

2019

Electronic screening and brief intervention to reduce marijuana use and consequences among graduate students presenting to a student health center: a pilot study

<https://hdl.handle.net/2144/39536>

"Downloaded from OpenBU. Boston University's institutional repository."

BOSTON UNIVERSITY
GRADUATE SCHOOL OF ARTS AND SCIENCES

Dissertation

**ELECTRONIC SCREENING AND BRIEF INTERVENTION TO REDUCE
MARIJUANA USE AND CONSEQUENCES AMONG GRADUATE STUDENTS
PRESENTING TO A STUDENT HEALTH CENTER: A PILOT STUDY**

by

TRACIE M. GOODNESS

B.S., University of Michigan, 2005
M.A., Boston University, 2011

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

2019

© 2019 by
TRACIE M. GOODNESS
All rights reserved

Approved by

First Reader

Tibor P. A. Palfai, Ph.D.
Professor of Psychological and Brain Sciences

Second Reader

Michael J. Lyons, Ph.D.
Professor of Psychological and Brain Sciences

Third Reader

Todd Farchione, Ph.D.
Research Associate Professor of Psychological and Brain Sciences

DEDICATION

To my parents. This is for you, Mom and Dad.

ACKNOWLEDGMENTS

Mom – to my cheerleader, my rock, my support, and an un-ending supply of energy and momentum. I don't know what I would have done without you. For everything you have done and continue to do, I am eternally grateful.

Dad – I wish you could have been here to see this. You were my original inspiration for making this happen (even though you knew it wouldn't be easy). I know how proud you would be of me.

My friends – I am lucky enough to have many I could include here. Your support along the way was priceless, and I am thankful for all that you have done. Sapana, you deserve a special mention. You have been there for me even before this started, for every step along the way, and you're here to celebrate the culmination of all of it.

Grandma – You raised a strong, smart, independent woman, who was the same, and she in turn raised me. You embodied being a strong, successful woman, and you modeled that for me. I wouldn't be who I am, or be where I am without you.

Brian – For all the emotional lifting that you did behind the scenes. Thank you, it did not go unnoticed. And for the patient fielding of all of my statistics questions. Thank you.

Leslie and Lauren – You helped more than you could ever know. Thank you for your support, feedback, and advice. You showed me it could be done, and let me know that I could do it, too.

Kat and Kelli – Thank you for your time and talents to help support the study.

Thank you to my committee members, Dr. Michael Lyons, Dr. Todd Farchione, Dr. John Otis, and Dr. Lisa Smith for your time, expertise, and feedback. For Dr. Farchione and Dr. Smith, who have also served as supervisors and mentors during my clinical time, I thank you for helping me and providing me with support and guidance.

To my supervisors, advisors, and mentors during my clinical rotations, fellowships, and internship: thank you. I have learned so much from you that I carry with me into my future clinical and research endeavors.

For a mentor in my personal life, CS, from whom I learned so much. I wish you could be here to see me now. I have no doubt of how proud you would be.

Finally, thank you to Dr. Tibor Palfai for the opportunity to work alongside you and learn in your lab. For allowing me to find my niche in your lab, and expanding my knowledge of addiction research and treatment. It is invaluable, and I thank you for that. I appreciate your guidance and assistance along the way, your feedback, and your dedication to and persistence in helping your students succeed.

**ELECTRONIC SCREENING AND BRIEF INTERVENTION TO REDUCE
MARIJUANA USE AND CONSEQUENCES AMONG GRADUATE STUDENTS
PRESENTING TO A STUDENT HEALTH CENTER: A PILOT STUDY**

TRACIE M. GOODNESS

Boston University Graduate School of Arts and Sciences, 2019

Major Professor: Tibor P.A. Palfai, Ph.D. Professor of Psychology

ABSTRACT

Background: Marijuana is one of the most frequently used drugs among individuals in emerging adulthood (i.e., 18-25) and is associated with negative health and academic consequences. As the majority of students do not seek treatment for their marijuana use, electronic screening and brief intervention (eSBI) has been used to reach students in “opportunistic” settings (e.g., primary care). Despite its promise for reducing hazardous drinking, the impact of eSBI for marijuana use has been mixed. Moreover, research to date has focused on undergraduates. There is little known about whether such approaches may influence graduate student marijuana use and consequences. The current pilot study sought to address this gap in the literature by examining an eSBI approach for reducing marijuana use among graduate students presenting to Student Health Services (SHS).

