 studies noted “substantial evidence that syringe exchange programs are effective in preventing HIV risk behavior and HIV sero-conversion among injection drug users” (Gibson, Flynn & Perales, 2001). Similarly, opiate-replacement therapies seek to reduce the injection and abuse of illicit opiates, improve access to health care, and promote psychological and social functioning among opiate-dependent individuals. Medication-assisted treatments began with the advent of methadone and have more recently expanded to include the use of suboxone and naltrexone. Rather than promoting detoxification or abstinence among opiate-depen-
dent individuals, these treatments offer stability and opportunities for engagement in rehabilitation programs, while also reducing the risk of criminal activity, overdose and risky drug use. Meta-analyses of methadone maintenance therapies suggest that such interventions are superior to drug-free alternatives in retaining patients in treatment and reducing heroin use and criminal activity (Mattick, Breen, Kimber, Davoli & Breen, 2003).

Harm reduction strategies for alcohol aim to reduce harmful consequences associated with alcohol use, and provide alternative strategies to zero-tolerance approaches. Though public and institutional support for zero-tolerance approaches prevail, harm reduction strategies for alcohol use have demonstrated efficacy for nearly 40 years (Marlatt & Witkiewitz, 2002). One of the first studies of its kind incorporated a moderate drinking goal as part of an inpatient study for male alcoholics. Results suggested that moderate drinking might be a more viable treatment goal for individuals with a history of alcohol abuse than complete abstinence (Sobell & Sobell, 1973). Advocates for harm reduction suggest that abstinence-based approaches to alcohol abuse take a “one size fits all” approach that may ostracize drinkers not interested in complete abstinence, and further stigmatize individuals who have not had success with twelve-step or zero-tolerance approaches (Marlatt et al., 2002).

Harm reduction approaches for alcohol use appear particularly useful for binge drinking, which tends to peak among adolescents and is associated with other risky behaviors. Adolescents report high rates of alcohol-related problems, and risky behaviors that often result in injury, unplanned or unprotected sex, and driving under the influence (Wechsler, Dowdall, Davenport & Castillo, 1995). Recent applications of harm reduction models for adolescent alcohol use acknowledge that most adolescents and young adults will use alcohol, and propose that encourag-
ing safer alcohol use is more pragmatic than encouraging abstinence (Marlatt et al., 2002).

Harm-reduction interventions demonstrate efficacy in reducing alcohol-related problems and high-risk drinking behaviors in college students (Leslie, 2008; Baer, Kivlahan & Marlatt, 1995; Dimeff et al., 1999).

**Protective Behavioral Strategies**

Protective Behavioral Strategies (PBS) are a harm reduction approach typically applied to risky drinking behaviors. Broadly, PBS provide cognitive and behavioral strategies that individuals can utilize before using, while using or instead of using psychoactive substances to reduce negative consequences and risky outcomes associated with drug use (Martens et al., 2004). PBS use is consistently negatively related to alcohol-related problems (Araas & Adams, 2008; Pearson, 2013; Prince, Carey & Maisto, 2013). This association, demonstrated across fourteen studies, has been observed for heavy drinking in the past 30 days (Pearson, Kite & Henson, 2012), typical drinking quantity (Martens et al., 2005; Pearson et al., 2012), and number of recent heavy drinking episodes (Sugarman & Carey, 2007). PBS for alcohol include avoiding drinking games, use of a designated driver, planned consumption of a specific number of alcoholic beverages, and plans to leave a party or social event at a predetermined time (Martens et al., 2004).

Use of PBS also appears to mediate intervention effects (Barnett et al., 2007; Murphy et al., 2012). Experimental data on the effects of PBS-based interventions for alcohol are somewhat inconsistent. Still some promising results have been observed. Four intervention studies have examined the impact of interventions incorporating PBS for alcohol on alcohol use outcomes. Two studies demonstrated that increased PBS use was associated with reduced alcohol use; with greater increases in PBS following intervention associated with greater improvement
in alcohol use outcomes (Barnett et al., 2007; Larimer et al., 2007). In a longitudinal study of college students (n = 1,488), participants were randomized to receive personalized feedback or assessment only. Participants in the feedback condition received 10 weekly postcards incorporating social norms for alcohol use, information on the effects of excessive alcohol use, and specific protective strategies participants could utilize to reduce risk. Overall, the feedback intervention significantly reduced drinking frequency, with a small effect observed (d = 0.18). Participants in the feedback condition demonstrated increased PBS use, and this increase mediated the relation between personalized feedback and drinking outcomes. Thus, the authors concluded that the impact of the intervention was due in part to increased use of PBS (Larimer et al., 2007).

In a study of college students referred for alcohol education following an alcohol-related incident, participants (n=225) were randomized to receive a brief motivational interviewing (BMI) intervention that incorporated social norms, motivational enhancement, personalized feedback, and specific PBS for alcohol use, or a computerized intervention focusing predominantly on alcohol-related consequences. Follow-up assessments were conducted at 3 and 12-months post-intervention to examine treatment effects. Increased use of PBS following the intervention fully mediated the relation between the BMI intervention and reduced drinking volume (Barnett et al. 2007). Again, this study suggests an important impact of PBS on drinking outcomes.

While these studies provide support for the role of PBS in alcohol-use outcomes among college students, two additional studies failed to find a mediation effect of PBS on drinking outcomes. In a study examining 21st- birthday drinking behaviors, a web-based personalized intervention (compared to an assessment-only control) significantly reduced estimated blood-alcohol
concentration (BAC) with small to moderate effect (d=0.33). In this study, the intervention focused on drinking intentions, BAC information, social norms, and PBS. Authors did not observe an increase in PBS use as a result of the intervention. While findings of this study did not support the role of PBS in intervention effects, the authors note several limitations in operationalization and assessment of PBS use. The authors note that the PBS included in the intervention were not identical to PBS actually measured, complicating interpretation of results. Similarly, estimated BAC is a very subjective measure of alcohol use outcomes. In line with previous research however, the authors did note that greater use of PBS predicted lower estimated BACs on 21st birthdays (Neighbors, Lee, Lewis, Fossos & Walter, 2009). Finally, a dismantling study examining the mechanisms of action in a variety of MI interventions failed to find a mediation effect of PBS in the relation between intervention and drinking outcomes. Importantly, this study did not incorporate any efforts to target PBS, and thus is quite different from previous studies (Walters, Vader Harris, Field & Jouriles, 2009).

