A brief motivational intervention for marijuana use in college students

Vivian S. Hwang
*University at Albany, State University of New York, vhwang@albany.edu*

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A Brief Motivational Intervention for Marijuana Use in College Students

by

Vivian S. Hwang

A Dissertation
Submitted to the University at Albany, State University of New York
in Partial Fulfillment of
the Requirements for the Degree of
Doctor of Philosophy

College of Arts and Sciences
Department of Psychology
2017
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Abstract

The prevalence of marijuana use has risen among young adults, and marijuana is the most frequently reported illicit drug on college campuses. There have been few intervention studies focused on brief motivational-enhancement and feedback-based interventions aimed at reducing college marijuana use.

The present study was conducted with participants who were referred to a substance use program as a result of violating a university drug infraction. Participants were randomized to either an intervention group or a no treatment control group (who were put on a one-month wait list and later received the intervention) and asked to complete an online baseline survey about their alcohol, marijuana, and other drug use. Those assigned to the intervention group then completed a single-session, in-person intervention utilizing a feedback profile generated from the participant’s responses to the survey. Follow-up assessments were completed one month after the intervention (or after a one-month wait period for control participants).

Significant reductions in marijuana use frequency and quantity, as well as marijuana-related problems, were demonstrated at one-month follow-up for both conditions. Contrary to study hypotheses, there was no significant difference between those in the intervention condition and those on the wait list in terms of these reductions. Directions for future research that may focus on indicated interventions for mandated student populations are discussed.
Introduction

Marijuana is the most commonly-used illicit drug among college students. Several national surveys gathering data on alcohol and drug use among adolescents and young adults have mapped trends in marijuana use among college students [e.g. Johnston, O’Malley, Bachman, Schulenberg, & Miech, 2016; Substance Abuse and Mental Health Services Administration (SAMHSA), 2014]. The most recent Monitoring the Future study by Johnston and colleagues (2016) reported on recent trends in the 2000s, noting that the annual prevalence of marijuana use among college students reached a high point of 36 percent in 2000, which then declined to 30 percent in 2006. This rate has since increased to a rate of 38 percent in the most recent 2015 survey, and lifetime prevalence among college students was reported to be 50.4 percent (Johnston et al., 2016). These surveys have also shown an increase in past month marijuana use among young adults from 2010-2015, with the 5-year increase in past month prevalence ranging from 18.5 to 19.6 percent (SAMHSA, 2014) to 17.5 to 21.1 percent (Johnston et al., 2016). Frequency of marijuana use has also increased among young adults, with reports that daily marijuana use has risen among college students most recently from 3.5 percent in 2007 to peak at 5.9 percent in 2014, but has since decreased to 4.6 percent in 2015 (Johnston et al., 2016).

Marijuana Dependence

Although not all marijuana users develop dependence, Anthony, Warner, and Kessler (1994) estimated that approximately 9.1 percent of marijuana users could become dependent. They also found that dependence among 15-24 year olds was highest within their study population at 15.3 percent (Anthony et al., 1994). Another national epidemiologic study found that approximately 1 in 3 past-year marijuana users in the general population met criteria for a
marijuana use disorder (Compton, Grant, Colliver, Glantz, & Stinson, 2004). Of the 6.9 million people aged 12 or older in 2013 who were identified with illicit drug dependence or abuse, the largest number of individuals were classified with marijuana dependence or abuse (SAMHSA, 2014). The number of individuals aged 12 or older with past year marijuana dependence or abuse was 4.2 million, at a rate of 1.6 percent of the total population aged 12 or older. This rate has been fairly consistent in prior years, but has declined somewhat since 2004, when the rate was 1.9 percent (SAMHSA, 2014). Several factors have been examined in determining what increases the probability of marijuana dependence, including age and early onset of marijuana use (Fergusson, Horwood, Lyskey, & Madden, 2003), frequency of use (e.g., Chen, Kandel, & Davies, 1997), quantity of use (Stephens, Babor, Kadden, & Miller, 2002; Looby & Earleywine, 2007), and comorbid use of alcohol (Smucker Barnwell, Earleywine, & Gordis, 2005).

One epidemiologic study targeting first-year college students found that 14.4 percent of students met at least one DSM-IV (American Psychiatric Association [APA], 1994) criteria for a marijuana use disorder, with 4 percent meeting criteria for abuse and 5.4 percent meeting criteria for dependence (Caldeira, Arria, Grady, Vincent, & Wish, 2008). In their study sample, of the students who reported using marijuana 6 or more days in the past month, 28.6 percent met criteria for abuse and 38.6 percent met criteria for dependence. Given the consistently high rates of marijuana use, abuse, and dependence among college students, it is important to recognize and understand the potential adverse health and psychosocial effects of use, as well as to develop interventions that might address related problems and consequences of use in college students.

**Marijuana-Related Consequences**

Marijuana use is associated with a variety of short and long-term negative consequences, particularly for older adolescent and young adult users such as college students. Research has
shown that marijuana use can adversely affect users, especially for adolescents and young adults with early onset of use and for those who become regular users (Hall, 2009). Caldeira and colleagues (2008) demonstrated that, even in the absence of marijuana abuse or dependence, first-year college students who had used marijuana 5 or more times in the past year reported concentration problems, driving while high, and missing class as the most prevalent marijuana-related problems they experienced.

Marijuana use has been related to behaviors that might increase risk of bodily danger and harm. Brady & Li (2013) found that nearly one-third of fatally injured drivers in the United States between the years of 2005-2009 tested positive for non-alcohol drugs. Cannabinol was the most commonly detected non-alcohol drug on drug tests completed on drivers who were killed within one hour of a motor vehicle accident (Brady & Li, 2014). In this study, the prevalence of testing positive for cannabinol after a fatal accident increased from 4.2% in 1999 to 12.2% in 2010. Results from the 2013 National Survey on Drug Use and Health (SAMHSA, 2014) indicated that the rate of driving under the influence of illicit drugs was highest among young adults aged 18 to 25 (10.6%), and this rate was lower than the rate in 2012 (11.9%). Research has also shown that 13 percent of college students report driving under the influence of marijuana (McCarthy, Lynch, & Pederson, 2007). One in six college students with access to a car drove while high on a substance other than alcohol in the past year, and marijuana was the drug most commonly used before driving (Arria, Caldeira, Vincent, Garnier-Dykstra, & O’Grady, 2011).

Epidemiological studies, although conflicting, generally provide evidence of an association between marijuana use and increased motor vehicle collision risk, whereas experimental studies have shown a dose-related effect of marijuana use on cognitive and
psychomotor impairments on driving performance tests (Ramaekers, Berghaus, van Laar, & Drummer, 2004). A recent meta-analysis of studies examining acute marijuana consumption and motor vehicle collisions found a near doubling of risk for a driver being involved in a serious motor vehicle collision, namely ones that resulted in serious injury or death (Asbridge, Hayden, & Cartwright, 2012). Li et al. (2012) likewise concluded that drivers who test positive for marijuana or self-report marijuana use are more than twice as likely as other drivers to be involved in motor vehicle crashes. A revised meta-analysis pooling the results from both of these studies adjusted for confounding factors, and concluded that acute marijuana intoxication was related to a statistically significant increase of low to moderate magnitude (Rogeberg & Elvik, 2016). Despite the risks associated with driving under the influence of marijuana, college students perceived driving after marijuana use as more acceptable than driving after drinking and perceived that negative consequences like being stopped by police or being in a substance-related accident were less likely (McCarthy et al., 2007).