Methods: Graduate students were screened during their visit to SHS. Those with monthly or greater marijuana use were approached to participate in the study. Forty-nine students completed web-based assessments and were randomly assigned to a web-based brief intervention (BI) or assessment only (AO). Participants completed measures of marijuana use frequency and negative consequences at baseline, 3- and 6-months. Those

in the BI condition completed a commercially available web-based intervention [eCHECKUPTOGO-marijuana] at baseline and at 3-months. In addition, readiness-to-change and descriptive norms were examined as potential moderators. It was hypothesized that those in the BI group would have fewer days of marijuana use and fewer negative consequences at the 6-month outcome. Latent growth modeling was used to provide effect size estimates for the influence of the intervention on 6-month outcomes. Results: Effect size estimates showed a small-to-medium effect ($f^2 = 0.09$) of the intervention on marijuana use frequency at 6-months. There was no evidence that the intervention influenced negative consequences. Secondary analyses suggested that those with higher levels of readiness-to-change (measured by the Action subscale) showed greater responsiveness to the intervention. Conclusions: These results suggest that eCHECKUPTOGO-marijuana intervention may hold promise as a method to reduce marijuana use among graduate students who present to primary care settings. Future research should test the efficacy of this approach in a full-scale randomized controlled trial.

TABLE OF CONTENTS

DEDICATION	iv
ACKNOWLEDGMENTS	v
ABSTRACT	vii
TABLE OF CONTENTS	ix
LIST OF TABLES	xiii
LIST OF FIGURES	xv
LIST OF ABBREVIATIONS	xvii
CHAPTER ONE: INTRODUCTION	1
Marijuana Use and Consequences	1
Screening and Brief Interventions	6
Screening and Brief Intervention for College Students in Health Settings	9
Screening and Brief Intervention for College Students in Student Health Centers	10
Electronic Screening and Brief Interventions	13
Electronic Screening and Brief Interventions of College Student Marijuana Use	14
Booster Sessions	19
Moderators of the Intervention	20
CHAPTER TWO: THE PRESENT STUDY	26
Overview	26
Primary Research Questions	27

Hypotheses	27
Primary Hypothesis.....	27
Secondary Hypotheses	27
CHAPTER THREE: METHODS	28
Subject Selection and Recruitment	28
Participants.....	28
Recruitment.....	29
Measures	30
Screening Measures	30
Assessments	32
Experimental Conditions	36
Procedures.....	37
CHAPTER FOUR: DATA ANALYSIS.....	38
Data Preparation.....	38
Power Considerations	39
Results.....	40
Screening and Enrollment.....	40
Baseline Descriptive Characteristics.....	41
Primary Analyses	42
Secondary Analyses	43
Moderators of Intervention Effects.....	45
Post Hoc Exploratory Analyses	49

Effect of the Intervention on Satisfaction Ratings	52
Effect of the Intervention on Substance-Related and Other Health-Related Information/Services Sought	53
CHAPTER FIVE: DISCUSSION.....	53
Primary Findings.....	54
Secondary Findings.....	56
Moderators	59
Post Hoc Findings	61
Graduate Students	63
Feasibility.....	64
Limitations	67
Strengths	69
Future Directions	69
Conclusions.....	73
APPENDICES	108
Appendix A – Initial Screener	108
Pre-Screener	108
Appendix B - Welcome Screen.....	110
Appendix C – Booster Session Introduction Screen.....	111
Appendix D – NIDA-Modified ASSIST	112
Appendix E - Frequency of Marijuana Use – 90 Days.....	121
Appendix F - Marijuana-Related Consequences	122

Appendix G - Marijuana Norms	123
Appendix H – Manuscript for Publication.....	124
BIBLIOGRAPHY.....	140
CURRICULUM VITAE.....	151