In examining these findings, it is important to consider inconsistent operationalization and measurement of alcohol PBS across studies as a source of discrepancy. Across studies, measures of PBS and the degree to which studies explicitly focus on PBS are quite variable. Similarly, sample size, statistical analyses, and study design are quite varied across studies. While the precise role of PBS in interventions targeting adolescent alcohol use remain unclear, some important implications can be drawn from existing data. In the above studies, when participants experienced an increase in PBS across time, PBS use emerges as a significant mediator. This suggests that studies should perhaps seek to increase PBS use over time as a means of bolstering interventions. It is also important to note that all of the existing studies have incorporated PBS into
larger intervention efforts, making it difficult to infer the exact mechanisms of action at place in treatment response. Future studies should seek to replicate observed findings suggesting PBS as a treatment mediator, and should also examine PBS as a primary intervention target. Finally, despite whether PBS use emerged as a significant treatment mediator, PBS use was consistently negatively associated with alcohol-related outcomes in the above studies. This suggests that the theory underlying the role of PBS in reducing alcohol-related outcomes is strong in spite of experimental inconsistencies. Perhaps with more methodological consistency, and replication efforts, more conclusive results will emerge.

**Protective Behavioral Strategies for Cannabis**

With growing evidence that PBS use is associated with fewer alcohol-related consequences in college students, recent efforts have begun to identify and examine PBS in cannabis users. Researchers recently developed a PBS scale for cannabis users (Pedersen, Hummer, Rinker, Traylor & Neighbors, 2016). This scale was developed following a comprehensive review of the young adult cannabis literature and an iterative process among investigators to identify strategies that adolescents could easily observe among themselves, were easy to understand, and appeared likely to be used by cannabis users to reduce risk. In developing this scale, authors assessed PBS that cannabis users rely on before, during, or instead of using cannabis, to reduce heavy use and negative consequences. A 73-item pool was reduced to a 50-item pool using an iterative process whereby investigators individually rated each item from 1 (poor) to 5 (excellent) for fit with pre-specified criteria. The resulting 50-item scale was administered to 636 college students, with analyses focusing on the 210 participants reporting cannabis use in the past six months.
Participants reported cannabis use consequences and completed the PBS scale. Some of the PBS for cannabis (PBSM) included limiting use of cannabis before work or school, avoiding use of cannabis to cope with sadness or depression, limiting cannabis use to weekends, buying less cannabis at one time to reduce quantity of use, and pausing from cannabis use to decrease symptoms of tolerance or dependence. Composite scores on the PBSM scale were significantly negatively associated with cannabis use consequences \( r = -.35 \) and scores on the CUDIT \( r = -.51 \), an assessment of cannabis use disorder. PBSM use was also negatively correlated with frequency of cannabis use \( \text{past month } r = -.50, \text{times per day } r = -.22 \)\. PBSM use was positively correlated with PBS use for alcohol including strategies for limiting or stopping drinking \( r = .22 \), manner of drinking \( r = .27 \), and efforts at reducing harm associated with alcohol use \( r = .28 \). All reported correlations were significant at the \( p < .01 \) level. The PBSM scale demonstrated high internal consistency, and principal component analyses demonstrated a single-factor structure for 39 items that accounted for 34% of variance in use (Pedersen et al., 2016).

In order to further develop and validate the PBSM scale, Pedersen and colleagues administered the scale to a geographically diverse sample \( n = 2,117 \) of college students from eleven states (Pedersen, Huang, Dvorak, Prince & Hummer, 2017). With this administration, the authors sought to further validate and examine the factor structure of the 50-item scale, and to develop a short form that would reduce respondent burden and time. This study utilized exploratory and confirmatory factor analyses (EFA and CFA respectively) and item response theory (IRT) and evaluated differential item functioning (DIF) to assess the initial 50-item scale. Analyses indicated that eight items should be dropped from the 50-item scale due to low factor loading. Another six items were removed due to CFA results that indicated overlapping content wording. Next,
investigators used IRT analyses to calibrate the remaining 36 items and results suggested that items were strongly related to the underlying latent construct that defines PBSM with high marginal reliability (0.97). DIF analyses suggested that 19 items exhibited at least one kind of DIF, resulting in a 17-item short form of the PBSM scale. IRT analyses calibrated the 17-item short form and again suggested high marginal reliability (0.93) and a good fit for the data (RMSEA = 0.04). Similarly, correlation between the 17-item and 36-item version was high ($r = 0.98$, $p < .001$). As with previous analyses, the 36-item and 17-item PBSM scales were significantly negatively correlated with cannabis use frequency, and cannabis-associated problems. Results from this follow-up analyses led authors to suggest future use of the PBSM-36 or the PBSM-17 as opposed to the previously investigated 39-item scale. Results from this study provide a strong methodological base for future investigations of PBSM (Pedersen et al., 2017).

Expanding on these findings, a 2017 study examined the role of PBSM in moderating the effects of risk and protective factors on cannabis use outcomes (Bravo, Anthenien, Prince, & Pearson, 2017). Risk and protective factors included impulsivity, cannabis use motives, gender, and cannabis use frequency. Consistent with previous research, impulsivity was conceptualized as a risk factor for cannabis use frequency and negative cannabis use outcomes. Cannabis motives appear to differentially predict cannabis outcomes. Motives of enhancement, expansion, and social performance are consistently associated with cannabis use while some research indicates no link or a negative association between coping and conformity motives in predicting cannabis use (Bonn-Miller & Zvolensky, 2009, Zvolensky et al., 2007; Bonn-Miller et al., 2007). Authors expected that PBSM would buffer the effects of risk factors on cannabis use outcomes. College students ($n=2,093$) currently using cannabis completed the study.
As hypothesized, risk factors were associated with higher levels of cannabis use and cannabis-associated problems. PBSM use was negatively associated with cannabis use frequency ($r = -.48$) and cannabis-associated consequences ($r = -.40$). High PBSM use and low cannabis use frequency was associated with the fewest negative consequences while combined low PBSM use and high cannabis use frequency was associated with the most negative outcomes. Risk for negative cannabis outcomes was amplified among individuals high on sensation seeking and low on PBSM use, suggesting a unique role of PBSM among those high in sensation seeking. Males who endorsed coping motives and an average level of PBSM demonstrated higher cannabis use frequency and cannabis-related consequences. Together, this study provides evidence that promoting PBSM among college students may be an effective harm reduction strategy, and that PBSM use appears protective in the development of cannabis-associated problems. This is particularly true in males using cannabis to cope, and those with high levels of sensation seeking (Bravo et al., 2017).