Marijuana has other possible health-related consequences. Although research has not been able to determine a connection between marijuana smoke and cancers that are typically linked to tobacco smoking (Melamede, 2005), studies have shown that regular marijuana smokers do demonstrate and report having more symptoms of respiratory-related issues. Although acute marijuana smoking seems to produce a bronchodilating effect, this effect might abate after prolonged smoking, whereas respiratory complications associated with long-term use include cough, phlegm production, and wheeze (Tetrault et al., 2007). Research also indicates that regular marijuana smoking is associated with other respiratory problems, including acute bronchitis episodes and symptoms of chronic bronchitis (Tashkin, Baldwin, Sarafian, Dubinett, & Roth, 2002). One criticism of research in this area is that studies do not always control for
various aspects of tobacco smoking and exposure, which prove to be confounding factors in determining which substance accounts for pulmonary issues (Tetrault et al., 2007). However, some studies have shown that a relatively short period of heavy use in young adults can result in respiratory effects and changes in spirometry, even after controlling for tobacco use (Taylor, Poulton, Moffitt, Ramankutty, & Sears, 2000). Respiratory complications in this study included wheezing, exercise-induced shortness of breath, chest tightness, and early morning sputum production (Taylor et al., 2000).

There is a growing body of literature examining both the short and long-term effects of marijuana use on neurocognitive functioning. Although there is evidence that acute marijuana intoxication impairs basic motor coordination, executive functioning, memory, and control of emotions and behavior (Crean, Crane, & Mason, 2011; Ramaekers et al., 2006), it has been demonstrated that these deficits are impacted by many factors such as age of onset of marijuana use, years of use, and amount of regular or daily use (Grant, Gonzalez, Carey, Natarajan, & Wolfson, 2003). It is less clear in the literature, however, if the effects of marijuana use on cognitive functioning are long-term (Bolla, Eldreth, Matohkik, & Cadet, 2005), if impairments resolve after abstinence (Pope, Gruber, Hudson, Huestis, & Yurgelun-Todd, 2002), and which factors contribute to the change in functioning, such as quantity of marijuana consumed and duration of use (Solowij et al., 2002). Cognitive deficits as a potential consequence of adolescent marijuana use are a particular concern for college students, as they might impact academic achievement and other educational outcomes (Becker, Collins, & Luciana, 2014).

Much of the research on the consequences associated with marijuana use in adolescents and young adults has examined the impact of early use on academics and educational outcomes. Besides the possible cognitive issues discussed above, marijuana use has been found to be
related to several factors indicating poorer academic achievement. A review of the literature discusses how cross-sectional studies have linked adolescent marijuana use and various educational outcomes, including lower grade point average (GPA), negative attitudes towards school, poor school performance, and less satisfaction with school (Lynskey & Hall, 2000). The authors also discussed that longitudinal studies have supported these findings, particularly the finding that early marijuana use independently increases the risk of leaving school early (Lynskey & Hall, 2000).

In recent longitudinal studies, increased marijuana use in adolescence and early adulthood was found to predict several education outcomes and related employment outcomes, including lower levels of degree attainment by age 25, as well as lower income at age 25, higher levels of welfare dependence, and higher unemployment rates, even after accounting for potentially confounding factors such as adolescent academic achievement and other family and developmental variables (Fergusson & Boden, 2008). Another study found that the most commonly endorsed marijuana-related problems were those that were most likely to affect students’ academic performance, including procrastination, memory loss, missing days of work/school, and decreased productivity (Buckner, Ecker, & Cohen, 2010). Arria and colleagues (2013) found that marijuana use disorders significantly predicted declining GPA by way of skipping classes and also predicted nonmedical use of prescription drugs for studying motives. Marijuana use disorders have also demonstrated significant associations with the failure to complete college (Hunt, Eisenberg, & Kilbourne, 2010).

Polysubstance use has also become a serious health concern, particularly among college students. Several studies have found associations between marijuana use and use of other substances, including alcohol, tobacco/cigarettes, and other illicit drugs (Mohler-Kuo, Lee, &
In one college sample, approximately 9 out of 10 (91%) of students who used marijuana in the past 30 days also used another illicit drug, smoked tobacco, or binge drank (Gledhill-Hoyt, Lee, Strote, & Wechsler, 2000). Marijuana users have also reported more alcohol use and alcohol-related problems than nonusers (Magill et al., 2009).

**Marijuana Motives**

Motivational models of substance use have largely focused on drinking motives, particularly in college students. These models suggest that people use substances in order to achieve certain desired outcomes, and that there are distinct categories of reasons, each with their own unique functions, precursors, and consequences (Cooper, 1994). Understanding the motivations to use substances such as marijuana in college students could be useful to identify potential at-risk students and inform prevention and intervention efforts (Newcomb, Chou, Bentler, & Huba, 1988).

Studies on marijuana motives have been largely based on the drinking motives literature. Simons, Correia, Carey, and Borsari (1998) adapted and extended Cooper’s (1994) Driving Motives Questionnaire to examine a proposed five-factor marijuana motives model, which included four motives that have consistently predicted drinking behavior (i.e., social, coping, conformity, and enhancement motives) as well as a marijuana-specific expansion motive. Their study supported the concurrent validity and internal consistency of the five-factor model, including the new expansion motive, and demonstrated that marijuana motives were predictive of marijuana use and use-related problems, even when taking into account lifetime use (Simons et al., 1998). This study also supported the discriminant validity of separate marijuana and
alcohol motives, showing that patterns of associations were different, even though motives predicted comparable amounts of variance in use and related problems.

Further studies have examined the associations of motives with different aspects of marijuana use in various populations. Experienced marijuana and alcohol users appear to use alcohol and marijuana for different reasons, with social motives being endorsed more highly for alcohol use, and expansion motives being endorsed more highly for marijuana use (Simons, Correia, & Carey, 2000). Individuals dependent upon marijuana report significantly greater coping motives than those abusing or using marijuana, and those abusing or dependent on marijuana report more enhancement and expansion motives for their marijuana use, demonstrating that not all marijuana users use for the same reasons (Bonn-Miller & Zvolensky, 2009). Zvolensky et al. (2007) found support for the five-factor model of marijuana motives, but found that only certain motives were uniquely related to certain outcomes. More specifically, they found that enhancement and social motives were related to increased current use, whereas conformity was negatively associated with use. Coping motives were surprisingly not significant predictors of use, although they were significantly related to various cognitive-affective factors such as negative affect and anxious arousal (Zvolensky et al., 2007). Understanding college students’ motives for marijuana use and how they might impact use, related problems, and other outcomes is important in helping to develop useful interventions based on motivational models.

**Motivational Interviewing Approaches for Substance Use**

Motivational Interviewing (MI) is a therapeutic approach characterized by a non-confrontational, non-judgmental style, and is a client-centered yet directive method used to enhance intrinsic motivation to change one’s behavior by exploring and resolving individuals’ ambivalence (Miller & Rollnick, 2002). Adaptations of motivational interviewing have been
found to be efficacious treatments for problems involving alcohol, drugs, diet, and exercise (Burke, Arkowitz, & Menchola, 2003). Both qualitative and quantitative reviews have concluded that brief, individual interventions that include MI combined with personalized feedback are effective in reducing alcohol consumption and problems for college students (Larimer & Cronce, 2011, Carey, Scott-Sheldon, Carey, & DeMartini, 2007). These interventions generally involve an MI-based philosophy (Miller & Rollnick, 2002) combined with cognitive-behavioral principles. One example of an established intervention is the Brief Alcohol Screening and Intervention for College Students (BASICS; Dimeff, Baer, Kivlahan, & Marlatt, 1999), which is a Tier I intervention, as established by the National Institute on Alcohol Abuse and Alcoholism (NIAAA, 2002). It is perhaps the most standardized, evidence-based, and most frequently implemented of these programs, and has demonstrated success with reducing alcohol use in college students who are “at risk” or heavy drinkers (NIAAA, 2002). Several studies have shown that college students receiving BASICS as an alcohol intervention have reported reductions in alcohol consumption and alcohol-related consequences (e.g., Marlatt et al., 1998; Baer, Kivlahan, Blume, McKnight, & Marlatt, 2001; Borsari & Carey, 2000; Murphy et al., 2001).