LIST OF TABLES

Table 1 Consort Diagram.....	74
Table 2 Baseline Description of Sample: Overall and by Experimental Condition	75
Table 3 Regression Table for Norms at 3 Months, Frequency Outcomes.....	77
Table 4 Regression Table for Norms at 6 Months, Frequency Outcomes.....	78
Table 5 Regression Table for Norms at 3 Months, Consequences Outcomes.....	79
Table 6 Regression Table for Norms at 6 Months, Consequences Outcomes.....	80
Table 7 Regression Table for Norms (High/Low Split) at 3 Months, Frequency Outcomes	81
Table 8 Regression Table for Norms (High/Low Split) at 6 Months, Frequency Outcomes	82
Table 9 Regression Table for Norms (High/Low Split) at 3 Months, Consequences Outcomes	83
Table 10 Regression Table for Norms (High/Low Split) at 6 Months, Consequences Outcomes	84
Table 11 Marijuana Readiness to Change – Subscale Scores and Total Score	85
Table 12 Regression Table for Action Scores at 3 Months, Frequency Outcomes	86
Table 13 Regression Table for Action Scores at 6 Months, Frequency Outcomes	87
Table 14 Regression Table for Action Scores at 3 Months, Consequences Outcomes	88
Table 15 Regression Table for Action Scores at 6 Months, Consequences Outcomes	89
Table 16 Regression Table for Action Scores (High/Low Split) at 3 Months, Frequency Outcomes	90

Table 17 Regression Table for Action Scores (High/Low Split) at 6 Months, Frequency Outcomes	91
Table 18 Regression Table for Action Scores (High/Low Split) at 3 Months, Consequences Outcomes	92
Table 19 Regression Table for Action Scores (High/Low Split) at 6 Months, Consequences Outcomes	93
Table 20 Other Substance Use – Past Days Used in Previous 90 Days; Individual Item Scores and Composite Score.....	94
Table 21 Satisfaction Ratings	96
Table 22 Percentages of Participants Who Sought Information/Services Related to Substance Use and Other Health Behaviors in Past 6 Months	97

LIST OF FIGURES

Figure 1 Conditional Latent Growth Model - Effect of Intervention on Frequency of Use at 3- and 6-Month Outcomes	98
Figure 2 Conditional Latent Growth Model - Effect of Intervention on Consequences of Use at 3- and 6-Month Outcomes	99
Figure 3 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Frequency of Use at 3-Months	100
Figure 4 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Frequency of Use at 6-Months	101
Figure 5 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Consequences of Use at 3-Months	102
Figure 6 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Consequences of Use at 6-Months	103
Figure 7 Simple Slopes Linear Regression Moderator Analyses – Effect of Action subscale of RTC Questionnaire (Dichotomized High/Low Split) on Frequency of Use at 3-Months	104
Figure 8 Simple Slopes Linear Regression Moderator Analyses – Effect of Action subscale of RTC Questionnaire (Dichotomized High/Low Split) on Frequency of Use at 6-Months	105
Figure 9 Simple Slopes Linear Regression Moderator Analyses – Effect of Action subscale of RTC Questionnaire (Dichotomized High/Low Split) on Frequency of Use at 3-Months	106

Figure 10 Simple Slopes Linear Regression Moderator Analyses – Effect of Action
subscale of RTC Questionnaire (Dichotomized High/Low Split) on Consequences of
Use at 6-Months 107

LIST OF ABBREVIATIONS

ACHA.....	The American College Health Association
ANOVA.....	One-way Analysis of Variances
AO.....	Assessment Only experimental condition
ASSIST.....	Alcohol, Smoking and Substance Involvement Screening Test
AUDIT.....	Alcohol Use Disorders Identification Test
BI.....	Brief Intervention experimental condition
BU.....	Boston University
CHSN.....	College Health Surveillance Network
CSQ.....	Client Satisfaction Questionnaire
EDs.....	Emergency Departments
eSBI.....	Electronic Screening and Brief Interventions
GPA.....	Grade Point Average
HSM.....	Healthy Stress Management
LGM.....	Linear Growth Model
MI.....	Motivational Interviewing
MLR.....	Maximum likelihood estimator
NIDA.....	National Institute on Drug Abuse
NSDUH.....	National Survey on Drug Use and Health
PBS.....	Protective Behavioral Strategies
PF.....	Personalized Feedback
PFI.....	Personalized Feedback Intervention