Identifying and measuring PBSM is a developing field. To date only one intervention has assessed the role of PBSM for reducing cannabis-related problems. In this study, 298 college students were randomized to receive a web-based intervention called “Marijuana eCheckuptogo” or a web-based stress management intervention. The experimental condition focused on correcting normative perceptions of cannabis use, measuring PBSM use, and encouraging participants to practice PBSM as a means of reducing problematic use. Participants in the control condition received information on healthy stress management strategies. Participants in both groups were asked to respond to follow up measures of cannabis use, PBSM use, and cannabis use norms 6-weeks following baseline.
At follow-up, participants in the experimental group reported lower perceived use prevalence, and less frequent monthly and weekly cannabis use compared with participants in the control condition. Interestingly, the experimental condition only resulted in increased PBSM use for females. Finally, the experimental condition was not associated with decreases in self-reported cannabis-associated problems. The authors propose that the observed decreases from heavy to somewhat-less-heavy cannabis use observed in the experimental condition, was not a sufficient decrease to impact cannabis-associated consequences. It is also possible, that longer-term follow-up would be necessary to detect decrements in cannabis-associated problems. Paired with more preliminary findings, this study offers support for the role of PBSM in buffering risk factors for problematic cannabis use. This study is not without limitations however. First, this study incorporated a list of PBSM into an existing personalized feedback intervention, making it difficult to determine the isolated effect of PBSM implementation on cannabis use frequency and cannabis-associated problems. Further, the study did not elaborate on ways to practice PBSM for the experimental condition. Rather, participants in the experimental condition were simply presented with a list of PBSM and instructed that these strategies may help to reduce problematic cannabis use. More work is needed to determine whether these findings can be extended to increase PBSM use over time in both male and female cannabis users, and whether a more targeted PBSM intervention may provide more robust effects. Based on previous findings, further work should also incorporate PBSM into interventions targeting adolescent cannabis users. Integration of PBSM into interventions targeting impulsivity may be particularly useful given an observed protective role of PBSM for individuals with elevated levels of sensation seeking (Bravo et al., 2017). Strategies incorporating PBSM to reduce cannabis-associated problems appear somewhat
easy to implement, and could likely be implemented in group settings, increasing cost-effectiveness and access to a diverse sample.

Though harm reduction efforts to reduce problematic cannabis use outcomes remain understudied, important implications can be drawn from previous findings. PBS approaches have demonstrated efficacy in reducing alcohol-related problems in adolescents. Preliminary findings suggest that PBS for cannabis are important predictors of problematic cannabis use, implying the utility of PBS interventions. Cannabis use and cannabis use disorder peak among college students (Caldeira et al., 2015). Harm reduction strategies may be particularly useful given this trend as well as current social and legal trends. As attitudes and legislation towards recreational and medical cannabis continue to shift, prevalence rates for cannabis may continue to increase. While there are clear risks of early, chronic and heavy cannabis use, the most practical and effective approaches for cannabis users may include strategies that aim to reduce problematic outcomes, rather than those targeting complete abstinence.

**The Current Study**

The current study examines the implementation of a brief harm-reduction intervention for cannabis users. This intervention incorporated PBSM as outlined by the PBSM scale developed by Pedersen and colleagues (2017). The current study examined the impact of a web-based PBSM intervention on PBSM use, cannabis-associated problems, and frequency of cannabis use at 1-month follow up. These measures were compared to a control group, in which individuals viewed a presentation outlining stress and coping strategies. The hypotheses of the present study were as follows:
1) Treatment condition (experimental vs. control) will have a significant impact on PBSM use, CAPS score and frequency of cannabis use at one month follow up. Specifically, we expect participants in the experimental condition to demonstrate increased PBSM use, decreased CAPS scores and decreased cannabis use frequency at 1-month follow up compared to the control group.

2) PBSM use will increase in the experimental group from baseline to follow up. Frequency of cannabis use and cannabis-associated problems will decrease in the experimental group from baseline to follow up.

3) Baseline and follow-up PBSM use will be associated with lower levels of cannabis-associated problems across treatment groups.

**Chapter 3: Methods**

Two distinct samples of participants were recruited for the current study: one sample of community cannabis users and a second sample of college-student cannabis users. The sample of community participants was recruited from Craigslist, Facebook, and Reddit. Community participants had the option to enter a raffle for a $10 amazon gift card following completion of the 1-month follow-up survey. The sample of college students was comprised of undergraduate students from the University at Albany research pool who received course credit for completing the experiment. Participants were excluded if they were under the age of 18, or not proficient in English. Prior to study procedures, all materials were submitted to and approved by the University at Albany Institutional Review Board.

**Procedure**
Following informed consent, participants were directed to a baseline survey. This first set of measures included questionnaires regarding demographics, past and current cannabis use, cannabis-associated problems, and baseline use of PBSM. Immediately after baseline measures, participants were randomized to the experimental intervention or a control intervention (explained in further detail below). At 1-month follow up, participants completed an additional set of measures. A description of each phase of the current study follows.

**Baseline Measures**

**Demographics**: Demographic data included age, level of education, sex/gender, race/ethnicity, and employment status.

**Cannabis use**: After completing demographic information, participants were asked to report on cannabis use. Cannabis consumption was assessed using the Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU; Cutler & Spradlin, 2017). The DFAQ-CU is the first psychometrically sound inventory for measuring frequency, onset, and quantity of cannabis use. This scale contains images of cannabis to facilitate the measurement of quantity used, as well as questions measuring route of administration, and form of cannabis used. This scale also measures typical THC levels. The DFAQ-CU has a six-factor structure measuring: daily use sessions, frequency of use, age of onset, and quantity of cannabis, cannabis concentrate and edible use. The factors demonstrate moderate to high reliability, with cronbach’s alpha coefficients ranging from .69 (daily sessions) to .95 (frequency of use). Factors have demonstrated convergent validity (MSHQ and Timeline Follow-back), predictive validity (CAST, CUDIT-R, CUPIT), and discriminant validity (AUDIT) (Cutler et al., 2017).
**Cannabis Associated Problems:** The Cannabis-Associated Problems Scale (CAPS) is a 19-item self-report assessment of the negative effects of cannabis on social relationships, self-esteem, motivation and productivity, work and finances, physical health, symptoms of withdrawal, blackouts, and legal problems (Lavender, Looby & Earleywine, 2008). Individuals were asked to rate their experience of each problem on a Likert scale from “no (0)” to “yes, very many times or a very serious problem (5)”. The Scale can be found in its entirety in the appendix. Cronbach’s alpha coefficients were high for both baseline (r = .979) and 1-month follow up administrations (r = .982).