Some variations of MI-based interventions involving personalized feedback have been shown to be efficacious in reducing marijuana use among adolescents (Walker et al., 2011) and adult users (Stephens, Roffman, Fearer, Williams, & Burke, 2007). However, few studies have examined how MI-based interventions might be adapted to specifically address college student marijuana use.

**Motivational Interviewing-Based Interventions Focused on College Marijuana Use**

Only a few studies have examined the secondary effects of motivational and personalized
feedback interventions targeting alcohol use on college students’ marijuana use (e.g., Grossbard et al., 2010; Magill et al., 2009). These studies present preliminary findings that an alcohol intervention might also have an effect on reducing marijuana use. However, the treatment effects in these studies were slight. One study was limited in that it did not have a no-treatment control group, but rather compared in-person sessions to feedback only (less than five minutes of in-person contact), and could not therefore attribute the findings to the intervention (Magill et al., 2009). Grossbard and colleagues (2010) found a significant treatment effect on past 30-day marijuana use at ten-month follow-up, namely that incoming college students who participated in a combined parent-delivered intervention and in-person, peer-facilitated BASICS session targeting alcohol did not show an increase in their marijuana use at follow-up while increases were seen in the other intervention conditions (i.e., parent intervention only, peer intervention only, and no-treatment control). Similarly, Kazemi and colleagues (2012) found that an alcohol intervention for first-year college students led to decreased use of marijuana, as well as alcohol six months later. However, White and colleagues (2015) combined data across nine studies of alcohol interventions and found no significant intervention effects on marijuana use at either short-term (1–3 month) or long-term (6–12 month) follow-up. One of the included studies, which included personalized, marijuana-specific feedback, did demonstrate a significant intervention effect on marijuana use at two-month follow-up (White et al., 2015). These studies provide some tentative evidence that motivational and personalized feedback approaches might have utility in a marijuana intervention, but indicate that more targeted approaches might be warranted for a more substantial effect on marijuana use.

In addition, a few studies have demonstrated encouraging evidence of the effect of programs targeting general student substance use, including effects on marijuana use.
specifically. One study that examined the effects of a single-session MI intervention addressing general substance use demonstrated reductions in cigarette, alcohol, and marijuana use, including reduced quantity and frequency of marijuana use (McCambridge & Strang, 2004). They also found promising evidence that those most at risk in their substance use at baseline were also most likely to show healthy, beneficial changes in their drug use behaviors at three-month follow-up, particularly with regards to marijuana use. Another study comparing an in-person MI intervention with a feedback-only intervention indicated significant reductions in whether participants used marijuana in the last month (White et al., 2006). In other words, nearly one-third (32.7%) of marijuana users who used at baseline did not use at follow-up. They also found that there was a pattern of reduction in frequency of marijuana use, but this result did not reach significance. White and colleagues (2006) acknowledged that their results should be interpreted with caution, as they did not compare the intervention groups to a no-treatment control group. Nevertheless, these studies provide some evidence that MI-based approaches may be effective in addressing marijuana use in college students.

Despite the prevalence of marijuana use and dependence on college campuses, there have only been a handful of studies evaluating interventions specifically targeting marijuana use in college students. Recent research (Lee, Neighbors, Kilmer, & Larimer, 2010) has demonstrated the effects of a web-based personalized feedback intervention on reducing marijuana use among college students, with reductions in use being moderated by reported family history of drug use and/or being more contemplative about changing their behavior at baseline. These results indicated short-term effects, as results that were evident at three-month follow-up were no longer detected six months after the intervention. Fischer and colleagues (2012) found that oral or written brief intervention with Canadian college students who were identified as high-frequency
marijuana users resulted in reductions in deep inhalation and/or breath-holding behaviors, as well as driving after marijuana use, at twelve-month follow-up. Lee and colleagues (2013) demonstrated evidence of short-term effects of a brief feedback-based intervention for college students who reported using marijuana on five or more days in the last month, and found that although there was no evidence for a reduction in days of use, intervention participants did report smoking fewer joints per week at three-month follow-up, although these differences were not evident at six months. The researchers posited that these more promising results could be attributed to receiving the intervention in person.

Another recent study (Palfai et al., 2014) that conducted a web-based screening and brief intervention through a university health center designed to address marijuana use and associated problems did not see a change in frequency of marijuana use at follow-up, but found a small, albeit not statistically significant, intervention effect in the reduction of marijuana-related problems. This preliminary effect size estimate was somewhat stronger for the group that completed the web-based assessment and intervention on-site at the university health center, which the researchers took to show possible benefits for on-site intervention. One possible explanation researchers gave for not seeing a reduction in use was their use of number of days as a measure of frequency, which did not account for other aspects of use, including contexts of use, frequency of use within the days students reported using, or more effective use of coping strategies (Palfai et al., 2014).

These studies indicate some promising support for an in-person, motivational and personalized feedback approach to addressing marijuana use and marijuana-related problems in college students. The results from previous studies suggest that taking quantity of marijuana use into account may yield a more accurate and comprehensive measure of students’ use, and that
these results may be short-term, given the brief nature of the intervention. Due to the non-judgmental and non-confrontational approach, college students might be more receptive to MI-based interventions (Marlatt, Larimer, Baer, & Quigley, 1993). In addition, Buckner and colleagues (2010) found that approximately a quarter of students reporting more than one marijuana-related consequence endorsed interest in receiving treatment for their use, and that treatment interest was related to frequency of use and number of related consequences.

The goal of the present study was to explore the feasibility and evaluate the efficacy of an intervention adapted from an evidence-based, motivational and personalized feedback program for alcohol to include and address other substance use, particularly marijuana. This pilot study involved the evaluation of an adapted intervention based on an established intervention for problem drinking, one that has been implemented at the university for the past ten years with positive results. The enhancement of an existing alcohol intervention to include other substances is in response to national and campus data that suggest other substance use among college students is on the rise, and that there may be negative consequences related to such use. The evaluation of this intervention was also intended to inform the investigators if the program fulfilled the needs identified on the campus to address marijuana, alcohol, and other drug use.

The current study compared baseline and one-month follow-up responses of two groups of students referred to the program – those who received an in-person intervention employing an MI approach and feedback delivery and those who were placed on a one-month wait list (no-treatment control group) who later received the intervention. It was hypothesized that the treatment group would show reductions in marijuana use (frequency and quantity), as well as in marijuana-related negative consequences. It was also hypothesized that marijuana motives
would be related with marijuana use and problems, and we expected to see certain patterns emerge for different motives.
Methods

Participants

Three hundred fifty-two students (81 females and 271 males) from a northeastern state university were recruited through university departments (e.g., Residential Life). All the participants were referred to the study as a result of committing a marijuana infraction of campus drug policy. These mandated students were informed that their participation in the study was separate from the fulfillment of their mandate. Students were required to be 18 years old to participate in the study. A power analysis was conducted based on two groups and an estimated effect size of partial $\eta^2 = .02$. It was determined that 81 participants per group are required to determine the presence of an effect, with alpha set at .05, and power at .95. This estimated effect size was based on previous analyses conducted on data collected through a similar study on the intervention addressing alcohol only.