**PBSM Use:** Baseline PBSM use was measured using the 17-item PBSM scale (Pedersen et al., 2017). Participants were instructed to rate the degree to which they engage in 17 protective behaviors while using cannabis. Answers range from 1 (never) to 6 (always). The PBSM-17 demonstrates high internal consistency (Cronbach’s alpha= .92), and as discussed, its psychometric properties have been tested rigorously. This scale can be found in its entirety in the appendix. Internal Consistency was high for both administrations of the PBSM-17, with cronbach’s alphas of .93 at baseline and .94 1-month follow-up.

**Intervention**

**Experimental Group:** Upon completion of baseline measures, participants randomized to the experimental group were instructed to watch a narrated video presentation (developed for this study) outlining the 17-items included in Pedersen and colleagues’ (2017) PBSM short-form scale. The 17-items included in the PBSM match closely with identified risk factors and frequently reported cannabis-associated problems. In particular, strategies were outlined that dis-
couraged daily use, use with family, use that may interfere with important obligations, use for the purpose of coping with underlying emotional difficulties, and use in high quantities or high potency. As discussed above, these patterns of use are associated with increased risk for cannabis problems, and capture commonly reported cannabis problems. In addition, the intervention provided strategies for reducing the risk of tolerance and encouraged users to more thoughtfully plan use episodes. Following the presentation, participants were presented with short vignettes and asked to consider how each hypothetical individual may effectively reduce the risks of cannabis use by implementing PBSM. After viewing this presentation, participants were asked to verify that they could adequately see and hear the presentation. Three comprehension questions were included to assess understanding of the presentation. Participants were then asked to rate the extent to which they perceived the outlined strategies as effective, and to select three strategies to use within the next month.

**Control Group:** Upon completing baseline measures, individuals in the control group were instructed to watch a narrated video presentation broadly discussing stress, and effective coping strategies. The presentation briefly defined stress, and then outlined several cognitive and behavioral strategies for coping with stress in an adaptive way. Again, participants in the control group were asked to verify that they could see and hear the presentation, asked three comprehension questions, and instructed to select three coping strategies to use within the next month.

**Follow-Up Measures**

Follow-up measures were much the same as baseline measures including the DFAQ-CU and CAPS. Follow-up measures also included a slightly modified version of the PBSM-17 as-
sessing past-month use of PBSM. This scale was identical to the PBSM-17 administered at baseline, but asked: “In the past month, how often have you engaged in the following behaviors while using marijuana/cannabis?” Participants also had an opportunity to provide qualitative information about the strategies used, barriers to using the strategies, and to describe other protective strategies they may have used.

**Statistical Analyses**

All data were analyzed using SPSS software, version 24. Below are hypotheses, with proposed methods for analyzing each. Prior to analyses, data were examined for violations of normality, homoscedasticity and multicollinearity. Data transformations were utilized in the case of variables that violated assumptions of normality. Again, study hypotheses were:

1. Treatment condition (experimental vs. control) will have a significant impact on PBSM use, CAPS score and frequency of cannabis use at one month follow up. Specifically, we expect participants in the experimental condition to demonstrate increased PBSM use, decreased CAPS scores and decreased cannabis use frequency at 1-month follow up compared to the control group.

2. PBSM use will increase in the experimental group from baseline to follow up. Frequency of cannabis use and cannabis-associated problems will decrease in the experimental group from baseline to follow up.

3. Baseline and follow-up PBSM use will be associated with lower levels of cannabis-associated problems, and less frequent cannabis use across treatment groups.

To test hypotheses 1 we conducted a two-way between subjects multivariate analysis of variance (MANOVA) on three dependent variables: PBSM use, CAPS scores, and frequency of
cannabis use. Treatment condition was entered as the independent variable. Data were first examined for univariate and multivariate outliers using standardized z scores on each dependent variable (univariate) and Mahalanobis distance (multivariate). Skewness statistics were examined for each dependent variable prior to analyses. Scatterplots were used to examine linearity. Bivariate correlations were used to assess multicollinearity among dependent variables. Existing literature suggests a moderate negative correlation between PBS and cannabis-associated problems (Bravo et al. 2017, Riggs et al., 2018). As suggested by Tabachnik & Fidell (2007), MANOVA works best with moderately negatively correlated dependent variables.

To test hypothesis 2, a paired samples t-test was conducted to examine change in PBSM over time for both the experimental and control groups.

To test hypothesis 3, bivariate correlations examined associations between baseline and follow-up PBSM use, cannabis use quantity and frequency, and cannabis-associated problems.

**Power Analysis**

G*Power 3.1 was used to compute necessary sample size for each treatment group and to ensure adequate power in detecting between-group differences (Faul, Erdfelder, Buchner & Lang, 2009). Existing data suggests that harm-reduction based interventions for alcohol use reduce alcohol-related consequences with observed effect size between Cohen’s d = .18 and Cohen’s d = .33 (Larimer et al., 2007; Neighbors et al., 2009). Similarly, interventions targeting problematic cannabis use demonstrate somewhat variable effects, with meta-analyses suggesting small to moderate effects (d = 0.2 - 0.5; Lundahl et al. 2010, Vaughn et al., 2004). With established cut-offs for type I and type II error (a=.05, B=.20) the a priori required sample size to compute mean differences between two independent groups with an effect size of d = .3 is n =
140, or 70 participants in each group. We aimed to recruit participants above this number to account for attrition.

**Chapter 4: Results**

Six-hundred and twenty participants provided consent and completed part 1 of the survey. Twelve participants indicated that they did not wish to provide consent for participation, and were therefore redirected to the end of the survey. Four-hundred and ten participants completed the 1-month follow-up questionnaire, and 210 participants did not complete the 1-month follow-up questionnaire. Data were analyzed to examine differences between participants who completed part two of the survey and those who did not. As indicated in table 1, completers and non-completers did not differ with regard to gender, age, race, level of education, frequency of cannabis use, or PBSM use. However, completers were significantly older than non-completers, and reported a higher level of cannabis-associated problems at baseline compared to non-completers.

Participants were on average 25.34 years old (SD= 8.87, range = 17-70) and 57% of the sample identified as female (43% male). With regard to education, about one-third of the sample reported “some college” or an associate’s or bachelor's degree. Approximately 25% of the sample reported a GED or high school equivalent. Full demographic data can be found in Table 2. No differences were observed between the treatment and control groups with regard to age, gender, education or race/ethnicity.

At baseline, participants reported using cannabis an average of 3.55 days per week (SD= 2.47), and 12.01 days per month (SD = 11.53), and reported that they first began using cannabis at an average age of 18.43 (SD = 4.41). In further examining cannabis use frequency at baseline,
18.2% of participants reported using cannabis 2-3 times per month, 20.2% of participants reported using cannabis 1-4 times per week, 4.1% reported using cannabis 5-6 times per week, 5.8% reported using one time per day, and 10.4% reported using more than one time per day. Further, 35.3% of participants reported using cannabis on both weekdays and weekends. No baseline differences were observed between the experimental and control groups with regard to cannabis use. At 1-month follow up, participants reported using cannabis an average of 2.94 days per week (SD = 1.74), ad 8.97 days per month (SD = 9.09). Baseline and follow-up statistics for frequency of cannabis use can be found in table 3.

To test hypothesis one, we conducted a 2-way (experimental condition, control condition) between subjects MANOVA on three dependent variables at 1-month follow-up: Protective Behavioral Strategy use (PBSM), Cannabis-associated Problems (CAPS), and Frequency of cannabis use per month (DPM). There were no univariate outliers as evidenced by examining standardized z scores on each dependent variable. There were eight multivariate outliers identified using Mahalanobis distance. These cases were removed from further analysis. Of the 410 participants who responded to baseline and follow up measures, 169 had no missing data and were thus included in the MANOVA model. Though this is a significant reduction in sample size, a sample of 169 is still above the necessary sample size of 140 indicated by the a priori power analysis. Participants with no missing data (n=169) endorsed a significantly higher level of cannabis-associated problems (t = 11.91, p < .000), and were significantly older (t = 12.14, p < .000) than participants with missing data. However, participants without missing data did not differ from those with missing data with regard to PBSM use, cannabis use frequency, race, or level of education. In examining frequency histograms for each dependent variable, as well as esti-
mates of skewness and kurtosis, PBSM, CAPS, and DPM all appear notably skewed. Square root and log transformations were applied to all three dependent variables prior to MANOVA analysis, resulting in acceptable skew. Linearity was assessed using bivariate scatterplots, which did not appear to reveal non-linear relationships. Bivariate correlations were moderate, suggesting that the multicollinearity was not present among dependent variables. The maximum correlation between dependent variables was .45. Assumptions were also met with regard to homogeneity of variance-covariance (Box’s M = 5.42, p = .51). Based on this information we proceeded with a preliminary Roy-Bargman stepdown analysis. This analysis prioritized dependent variables (PBSM use, then CAPS, then DPM) to test the homogeneity of regression assumption for each DV.

Our primary MANOVA Model included main effects of PBSM, CAPS, and DPW and their interaction terms. We used the sequential adjustment for nonorthogonality of the dependent variables. We also requested stepdown $F$ tests. Using a more conservative approach, Pillais criterion was used to interpret omnibus tests. The omnibus test for the interaction effect on the combination of the DVs was not statistically significant ($F= 1.31, p =.27; \text{partial } \eta^2 = .02$). Full results for omnibus MANOVA appear in Table 4. Univariate $F$ and stepdown $F$ tests for condition were non-significant. Stepdown $F$ tests are reported in Table 5. Combined, findings suggest that treatment condition did not significantly predict scores on measures of PBSM, CAPS, or DPW. Therefore, hypothesis 1 was not supported.

To test hypothesis two, paired sample t-tests examined whether participants in the experimental group reported a significant increase in PBSM use between baseline and follow up. As predicted, participants in the experimental group reported a significant increase in PBSM use be-
tween baseline and follow up (t = -4.13, p < .000; Cohen’s d = .47). However, contrary to our expectations, the control group also reported a significant increase in PBSM use between baseline and follow up (t = -3.06, p < .000; Cohen’s d = .37). Similarly, participants in the experimental group reported a significant decrease in cannabis use frequency (t = 4.46, p < .000; Cohen’s d = .38). Again, participants in the control group also reported a significant decrease in cannabis use frequency (t = 6.0, p < .000; Cohen’s d = .44). Neither the experimental nor control group reported a significant change in cannabis-associated problems between baseline and follow up.

To test hypothesis 3, bivariate correlations provided associations among dependent variables. At baseline, PBSM use was significantly (p < .000) negatively associated with cannabis associated problems (r = -.12), monthly cannabis use (r = -.37), weekly cannabis use (r = -.35), grams of cannabis used each use session (r = -.34), and grams of cannabis used each week (r = -.40). At 1-month follow up, PBSM use was negatively associated with cannabis associated problems, but this association was non significant (r = -.07, p > .05). Similarly, PBSM use at follow up was no longer significantly associated with weekly cannabis use (r = -.10, p > .05) or grams of cannabis used each session (r = -.10, p > .05). However, at follow up, PBSM use was significantly associated with monthly cannabis use (r = -.16, p < .01) and grams of cannabis used each week (r= -.18, p < .01). As expected, cannabis-associated problems were positively correlated with measures of cannabis use frequency and quantity at both baseline and follow up. See tables 6 and 7 for correlations.

**Chapter 5: Discussion**

The purpose of the present study was to test whether a brief web-based intervention
highlighting PBSM could successfully increase PBSM use, decrease cannabis-associated problems, and decrease cannabis use frequency. After completing baseline measures, participants in the present study were randomized to the experimental condition, which included a narrated video presentation outlining 17 PBSM and encouraging adoption of three strategies in the next month, or to a control condition which included a narrated video presentation on stress and coping strategies. Contrary to our hypotheses, treatment condition did not significantly impact PBSM use, cannabis-associated problems, or cannabis use frequency. Interestingly, though there were no significant effects of treatment condition on these outcomes, participants in both the experimental and control group endorsed greater PBSM use, and reduced monthly cannabis use between baseline and follow up. This finding suggests that exposure to the PBSM scale alone (as occurred across treatment conditions), may have contributed to increased PBSM and decreased cannabis use. PBSM use at baseline was also significantly negatively associated with cannabis associated problems, and cannabis use frequency and quantity. However, somewhat surprisingly, the association between PBSM use and cannabis-associated problems was not significant at 1 month follow up. Still, PBSM use was significantly negatively associated with monthly cannabis use and quantity of weekly cannabis use at follow up.