Of the 352 participants recruited, 39 (10%) reported no marijuana use at baseline, 24 (6%) did not consent to participate in the study, 18 (5%) were eligible, but their data was deemed inaccurate by clinicians during the intervention session, and 1 (.3%) was under 18 years of age. These individuals were not included in data analyses. Furthermore, of the remaining participants, 85 (22%) did not complete the intervention session, 32 (8%) were assigned to the wait list condition and did not complete the second baseline survey, 21 (5%) did not complete the one-month follow-up survey, and 3 (.8%) completed the one-month survey several months after they were due to complete it. The remaining sample included data from 29 participants who were assigned to the wait list and completed both the intervention and one-month follow-up. Their data was included as part of the intervention group. The study sample therefore consisted of 167 eligible cases (39 females, 128 males). The intervention group consisted of 92 participants, and the wait list control group consisted of 75 participants.
In the study sample, participants ranged in age from 18 to 23 years (M = 19.03, SD = 1.11). The largest proportion of the participants were first year students (48%), followed by sophomores (29%), juniors (17%), and seniors (5%). Average grade point average (GPA) was 3.03 (SD = .53). Their ethnic/racial background was 63% Caucasian, 10% African American, 11% Hispanic, 7% Asian, and 2% “other” (Table 1). Seven percent endorsed multiple ethnicities.

**Procedure**

Students referred by university professionals as a result of a campus drug policy infraction were given information about the research study when they received information via an email attachment about their mandated program requirements. Although referrals could be made outside of judicial mandates (e.g., interested students seeking mental health services through the university counseling center who have not violated a campus drug policy), it was expected that a large portion of the study sample would be recruited through this procedure. Participants were recruited over the course of three school semesters.

All referred students were given a website link to the baseline survey (Appendix A and Appendix B), which provided more detailed informed consent about the study procedures. They were then given the choice to accept or decline participation in the study, and directed to the survey questions. After participants completed the baseline survey online, they were contacted by study personnel to schedule their in-person intervention session. Students who agreed to participate in the study were also informed at this time to which group they had been randomly assigned (treatment or no-treatment control). Participants assigned to the no-treatment control group were placed on a one-month wait list, after which they completed a second baseline survey and then scheduled to receive the intervention. Students who were referred near the end of a
semester and could not schedule an intervention appointment for that semester were required to retake the baseline survey the next semester to participate in the study. This was to ensure that the personalized feedback profile used in the intervention would contain the most current information.

The study survey consisted of questions that were used to create the personalized feedback profile that clinicians reviewed during the intervention session. Although for purposes of this study only the marijuana-related measures were analyzed and discussed, the survey and intervention also included questions and information about alcohol use, non-medical use of prescription drugs, and other illicit drug use. The online survey site allowed for skip logic, which directs students through survey sections based on whether or not they report using certain substances. For instance, students would encounter a question asking if they currently, or have ever, used alcohol. Students responding affirmatively would be taken to the section of alcohol-related measures, whereas students responding in the negative would then be taken to the marijuana section of the survey. This allowed for the feedback profile, as well as the intervention, to be tailored specifically to the participant’s use and concerns.

The intervention consisted of one face-to-face session with a trained mental health clinician at a university counseling center, lasting 1.5 hours. The focus of the session was to review the personalized feedback profile generated from the participant’s responses to the survey about their substance use habits, motivations for use, consequences experienced, expectancies, possible misperceptions of university norms, protective behaviors, mental health, and future goals. Because there are varying degrees of research and information about different substance categories, the sections developed for this intervention likewise varied in their breadth and scope. The marijuana section of concern to this current study included discussion of the individual’s
pattern of marijuana use, university norms, motives for use, marijuana-related consequences, costs associated with use (including discussion on money and possible associated calorie intake), and educational information about possible protective behaviors and dependence.

Although treatment fidelity was not analyzed for the current study, several measures were taken to ensure the quality and consistency of the delivered intervention sessions. Clinicians were specifically selected to implement the intervention based on their level of experience with MI and delivering brief, personalized feedback interventions for alcohol use. These clinicians had already received training on the aforementioned BASICS program, after which the current intervention was modeled. Prior to delivering these interventions, clinicians completed additional training specific to delivering the intervention with the new feedback profile sections on marijuana and other substance use. In addition, clinicians filled out a progress note after each intervention session on what substances and which profile areas were discussed in the session. They also recorded whether or not the profile data (generated from each participant’s survey) was generally accurate or inaccurate, given what was reported by the participant in session.

At the conclusion of the intervention session, participants were reminded that they would receive an email to complete the one-month follow-up survey. One month after their session, participants were emailed and asked to complete the survey website link by study personnel. Participants in either condition received book store gift certificates valued at $10 for completing the initial baseline surveys, $10 for repeat baseline surveys (if assigned to the wait list conditions, which served as their one-month follow-up), and $20 for one-month follow-up surveys following the intervention.
Measures

Demographic information. Demographic information was collected in order to describe the sample and analyze for any potential effects of these characteristics. Participants were asked to report their gender, race/ethnicity, current age, class year, GPA, and age when they first used marijuana (see Appendix A).

Marijuana use. To assess frequency of marijuana use we used a modified version of the Daily Drinking Questionnaire (DDQ; Collins et al., 1985). The DDQ has been used to ask respondents about the number of drinks and amount of time spent drinking on each day of the week. The current study version was modified to ask participants how many times they used marijuana and for what length of time they were under the influence of marijuana on each day of the week. As part of this measure, they were also asked what time(s) of the day they were most likely to use for each day of the week, but this was added primarily for the purposes of providing information for the feedback profile used in the intervention rather than for purposes of study analyses.

As a direct measure of quantity of use, participants were asked to report how many quarter ounces of marijuana they use in a typical month of use (Walden & Earleywine, 2008). Questions about marijuana use also include the typical method of use (e.g., joint, bong, food consumption, etc.), as well as an indirect measure of quantity, which included two questions regarding the intensity of intoxication (Walden & Earleywine, 2008). Participants were asked to rate their usual and maximal levels of intoxication along a six-point scale (1 = ‘light buzz’, 6 = ‘very high’).
Marijuana-Related problems. The Marijuana Problems Scale (MPS; Stephens et al., 2000) assesses the negative legal, social, and occupational consequences of use. The MPS is a 19-item questionnaire that asks respondents to rate problems resulting from marijuana use on a six-point scale (i.e., 0 = no problem, 5 = serious problem). The measure has demonstrated good internal consistency (Stephens et al., 2002; Lavender, Looby, & Earleywine, 2008). Cronbach alpha reliabilities for this study were estimated at .91 at baseline and .88 at one-month follow-up.

Although Lavender et al. (2008) demonstrated that five of the listed items show potential for gender bias, we elected to include all 19 items in this study for purposes of using the information for the feedback profile used in the intervention. There are also six additional items that were included in the survey to be used during the intervention, but were not included in the analyses of the MPS measure for this study.

Motives for marijuana use. The Marijuana Motives Measure (MMM; Simons et al., 1998), is a 25-item, five-factor measure of motives for using marijuana, modified from Cooper’s (1994) extensively-used measure of drinking motives. The MMM asks about five motives for marijuana use: conformity, coping, enhancement, expansion, and social. Respondents are asked to rate how often they use marijuana for the listed reason on a five-point response range (1 = Almost never/Never to 5 = Almost always/Always). This measure has been validated in several samples of young adult and adult marijuana users, and has also shown good internal consistency (e.g., Simons et al., 1998; Chabrol, Duconge, Casas, Roura, & Carey, 2005; Zvolensky et al., 2007; Benschop et al., 2015). Cronbach alpha reliabilities were excellent for each of the subscales at baseline in our study, and ranged from .90 to .94. Internal consistency was similar at follow-up assessments, ranging from .89 to .93. As discussed previously, marijuana motives
have demonstrated significant associations with marijuana use and related problems, and are thus important to examine in the context of a motivational-based intervention.
Results

Preliminary Analyses

The outcome variables were first examined for outliers that might compromise the accuracy of conclusions drawn from the data. Outliers were identified as values that were three standard deviations above the variable mean, and were replaced with the value that was three standard deviations above the mean. The distributions of the outcome variables were then examined for normality. All outcome variables except for the two measures of intensity of intoxication showed violations of normality at baseline based on skew and kurtosis values, and were log transformed. Transformations were applied to both baseline and follow-up variables so that they could be evaluated on the same scale of measurement.