A small but growing body of literature suggests that PBSM use is negatively associated with cannabis use frequency, quantity, and cannabis-associated problems (Pedersen et al.; 2016, Pedersen et al., 2017; Bravo et al., 2017; Riggs et al., 2018). Similarly, previous work suggests that PBSM appears to buffer the relation between risky patterns of cannabis use and cannabis-associated problems (Bravo et al., 2017). To date, only one longitudinal study encouraged adoption of PBSM in a sample of cannabis users. However, this study combined PBSM into a person-
alized feedback intervention, and simply presented participants with a list of PBSM to encourage use (Riggs et al., 2018).

To our knowledge, in spite of theoretical support, no intervention studies have examined the impact of an intervention directly encouraging PBSM use on adoption of PBSM, cannabis use frequency, or cannabis-associated problems. Therefore, the present study examined whether an intervention aimed at providing information on PBSM and encouraging adoption of these strategies would significantly increase PBSM use, decrease cannabis use frequency, and decrease cannabis-associated problems compared with a control condition. In addition to providing a list of PBSM, participants in the experimental group were presented with a narrated video presentation describing each strategy, two vignettes describing successful application of these strategies with two fictional individuals, and explicit instruction to commit to using at least three of the outlined strategies in the following month. Participants in the control condition were presented with a narrated presentation outlining stress and adaptive coping. Details of each hypothesis appear below.

**Hypothesis 1**

We hypothesized that treatment condition would significantly impact PBSM use, cannabis-associated problems, and frequency of cannabis use. Specifically, we expected participants in the experimental group to report greater PBSM use, decreased cannabis-associated problems, and decreased cannabis use frequency at one-month follow up. Results did not provide support for the first hypothesis. Treatment condition did not significantly impact PBSM use,
cannabis-associated problems, or cannabis use frequency at 1-month follow up. The main effect of treatment condition on the linear combination of dependent variables was not significant. Similarly, univariate examinations of the direct effect of treatment condition on each dependent variable were nonsignificant.

**Hypothesis 2**

We hypothesized that participants in the experimental condition would demonstrate a significant increase in PBSM and a decrease in cannabis use frequency and cannabis-associated problems between baseline and one-month follow up. Paired sample t-tests provided partial support for this hypothesis. Participants in the experimental group did report a significant increase in PBSM use, and a significant decrease in monthly cannabis use. However, participants in the experimental group did not report a significant change in cannabis-associated problems between baseline and follow up. Unexpectedly, participants in the control group also reported a significant increase in PBSM use, a significant decrease in cannabis use frequency between baseline and follow up. Neither the experimental nor control group reported a significant change in cannabis-associated problems between baseline and follow up.

**Hypothesis 3**

We hypothesized that, building on previous research, PBSM use would be negatively associated with cannabis-associated problems overall (regardless of intervention condition or time point). Similarly, we expected PBSM use to be negatively associated with frequency of cannabis use and we expected frequency and quantity of cannabis use to be positively associated with cannabis-associated problems. We found partial support for these hypotheses. That is, at baseline
and follow-up, cannabis-associated problems were significantly positively associated with frequency and quantity of cannabis use. Similarly, at baseline, CAPS and PBSM were significantly negatively correlated. However, at follow up CAPS and PBSM demonstrated a negative but non-significant association. Finally, at baseline, PBSM use was significantly, negatively correlated with all cannabis use variables. However, at one-month follow up, PBSM was only significantly correlated with monthly cannabis use, and grams of cannabis used each week.

**Interpretation of Null Findings**

Though the number of explanations for null findings is potentially infinite, several explanations appear theoretically sound. First, it is possible that though our sample size exceeded the sample size calculated in the a priori power analysis, the present study was underpowered. 410 participants completed parts 1 and 2 of the survey. However, due to the limitations of MANOVA, only 169 participants without missing data were included in the MANOVA model. Comparisons of participants with and without missing data suggests that participants included in the MANOVA endorsed a higher level of cannabis-associated problems, and were older on average compared to participants with missing data. Therefore, it appears possible that listwise deletion inherent in MANOVA contributed to null findings by disproportionately excluding younger participants, and participants with a higher level of cannabis-associated problems. It is possible that a sample inclusive of younger participants and participants with a lower level of cannabis-associated problems may have produced different effects. Theoretically, younger individuals, and those with less problematic cannabis use may have been more responsive to the effects of the current intervention, as cannabis-use patterns may be less ingrained or more malleable. In examining results with regard to hypotheses 2 and 3, it appears possible that exposure to the list of PBSM
alone may have encouraged adoption of these strategies in both the experimental and control group. Such a process has been proposed by previous research with alcohol, whereby exposure to a list of PBS for alcohol was paired with personalized feedback, and exposure to these strategies alone appeared to mediate reductions in alcohol use (Murphy et al., 2012). Similarly, in the only published intervention targeting PBSM, incorporation of PBSM into a personalized feedback intervention simply instructed participants to review the PBSM-17 scale while being instructed to use these strategies in the next 6 weeks (Riggs et al., 2018). Therefore, it does appear possible that participants in both groups adopted these strategies with or without direct instruction to do so, and regardless of the narrated video presentation that followed. While the intervention condition did appear to significantly increase PBSM use, a simultaneous increase in PBSM use in the control condition likely contributed to null findings in MANOVA. Similarly, participants in both the experimental and control groups reported a significant decrease in monthly cannabis use between baseline and follow up. Interestingly, across both groups, there were no significant differences reported with regard to cannabis-associated problems.

Though somewhat less probable, it is also possible that perhaps the control condition presentation was not neutral enough. That is, in providing information on adaptive coping strategies, perhaps participants in the control condition were less likely to use cannabis to cope with emotional distress or other stressors. It is also possible that the present findings represent regression to the mean, rather than an intervention effect. Previous work also suggests that measurement alone may contribute to alterations in behavior. Thus, it is possible that the current findings represent reactivity to measurement of cannabis use and PBSM use, rather than an effect of the PBSM scale. Finally, it is also possible that in spite of efforts to mask the purpose of the present
study, demand characteristics contributed to an over-reporting of PBSM use and an under-reporting of CAPS by participants in both groups at follow-up. Similarly social desirability biases may have contributed to over-reporting of PBSM use and under-reporting of CAPS.

In spite of non-significant findings for hypothesis 1, we did find partial support for hypothesis 2. It is notable that the experimental condition did appear to increase PBSM use over time. The present study included a brief and cost-effective intervention that would be relatively easy to disseminate if replicated. The increased PBSM use observed in the control condition also provides some preliminary evidence that exposure to the PBSM-17 scale alone, appears to yield a similar result to the active control condition. If replicated, this finding could contribute to an even briefer intervention for cannabis users interested in harm reduction strategies.