Descriptives and Baseline Equivalence

Demographics. Chi-square analyses showed no significant group differences in gender, $\chi^2(1, 167) = .31, p = .58$, race/ethnicity, $\chi^2(6, 167) = 6.47, p = .37$, or class year, $\chi^2(3, 167) = 4.06, p = .25$. One-way analyses of variance (ANOVA) showed no significant difference in estimated GPA, $F(1, 148) = .32, p = .57$. There was, however, a significant between-groups difference in age, $F(1, 166) = 6.69, p < .05$. Demographic means and standard deviations are shown in Table 1.

Baseline marijuana use, consequences, and motives. Descriptive statistics for each outcome variable at both time points are listed in Tables 2 and 3. The two groups were compared on marijuana quantity and frequency variables, problems related to use, and marijuana motives at baseline. No significant differences were found for reported quantity, $F(1, 162) = .14, p = .71$, times used per week, $F(1, 166) = 2.60, p = .11$, hours used per week, $F(1, 166) = 3.07, p = .08$, usual level of intoxication, $F(1, 165) = 1.18, p = .28$, peak level of intoxication in the last
30 days, $F(1, 164) = .14, p = .71$, and problems related to marijuana use, $F(1, 156) = .004, p = .95$. There were also no significant differences at baseline between the groups on any of the marijuana motives subscales [social, $F(1, 164) = 1.48, p = .23$; coping, $F(1, 164) = .28, p = .60$; enhancement, $F(1, 164) = .71, p = .40$; conformity, $F(1, 164) = .07, p = .79$; expansion, $F(1, 164) = .31, p = .58$]. The means and standard deviations for outcome variables by time and condition are displayed in Table 4.

**Attrition Analyses**

As reported above, 21 percent of the recruited participants were ineligible and 36 percent were lost to attrition by follow-up, and attrition analyses were conducted to determine if there were any differences between completers and non-completers. Independent samples t-tests demonstrated that completers and non-completers did not differ at baseline on current age, $[t(389) = .28, p = .78]$, age first used marijuana, $[t(341) = -.53, p = .60]$, reported quantity, $[t(369) = 1.49, p = .14]$, times used per week, $[t(357) = .64, p = .52]$, hours used per week, $[t(357) = 1.12, p = .27]$, and problems related to use, $[t(332) = -.50, p = .62]$. Those who did not complete the study reported significantly higher usual level of intoxication, $[t(356) = 2.12, p < .05]$, higher peak level of intoxication, $[t(351) = 2.10, p < .05]$, and lower GPA, $[t(336) = 2.57, p < .05]$.

**Effect of Intervention at One-month Follow-up**

It was hypothesized that frequency and quantity of marijuana use for the treatment group would be reduced at one-month follow-up, as well as the number of marijuana-related problems and motives. In order to assess changes between baseline and one-month follow-up post-intervention, repeated measures ANOVAs were conducted with each of the outcome variables, with time as the repeated factor and group membership entered as the between-subjects factor.
**Quantity and frequency of marijuana use.** Although there was a significant main effect of time on quantity of marijuana used, $F(1, 157) = 19.78, p < .001$, there was no significant interaction effect, $F(1, 157) = .12, p = .73$. There was also no significant between-groups effect for condition, $F(1, 157) = .19, p = .67$. For usual level of intoxication, there was no significant difference over time, $F(1, 139) = 3.19, p = .08$, as well as no significant interaction effect, $F(1, 139) = .001, p = .97$, and no significant between-group difference, $F(1, 139) = 2.34, p = .13$. For peak level of intoxication in the past 30 days, there was a significant main effect of time, $F(1, 130) = 23.77, p < .001$, but no significant interaction effect, $F(1, 130) = .89, p = .35$, and no significant difference between conditions, $F(1, 130) = 1.04, p = .31$.

The frequency variables of hours per week and times per week demonstrated a similar pattern of findings. For the hours per week variable there was a significant main effect of time, $F(1, 138) = 37.32, p < .001$, but no significant interaction effect, $F(1, 138) = .23, p = .63$, or main effect of condition, $F(1, 138) = .33, p = .57$. For the times per week variable there was also a significant reduction over time, $F(1, 138) = 35.17, p < .001$, but no significant interaction effect, $F(1, 138) = .23, p = .64$, or significant main effect of condition, $F(1, 138) = .24, p = .63$.

**Consequences and motives.** Similar to the results for the marijuana quantity and frequency measures, there was a significant main effect of time for marijuana-related problems, $F(1, 120) = 15.67, p < .001$, but no significant interaction effect, $F(1, 120) = .11, p = .74$, or between-groups difference, $F(1, 120) = .20, p = .66$.

Four of the five marijuana motives subscales demonstrated a similar pattern of findings: social motives significant main effect of time, $F(1, 134) = 7.64, p < .05$, no significant interaction effect, $F(1, 134) = 1.93, p = .17$, or between-groups difference, $F(1, 134) = .01, p = .91$; coping motives significant main effect of time, $F(1, 134) = 15.40, p < .001$, no significant
interaction effect, $F(1, 134) = .06, p = .80$, or between-groups difference, $F(1, 134) = .03, p = .87$; enhancement motives significant main effect of time, $F(1, 134) = 16.66, p < .001$, no significant interaction effect, $F(1, 134) = .60, p = .44$, or between-groups difference, $F(1, 134) = .03, p = .87$; expansion motives significant main effect of time, $F(1, 134) = 8.05, p < .05$, no significant interaction effect, $F(1, 134) = 1.86, p = .18$, or between-groups difference, $F(1, 134) = .03, p = .87$. For the conformity motives there was no significant main effect of time, $F(1, 134) = .59, p = .45$, nor was there a significant interaction effect, $F(1, 134) = 2.82, p = .10$, or between-groups difference, $F(1, 134) = .001, p = .98$. Examination of the group conformity motives means showed that the wait list group motives decreased while the intervention group motives actually increased, although this difference was not significant.

**Impact of problem severity.** When participants who did not endorse any marijuana-related problems on the MPS were taken out of the study sample, significance testing was not affected.

**Correlation and Regression Analyses**

Correlations for each of the variables and baseline and one-month follow-up are presented in Tables 5 and 6, respectively.

Multiple regression analysis was used to test if baseline use and motives predicted marijuana-related consequences at one-month follow-up. Results indicated that the predictors explained 24% of the variance ($R^2 = .24, F(11,120) = 3.13, p < .01$). It was found that baseline conformity motives significantly predicted consequences at follow-up ($\beta = .23, p < .05$), as did enhancement motives ($\beta = .28, p < .05$).
Discussion

Discussion of Main Findings

The present study sought to pilot and evaluate a newly-developed motivational and personalized feedback intervention that included information and personalized feedback regarding students’ marijuana use. To date, it is the first study with a mandated college student sample that examined the possible differential effects of an in-person treatment compared to a wait list control condition on marijuana use. This study proposed that the in-person intervention condition would result in significant decreases in marijuana use quantity and frequency, as well as negative consequences and motives, and that there would be significant differences between the effects of the conditions. The results did not support this hypothesis, as there were no significant differences between the conditions. However, this study did find in the overall sample that participants significantly decreased their marijuana use frequency and quantity, and experienced a significant decrease in marijuana-related problems. Participants also significantly decreased their motives for marijuana use over time, except for conformity motives, which increased for the intervention group and decreased for the wait list group.

The use of a mandated college student sample could have contributed to the results of this study. Although this study was not originally limited to mandated students, ultimately the entire sample was comprised of mandated students. This was due to time and financial constraints, as well as the volume of sanctioned referrals for on-campus infractions the university counseling center received. Mandated students are also considered to be an at-risk population (Barnett et al., 2004), and therefore delivery of the intervention to these students was prioritized. To our knowledge, this is the only mandated student study with a sample comprised solely of students mandated for marijuana use infractions.
Much of the research on mandated student populations has focused on alcohol, where brief intervention studies have been found to be generally effective in changing alcohol variables (e.g., Borsari & Carey, 2005; Fromme & Corbin, 2004; White et al., 2007), but others have found no significant treatment effects (e.g., Cimini et al., 2009). Only one previous study compared the effects of a brief, two-session intervention implementing MI and personalized feedback that included marijuana-related information to a written feedback-only condition on a mandated college student population (White et al., 2006). Students who received assessment and written feedback demonstrated similar changes to those who received the in-person feedback sessions with regards to alcohol consumption, prevalence of cigarette and marijuana use, and problems related to alcohol and drug use. This previous study differs from the current study in that it included both students mandated for alcohol (88.6%) and marijuana infractions (11%), and did not separate these groups in their analyses due to group size, whereas the present study only included those referred for a marijuana infraction. Furthermore, White and colleagues (2006) compared two types of interventions, whereas the present study used an assessment-only wait list control.

Despite the notion that illicit drug use may be qualitatively different from risky alcohol use and other health behaviors that respond to brief interventions (Saitz, 2014), and due to the paucity of research on mandated student populations for marijuana-related interventions and outcomes, previous research on alcohol interventions serves as a platform for considering the present study results. Our findings are consistent with previous findings, suggesting that reductions in substance use and related outcomes may be a result of being caught for an infraction and mandated (White et al., 2008). Morgan, White, and Mun (2008) found that students mandated for alcohol-related infractions significantly reduced peak blood alcohol
concentration (BAC) levels, total weekly drinks, and frequency of alcohol use after the violation before any intervention. Furthermore, the greater the severity of the infraction resulted in greater reductions in alcohol use pre-intervention. Studies by both Fromme and Corbin (2004) and Carey and colleagues (2011) found that female mandated students who had been assigned to a wait list control group showed significant decreases in alcohol use over time before intervention, indicating that the sanction alone may have led to behavior change. Barnett and colleagues (2004) considered that the delay in time between the precipitating event, referral, baseline assessment, and delays in scheduling intervention could have an effect on recall and saliency of the event. They noted that the majority of mandated students in their study indicated their behavior change was due to the incident (Barnett et al., 2004). For college students, getting in trouble with the university may result in self-initiated change, particularly as these are primarily students living in on-campus dormitories where drug use is prohibited.

In the present study, all referred marijuana infractions occurred on campus, and the campus conduct policy was to involve the campus police department in the initial response, whereas alcohol infractions do not involve campus police. The involvement of campus law enforcement may have had several varying effects on the mandated students. One possibility was that the involvement of police may have increased the sense of severity of the mandate over alcohol infractions, which involve Residential Life staff only. Furthermore, depending on the circumstances of the referring event, students may have faced legal charges in addition to campus sanctions.

Another possibility is that police involvement may have contributed to student resistance or defensiveness in reporting on baseline assessments and in attending the intervention sessions. Clinicians were asked to indicate if the information on the feedback profile (generated with the
responses from the baseline assessment), as it was discussed in session, was found to be
generally accurate or generally inaccurate. Inaccuracies were explained in clinician’s
documentation, and students were reported to have either under- or over-reported on their
surveys. Profiles deemed inaccurate by clinicians after the intervention session were not
included in analyses, and there was no way to determine for wait list participants whether their
initial baseline assessments were accurate or inaccurate. Presenting inaccurate information,
particularly under-reporting, could be a sign of defensiveness or resistance as a result of external
pressure to change (Cavaiola, 1984; Zonana & Norko, 1993).

The significant time effects found for both conditions in the present study are also
perhaps consistent with research supporting the role of assessment and/or self-monitoring in
promoting substance use reductions and changes in substance-related behaviors. It has been
found that self-monitoring (Cronin, 1996; Garvin, Alcorn, & Faulkner, 1990) has led to changes
in alcohol use and/or related problems in the absence of any other intervention. Studies
evaluating the effects of alcohol screening on reducing self-reported drinking and problems
provide evidence that null findings in brief intervention studies may be at least partly explained
by the effects of screening/assessment (e.g., Kypri, Langley, Saunders, & Cashell-Smith, 2007;
in alcohol use for both intervention and control group participants, suggesting that assessment
itself may serve as a minimal intervention. A review of studies evaluating assessment reactivity
noted the possibility of a mild intervention effect of brief assessments on college students, but
recognized that results have been mixed (Bernstein, Bernstein, & Heeren, 2010). A meta-
analysis of ten brief alcohol intervention trials observed that, for non-intervention control groups,
answering questions about drinking behavior may be exposing individuals to an integral part of
the intervention (McCambridge & Kypri, 2011). Their study also suggested stronger evidence for assessment reactivity in student trials than in general adult studies. It is therefore possible that filling out the baseline assessments exposed wait list participants in the present study to feedback about their use, and previous research supports that this exposure may result in some behavioral changes. Evaluation apprehension and social desirability bias are two theoretical explanations for assessment reactivity (Kypri et al., 2007). In the present study, concerns about being negatively evaluated for their use, and facing an in-person meeting to discuss use may have resulted in reduced reported use, even for individuals assigned to the wait list control, as they would eventually receive the intervention.

One of the quantity variables, usual intensity of intoxication, was the only variable that did not demonstrate a significant decrease over time. Although it is intended to be an indirect measure of quantity and was correlated with self-reported direct quantity of use, one possibility for this different result may have been that participants’ tolerance dropped as their use dropped, but self-observed intensity of intoxication did not.

**Marijuana Motives**

This study explored the relations between motives of marijuana use and different marijuana variables. Consistent with previous literature, certain motives were found to be positively related to marijuana use frequency and quantity, including enhancement, expansion, coping, and social motives (Bonn-Miller, Zvolensky, & Bernstein, 2007; Chabrol et al., 2005; Simons et al., 1998, 2000). Conformity motives demonstrated a different pattern from other motives, and were only significantly correlated with consequences at baseline beyond correlations with the other motives subscales. At one-month follow-up, conformity motives were significantly correlated with both consequences and quantity of use. Previous research
demonstrated that conformity motives were not significantly related to marijuana use, but were significantly related to consequences (Lee, Neighbors, & Woods, 2007). When baseline use and motives variables were regressed on follow-up consequences in this study, enhancement and conformity motives were both significant predictors of consequences. Simons and colleagues (2008), found similarly that although conformity and social motives were not significant predictors of marijuana use, they were significant predictors of consequences. Contrary to previous research (e.g., Looby & Earleywine, 2007; Walden & Earleywine, 2008; Zeisser et al., 2012), neither quantity nor frequency of use significantly predicted marijuana-related consequences. The fact that these variables did not predict consequences, but enhancement and conformity motives did, may indicate that the nature of the circumstances around the referral to intervention had a greater impact than the intervention itself. These results may be indicative of some effect that getting in trouble with the University and law enforcement had on conformity motives, although no previous literature has examined the possibility of such an effect. The results of the present study must be interpreted with caution however, as the sample mean for conformity motives was not only very low ($M = 1.21, SD = 0.59$; $1 = $no endorsement of conformity motives$)$, but conformity motives also demonstrated a very low base rate in our sample (75% did not endorse any conformity motives at baseline, 78% did not endorse any conformity motives at follow-up). There are few explanations discussed in previous studies for the conformity motive variable, although it seems to interact with other variables differently than other motives subscales. It is possible that the low endorsement of this motive demonstrates a social desirability effect, wherein young adults do not wish to acknowledge wanting to fit in with their peers.
Limitations