Finally, though we only found partial support for hypothesis 3, PBSM use at baseline was significantly negatively associated with monthly cannabis use, weekly cannabis use, grams of cannabis used per session, grams of cannabis used per week, and cannabis-associated problems. Correlations ranged from small to moderate (r = -.34 to -.40). Still, this finding provides additional support for the buffering effect of PBSM, and offers additional evidence that pursuit of these strategies may be particularly worthwhile in reducing risky cannabis use. The negative association between PBSM use and cannabis-associated problems was somewhat weaker, suggesting that perhaps PBSM use does not adequately capture facets of problematic cannabis use beyond frequency and quantity of use. However, given the link between heavy, frequent cannabis use and the development of cannabis-associated problems (Volkow et al., 2014), interventions that can increase PBSM use and decrease frequency and quantity of use appear quite valuable.

Limitations
Although the present-study provided some support for a brief, web-based PBSM oriented intervention, it is not without limitations. The present study was fully online. There is some research to suggest that internet-based research is beneficial in providing a sense of convenience, anonymity, and perhaps even encouraging more honest responding (Teitcher et al., 2015). However, there are limitations inherent in online research. First, in-person research provides a greater degree of control of the environmental stimuli present during survey completion. While the present study instructed participants to complete the survey in a private, quiet location, and ensure that they could adequately see and hear the video presentations, there is no way to guarantee that participants viewed the survey under optimal conditions. It is therefore not possible to measure the impact of environmental stimuli on comprehension of survey materials and instructions. Similarly, access to the Internet and comfort or familiarity with online surveys may have impacted the ethnic, racial and age demographics of the present sample. Though there was a wide age range in the present sample, the mean age was 25.34. This suggests that the present findings may not generalize to older cannabis users, who may feel less compelled to participate in research, or who may exhibit different patterns of cannabis use.

Another limitation of the present study lies in the fact that participants in both the experimental and control groups were exposed to the PBSM-17 scale at baseline. While this decision was made in an effort to measure change over time, it appears possible that exposure to the scale contributed to some degree of reactivity in the control group, which may account for the significant increase in PBSM use and decrease in cannabis-associated problems observed in the control group. It may have been beneficial to only administer the PBSM-17 to the control group at 1-month follow up. However, given how limited intervention work with the PBSM-17 is, there was
little reason to expect that exposure to the scale alone would encourage adoption of these strategies, and it appeared worthwhile to gather a baseline measure of PBSM use across conditions. Future work should seek to replicate the present findings, and further examine the degree to which exposure to the PBSM-17 scale alone encourages adoption of these strategies and potentially, reduction in cannabis use and associated problems.

Unfortunately, it is also not possible to measure whether the observed increases in PBSM use across treatment conditions represents regression to the mean, or reactivity to measurement. That is, it appears possible that participation in the survey, which asked participants to quantify their cannabis use, PBSM use and cannabis-associated problems, contributed to reductions in use, and increases in PBSM use. There is research to suggest that tracking of problematic behaviors alone may contribute to reductions in that behavior (Hayes & Cavior, 1977; Nelson & Hayes, 1980). Therefore, it is possible that increased awareness of frequency and quantity of cannabis use, contributed to reductions in these variables over time.

Another limitation lies in the fact that participants in both treatment conditions endorsed a relatively low level of cannabis-associated problems. This somewhat restricted range limits generalizability of the present findings to cannabis users with low levels of cannabis-associated problems. Further work is needed to examine whether the present findings replicate in samples with higher levels of cannabis-associated problems.

**Future Directions**

In examining the limitations of the present survey, there are several future directions to consider. First, as discussed above, the present study appears to suggest that exposure to the PBSM-17 alone may contribute to adoption of these strategies over time. If further
work provides support for this finding, an even briefer, easy to disseminate intervention encouraging PBSM adoption may result. Further work should also measure the impact of PBSM-based interventions on PBSM use, cannabis-use and cannabis-associated problems during a longer follow up period. Studies that include objective measures of cannabis use, as well as a more controlled study environment also appear warranted. The present survey also did not include measures of social desirability, or an objective measure of cannabis use. Therefore, the findings are limited by self-report biases. Further work should also examine whether the present findings remain beyond 1-month follow up, and whether the observed increases in PBSM use actually contribute to reductions in cannabis-associated problems over time. Previous work suggests that cannabis-associated problems may be less responsive to short-term PBSM interventions, as the modest reductions in quantity or frequency of use do not immediately translate into reductions in cannabis-associated problems (Riggs et al., 2018).

In spite of these limitations, the present study offers a novel examination of a brief, web-based PBSM intervention for cannabis use. It offers additional support for the buffering effect of PBSM on the development of heavy, frequent cannabis use, and cannabis-associated problems. If replicated, the present findings may also provide rationale for a cost-effective, easy to disseminate harm-reduction intervention for cannabis users interested in preventing the development of problematic use patterns.
References


Table 1

Demographic Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Completers (n= 410)</th>
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<th>Non Completers (n=210)</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>53%</td>
<td></td>
<td>48%</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>12%</td>
<td></td>
<td>13.8%</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>17%</td>
<td></td>
<td>6.2%</td>
<td></td>
</tr>
<tr>
<td>Mixed Race</td>
<td>9.5%</td>
<td></td>
<td>11.4%</td>
<td></td>
</tr>
<tr>
<td>American Indian</td>
<td>.7%</td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Native Hawaiian</td>
<td>.2%</td>
<td></td>
<td>1%</td>
<td></td>
</tr>
</tbody>
</table>
Indicates a significant difference at p < .01. CAPS: Cannabis-Associated Problems (Range = 1 – 5). PBSM use: Protective Behavioral Strategies for Marijuana (Range = 1 – 6). DPM: number of days using cannabis in the past month (Range = 1 – 31). DPW: number of days using cannabis in the past month (Range = 1 – 7).