The results of the present study should be considered within the context of its challenges and limitations. One limitation of the present study was that it relied solely on self-report measures without biological markers or collateral reports. Collaterals have been shown to be unreliable in studies on alcohol use in student and young adult populations (for review see Babor, Stephens, & Marlatt, 1987). It is unclear if this would also be the case for marijuana use, and the fact that methods for collecting self-reported marijuana use data are not standardized presents a methodological challenge (Mariani, Brooks, Haney, & Levin, 2011). Biological markers for marijuana use can be costly and not time-efficient, and were not a feasible option for this study. Generalizability is also a concern for the present findings, as the study sample was predominantly Caucasian, male, and from the northeastern states.

The high rate of attrition was a concern for this study, as it affected the overall power of the study. Many students did not follow-up after the initial baseline assessment. Study personnel actively followed up with study participants via email and phone contacts for continued participation, but these efforts may not have been enough. Although the referring departments had a procedure for tracking student’s progress, it was a concern of the researchers that many students were not actively tracked through this system for the completion of their sanctions and therefore did not complete study or sanction procedures. An additional complication in follow-up was the timing of a portion the sanctions and the limitations of the school semester schedule. Students who were caught and received sanctions at the end of a semester and before a recess had to delay participation in the intervention and the study, and were therefore more likely to not complete the procedures. Another possible explanation for the missing follow-up data may have been that students completed follow-up questionnaires, but used skip logic to not answer the marijuana section. This may have been due to questionnaire
fatigue or misunderstanding the opening question “Do you currently or have you ever used marijuana?” that would direct them to the marijuana-related questions.

Questionnaire fatigue was certainly a concern for this study, as the larger intervention sought to address any alcohol and/or drug use pertinent to the individual. The questionnaire therefore had two purposes, to collect data for research and to collect information that could be directly used for personalized feedback purposes. Wherever possible, researchers sought to limit the amount of assessment questions for each of these two purposes. The questionnaire employed skip logic so that participants did not have to answer questions that did not pertain to them. However, each section included several measures each, and this may have increased fatigue over the course of the questionnaire, particularly at follow-up, and particularly if students used multiple substances.

This study did not analyze treatment fidelity, although clinicians did complete brief follow-up paperwork documenting which types of substances were addressed in each intervention, as well as which topics in the feedback profile were discussed with individuals during the session. Unfortunately, because this pilot study was conducted within the service delivery of a university counseling center, interventions were individualized for participants and may have varied somewhat in both content and delivery. Further research should evaluate treatment fidelity with review of sessions and regular meetings with clinicians to discuss treatment delivery.

**Future Directions**

This pilot study was the first study to evaluate a brief MI intervention using personalized feedback on marijuana use with college students mandated to treatment for a marijuana-related offense compared to a wait list control group. There were no significant differences between the
those who completed the intervention and those who were assigned to the wait list, but there were overall reductions in marijuana-related variables over time. The significant effect of time may be attributed to assessment reactivity, or perhaps as a response to being in trouble with university police and Residential Life. The limitations and challenges of the study could also contribute to understanding the lack of findings. There is still very little known about the effectiveness of brief interventions for substances other than alcohol in college students. The challenge remains to develop and evaluate what treatment elements may be most effective for students who use marijuana. Dennhardt and Murphy (2013) suggest possible tailoring of interventions to specific drug types, and provide the specific examples, such as including training in study skills for students reporting nonmedical use of prescription stimulants for enhanced concentration or including coping skills training for students reporting marijuana use for the purposes of relieving stress.

Given the level of attrition in the present study, perhaps exploring other types of interventions like the stepped-care model demonstrated in Borsari and colleagues (2012) for preventing alcohol use in mandated college students. Students were initially screened for level of use, and all received brief advice as part of their sanction. Those identified as having a higher level of use were then referred to a more intensive intervention (Borsari et al. 2012). This may offer a more cost-effective and efficient option for offering mandated treatment, particularly for busy agencies responding to a large number of referrals.

Although our pilot study could not support the hypothesis that our brief intervention reduced marijuana use and problems over no treatment for mandated students, existing research suggests that voluntary marijuana users may benefit from a brief motivational intervention model. Continued research is necessary to develop and identify which treatment components
and formats can be effective for mandated students, and to identify possible mediators and moderators of treatment outcomes.
References


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Murphy, J. G., Duchnick, J. J., Vuchinich, R. E., Davison, J. W., Karg, R. S., Olson, A. M., … &


### Table 1.

Demographics, Grade Point Average, and Year in School

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (n = 167)</th>
<th>Intervention (n = 92)</th>
<th>Wait list (n = 75)</th>
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<tbody>
<tr>
<td>Mean (SD) Age</td>
<td>19.03 (1.12)</td>
<td>19.23 (1.19)</td>
<td>18.79 (0.98)</td>
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<tr>
<td>Gender</td>
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<td>Male</td>
<td>128 (77%)</td>
<td>69 (75%)</td>
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<td>Female</td>
<td>39 (23%)</td>
<td>23 (25%)</td>
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<tr>
<td>Caucasian American</td>
<td>105 (63%)</td>
<td>57 (62%)</td>
<td>48 (64%)</td>
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<td>17 (10%)</td>
<td>10 (11%)</td>
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<td>Hispanic/Latino</td>
<td>18 (11%)</td>
<td>10 (11%)</td>
<td>8 (11%)</td>
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<td>11 (7%)</td>
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<td>Multiple ethnicities</td>
<td>12 (7%)</td>
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<td>5 (7%)</td>
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<tr>
<td>Other</td>
<td>3 (2%)</td>
<td>0 (0%)</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>Mean (SD) GPA</td>
<td>3.03 (0.53)</td>
<td>3.01 (0.54)</td>
<td>3.06 (0.52)</td>
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<td>Year in school</td>
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<td>First year</td>
<td>80 (48%)</td>
<td>40 (44%)</td>
<td>40 (53%)</td>
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<tr>
<td>Sophomore</td>
<td>49 (29%)</td>
<td>26 (28%)</td>
<td>23 (31%)</td>
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<tr>
<td>Junior</td>
<td>29 (17%)</td>
<td>19 (21%)</td>
<td>10 (13%)</td>
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<tr>
<td>Senior</td>
<td>9 (5%)</td>
<td>7 (8%)</td>
<td>2 (3%)</td>
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*Note. GPA = Grade Point Average*
Table 2.