**Table 2**

*Demographic Characteristics*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental (n=179) M (SD)</th>
<th>Control (n=200) M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>25.25 (8.33)</td>
<td>26.60 (10.83)</td>
</tr>
<tr>
<td>Gender</td>
<td>58% female</td>
<td>54% female</td>
</tr>
<tr>
<td>Race</td>
<td>White</td>
<td>Black</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td>54%</td>
<td>10.6%</td>
</tr>
<tr>
<td></td>
<td>52%</td>
<td>13.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Some College</th>
<th>HS / GED</th>
<th>Bachelor’s</th>
<th>Associate’s</th>
<th>Master’s</th>
<th>Doctorate</th>
<th>Less than HS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33.8%</td>
<td>22.2%</td>
<td>19.7%</td>
<td>8.1%</td>
<td>8.1%</td>
<td>5.6%</td>
<td>1.3%</td>
</tr>
<tr>
<td></td>
<td>29.6%</td>
<td>24.0%</td>
<td>19.6%</td>
<td>11.7%</td>
<td>6.7%</td>
<td>6.7%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

**Table 3**

*Means, Standard Deviations for Dependent Variables*
* indicates significant within-group differences at p < .01. CAPS: Cannabis-Associated Problems (Range = 1 – 5). PBSM use: Protective Behavioral Strategies for Marijuana (Range = 1 – 6).

DPM: number of days using cannabis in the past month (Range = 1 – 31). DPW: number of days using cannabis in the past month (Range = 1 – 7).

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DPW</td>
<td>3.43 (2.36)</td>
<td>2.76 (1.79)*</td>
<td>3.90 (2.55)</td>
</tr>
<tr>
<td>DPM</td>
<td>11.79 (11.00)</td>
<td>8.85 (8.90)*</td>
<td>13.73 (12.10)</td>
</tr>
<tr>
<td>PBSM</td>
<td>4.19 (1.01)</td>
<td>4.26 (.94)*</td>
<td>4.10 (1.05)</td>
</tr>
<tr>
<td>CAPS</td>
<td>2.17 (1.40)</td>
<td>2.25 (1.39)</td>
<td>2.16 (1.36)</td>
</tr>
</tbody>
</table>

Table 4

Omnibus MANOVA results (Combination of PBSM use, CAPS, and DPW)

<table>
<thead>
<tr>
<th>IV</th>
<th>Pillais</th>
<th>F</th>
<th>df</th>
<th>p</th>
<th>η[^2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>.02</td>
<td>1.31</td>
<td>3.00</td>
<td>.274</td>
<td>.02</td>
</tr>
</tbody>
</table>

Table 5

Results from Standard Univariate and Stepdown Tests

<table>
<thead>
<tr>
<th>IV</th>
<th>DV</th>
<th>Univariate F</th>
<th>df</th>
<th>p</th>
<th>Stepdown F</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
</table>

DPM: number of days using cannabis in the past month.

Table 6

Baseline Correlations

<table>
<thead>
<tr>
<th>Condition</th>
<th>PBSM 1</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPS</td>
<td>.01</td>
<td></td>
<td>.92</td>
<td>.01</td>
<td>.92</td>
</tr>
<tr>
<td>DPM</td>
<td>3.73</td>
<td>1, 167</td>
<td>.06</td>
<td>3.71</td>
<td>1, 166</td>
</tr>
<tr>
<td></td>
<td>.35</td>
<td>1, 167</td>
<td>.56</td>
<td>.22</td>
<td>1, 165</td>
</tr>
</tbody>
</table>


DPM: number of days using cannabis in the past month.

Table 7

Correlations at 1-month follow up

1. CAPS
2. PBSM -.12 *
3. DPW .35 * -.40*
4. DPM .37 * -.36* .89*
5. Grams per week .18* -.34* .64* .68* 1
6. Grams per session .28* -.40* .43* .46* .72*

* Indicates significance at p < .000


DPW: number of days using cannabis in the past week. DPW: number of days using cannabis in the past month.
<table>
<thead>
<tr>
<th></th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CAPS</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PBSM</td>
<td>-.07</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. DPW</td>
<td>.49*</td>
<td>-.11</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. DPM</td>
<td>.57*</td>
<td>-.16*</td>
<td>.44*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5. Grams per week</td>
<td>.56*</td>
<td>-.18*</td>
<td>.60*</td>
<td>.27*</td>
<td>1</td>
</tr>
<tr>
<td>6. Grams per session</td>
<td>.56*</td>
<td>-.10</td>
<td>.47*</td>
<td>.54*</td>
<td>.17*</td>
</tr>
</tbody>
</table>

* Indicates significance at p < .000

CAPS: Cannabis-Associated Problems. PBSM: Protective Behavioral Strategies for Marijuana. DPW: number of days using cannabis in the past week. DPW: number of days using cannabis in the past month.

Appendix 1: Cannabis-Associated Problems Scale (CAPS)
<table>
<thead>
<tr>
<th>Problem Description</th>
<th>0 No</th>
<th>1 Yes, but only once or a very minor problem</th>
<th>2 Yes, but only a couple of times or a minor problem</th>
<th>3 Yes, a few times or a moderate problem</th>
<th>4 Yes, many times or a somewhat serious problem</th>
<th>5 Yes, very many times or a very serious problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems between you and your partner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems in your family</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to neglect your family</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems between you and your friends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to miss days at work or to miss class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to lose a job</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to have lower productivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withdrawal symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackouts or flashbacks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please mark 3 here</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty sleeping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial difficulties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to have a lower energy level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to feel bad about your use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowered self-esteem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to procrastinate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You to lack self-confidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Appendix 2:** Protective Behavioral Strategies for Marijuana (PBSM-17) Scale
### 17-item version of the Protective Behavioral Strategies for Marijuana Scale (PBSM-17)

<table>
<thead>
<tr>
<th>Item</th>
<th>Never</th>
<th>Rarely</th>
<th>Occasionally</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use marijuana only among trusted peers</td>
<td></td>
<td>1 2 3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Avoid use while spending time with family</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Avoid using marijuana before work or school</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Avoid using marijuana to cope with emotions such as sadness or depression</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Limit use to weekends</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Only purchase marijuana from a trusted source</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Avoid using marijuana habitually (that is, every day or multiple times a week)</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Use a little and then wait to see how you feel before using more</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Avoid mixing marijuana with other drugs</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Avoid using marijuana in public places</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Take periodic breaks if it feels like you are using marijuana too frequently</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Buy less marijuana at a time so you smoke less</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Have a set amount of “times” you take a hit (e.g., passing on a shared joint if you have already hit that limit)</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Avoid methods of using marijuana that can make you more intoxicated than you would like (e.g., using large bongs, volcano, ‘edibles,’ etc.)</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Only use one time during a daynight</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Limit the amount of marijuana you smoke in one sitting</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Avoid using marijuana before engaging in physical activity (i.e., exercise, hiking)</td>
<td>1 2</td>
<td>3 4 5 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