*Baseline Marijuana Quantity, Marijuana Frequency, Marijuana-Related Consequences, and Marijuana Motives*

<table>
<thead>
<tr>
<th>Time</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Skewness</th>
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<th>Kurtosis</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Statistic</td>
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<td>Statistic</td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Marijuana Quantity</td>
<td>163</td>
<td>1.26</td>
<td>1.25</td>
<td>1.52</td>
<td>0.19</td>
<td>1.75</td>
<td>0.38</td>
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<tr>
<td>Usual High</td>
<td>166</td>
<td>3.53</td>
<td>1.15</td>
<td>-0.04</td>
<td>0.19</td>
<td>-0.03</td>
<td>0.38</td>
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<tr>
<td>Peak High</td>
<td>165</td>
<td>4.28</td>
<td>1.70</td>
<td>-0.58</td>
<td>0.19</td>
<td>-0.90</td>
<td>0.38</td>
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<tr>
<td>Number of Hours Per Week</td>
<td>167</td>
<td>12.12</td>
<td>16.29</td>
<td>2.58</td>
<td>0.19</td>
<td>6.80</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Number of Times Per Week</td>
<td>167</td>
<td>5.70</td>
<td>7.13</td>
<td>2.19</td>
<td>0.19</td>
<td>4.42</td>
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*Note.* Means and standard deviations in the table are not log transformed.
Table 3.

One-month Marijuana Quantity, Marijuana Frequency, Marijuana-Related Consequences, and Marijuana Motives

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Note. Means and standard deviations in the table are not log transformed.
Table 4.

*Baseline and One-Month Descriptives for Intervention and Waitlist Conditions*

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<td>M</td>
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*Note.* Means and standard deviations in the table are not log transformed.
Table 5.

Bivariate Correlations Among Study Variables at Baseline

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Note. **p < .001, *p < .05.
Table 6.

*Bivariate Correlations Among Study Variables at One-Month*

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<td>.58**</td>
<td>.17*</td>
<td>-</td>
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</tbody>
</table>

*Note.* **p < .001, *p < .05.*
Appendix A

Demographic Information

1. What was your biological sex at birth (this is used to create an individualized blood alcohol level chart)?
   Male
   Female
   Not listed here (please specify):

2. What is your current gender?
   Male
   Female
   Transgender
   Not listed here (please specify):

3. What is your race/ethnicity? (select all that apply)
   Black or African American
   Asian
   American Indian
   Hispanic/Latino
   Native Hawaiian or other Pacific Islander
   Alaska Native
   White
   Other (please specify):

4. What is your date of birth?

5. What is your current age?

6. What is your current class year?
   Freshman
   Sophomore
   Junior
   Senior
   Other (please specify):

7. At what age did you first use marijuana?
Appendix B

A. Marijuana Use

1. Do you currently or have you ever used marijuana (cannabis, pot, weed, grass)?
   - Yes
   - No

2. How many quarter ounces of marijuana do you use in a typical month, on average? (a quarter ounce = 7g)

3. What is the typical means by which you consume marijuana (check all that apply)?
   - Joint
   - Bowl
   - Bong
   - One-hitter
   - Vaporizer
   - Ingestion (e.g., food)
   - Other (please specify)

4. Approximately how ‘high,’ ‘buzzed,’ ‘stoned,’ or intoxicated do you usually get when you use marijuana?
   - 1
   - 2
   - 3
   - 4
   - 5
   - Light buzz
   - Very high

5. What’s the highest you’ve been in the past 30 days?
   - 1
   - 2
   - 3
   - 4
   - 5
   - Light buzz
   - Very high

B. Daily Marijuana Use

On the following pages, please indicate the number of joints that you typically used on each day of the week over the past 30 days. Please also indicate over how many hours you were high or under the influence of marijuana on each typical day of use.

Monday
- I do not typically use marijuana on Mondays
- I typically use marijuana on Mondays and the number of times I use is:
  - Over how many hours are you usually high or under the influence of marijuana on Mondays?
  - What time of day do you typically use marijuana on Mondays? (check all that apply)
    - Morning
    - Afternoon
    - Evening
    - Late at night

55
Tuesday
- I do not typically use marijuana on Tuesdays
- I typically use marijuana on Tuesdays and the number of times I use is:
  o Over how many hours are you usually high or under the influence of marijuana on Tuesdays?
  o What time of day do you typically use marijuana on Tuesdays? (check all that apply)
    ▪ Morning
    ▪ Afternoon
    ▪ Evening
    ▪ Late at night

Wednesday
- I do not typically use marijuana on Wednesdays
- I typically use marijuana on Wednesdays and the number of times I use is:
  o Over how many hours are you usually high or under the influence of marijuana on Wednesdays?
  o What time of day do you typically use marijuana on Wednesdays? (check all that apply)
    ▪ Morning
    ▪ Afternoon
    ▪ Evening
    ▪ Late at night

Thursday
- I do not typically use marijuana on Thursdays
- I typically use marijuana on Thursdays and the number of times I use is:
  o Over how many hours are you usually high or under the influence of marijuana on Thursdays?
  o What time of day do you typically use marijuana on Thursdays? (check all that apply)
    ▪ Morning
    ▪ Afternoon
    ▪ Evening
    ▪ Late at night

Friday
- I do not typically use marijuana on Fridays
- I typically use marijuana on Fridays and the number of times I use is:
  o Over how many hours are you usually high or under the influence of marijuana on Fridays?
  o What time of day do you typically use marijuana on Fridays? (check all that apply)
    ▪ Morning
    ▪ Afternoon
    ▪ Evening
    ▪ Late at night

Saturday
- I do not typically use marijuana on Saturdays
- I typically use marijuana on Saturdays and the number of times I use is:
  o Over how many hours are you usually high or under the influence of marijuana on Saturdays?
  o What time of day do you typically use marijuana on Saturdays? (check all that apply)
    ▪ Morning
    ▪ Afternoon
    ▪ Evening
    ▪ Late at night

Sundays
- I do not typically use marijuana on Sundays
- I typically use marijuana on Sundays and the number of times I use is:
  o Over how many hours are you usually high or under the influence of marijuana on Sundays?
  o What time of day do you typically use marijuana on Sundays? (check all that apply)
    ▪ Morning
    ▪ Afternoon
    ▪ Evening
    ▪ Late at night

C. Marijuana Problems Scale

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<td></td>
<td>Serious problem</td>
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</table>

Please indicate, for the last 30 days, the degree to which marijuana use has caused you

1. Problems between you and your partner
2. Problems in your family
3. To neglect your family
4. Problems between you and your friends
5. To miss days at work or to miss class
6. To lose a job
7. To have lower productivity
8. Medical problems
9. Withdrawal symptoms
10. Blackouts or flashbacks
11. Memory loss
12. Difficulty sleeping
13. Financial difficulties
14. Legal problems
15. To have a lower energy level
16. To feel bad about your use
17. Lowered self-esteem
18. To procrastinate
19. To lack self-confidence

D. Marijuana Motives Measure

Here is a list of reasons people give for using marijuana. Thinking of all the times you use marijuana, how often would you say that you use marijuana for each of the following reasons? There are no right or wrong answers to these questions. If you no longer use marijuana, please answer for when you previously used marijuana.

Almost/Never / Some of the time / Half of the time / Most of the time / Almost always/Always

1. To forget my worries
2. Because my friends pressure me to use marijuana
3. Because it helps me enjoy a party
4. Because it helps me when I feel depressed or nervous
5. To be sociable
6. To cheer me up when I am in a bad mood
7. Because I like the feeling
8. So that others won’t kid me about not using marijuana
9. Because it’s exciting
10. To get high
11. Because it makes social gatherings more fun
12. To fit in with the group I like
13. Because it gives me a pleasant feeling
14. Because it improves parties and celebrations
15. Because I feel more self-confident and sure of myself
16. To celebrate a special occasion with friends
17. To forget about my problems
18. Because it’s fun
19. To be liked
20. So I won’t feel left out
21. To know myself better
22. Because it helps me be more creative and original
23. To understand things differently
24. To expand my awareness
25. To be more open to experiences