RTC..... Readiness to Change
RTCQ..... Readiness to change questionnaire
SAMHSA..... Substance Abuse and Mental Health Services Administration
SBI Screening and Brief Interventions
SBIRT Screening, Brief Intervention and Referral to Treatment
SHC..... Student Health Centers
SHS Student Health Services
US..... United States

CHAPTER ONE: INTRODUCTION

Marijuana Use and Consequences

Marijuana is one of the most frequently used substances among those in emerging adulthood (ages 18-25) (Johnston, 2013). In the most recent survey of the National Survey on Drug Use and Health (Center for Behavioral Health Statistics and Quality, 2018) approximately 1 in 5 (20.8%) young adults (age 18-25) reported the use of marijuana in the past month, which amounts to 7.2 million current users in this age group alone. Rates of marijuana use have risen annually, with most growth occurring in adults aged 26+, and to a lesser extent, adults 18-25 (Center for Behavioral Health Statistics and Quality, 2018). Rates of marijuana use among college student-specific samples tend to be similar. The most recent Core Institute survey (a national study that assesses the nature, scope, and consequences of alcohol and drug use) (Core, 2014) showed that 32.5% of students reporting marijuana use in the last year, with 18.8% reporting use in the past 30 days. Analyses from a recent survey of eleven US universities showed that almost 6% of students report daily use of marijuana (Pearson, Liese, & Dvorak, 2017), while other studies report that daily usage for college-age students to be at an all-time high in the past 30 years (Schulenberg et al., 2017).

Heavy marijuana use is associated with negative outcomes in multiple domains, such as physical and psychological health (Arria, Garnier-Dykstra, Caldeira, et al., 2013; Caldeira, Arria, O'Grady, Vincent, & Wish, 2008), increased impulsivity and increased engagement in risky behaviors (e.g., unprotected sex, operating vehicles under the influence, use of other illicit substances) (Bell, Wechsler, & Johnston, 1997; Caldeira et

al., 2008; McCarthy, Lynch, & Pederson, 2007; Phillips, Phillips, & Duck, 2018; Simons, Maisto, & Wray, 2010), and higher likelihood of experiencing negative interpersonal and physical consequences (Caldeira et al., 2008).

Marijuana use is associated with reductions in healthy social and recreational activities and is linked with higher rates of heavy drinking and substance-use problems (Caldeira et al., 2008; Keith, Hart, McNeil, Silver, & Goodwin, 2015). There is also evidence to suggest that marijuana use is linked with higher rates of co-morbid psychiatric symptoms and disorders, such as depression and anxiety (Buckner, Keough, & Schmidt, 2007; Hayatbakhsh et al., 2007; Keith et al., 2015; Wright, 2015). Further, substance use in adolescence and emerging adulthood may be linked to more severe mental illness such as psychosis or schizophrenia, with possible correlations of first-episode psychosis precipitated by marijuana use (Wright, 2015).

Long-term and/or heavy use of marijuana has been shown to affect concentration, motivation, and produce changes in brain structure (e.g., hippocampus, prefrontal cortex, & amygdala) (Arria, Caldeira, Bugbee, Vincent, & O'Grady, 2015; Battistella et al., 2014; Churchwell, Lopez-Larson, & Yurgelun-Todd, 2010; Hall, 2015; Volkow, Compton, & Weiss, 2014; Yücel et al., 2008). These effects are associated with poor cognitive function in adulthood (Ehrenreich et al., 1999; Gruber, Sagar, Dahlgren, Racine, & Lukas, 2012; Solowij et al., 2011). In particular, poor visual scanning capacity, lowered attention span, lowered impulse control, and lowered executive function appear to persist well into adulthood (Wright, 2015).

In addition to these consequences, college students who use marijuana demonstrate negative academic outcomes, including decreased time spent studying (Phillips, Phillips, Lalonde, & Tormohlen, 2015), lower first-semester GPA, increased number of “skipped” classes, longer duration to graduation (Arria et al., 2015), and overall lower IQ scores (Meier et al., 2012; Pope et al., 2003). The experience of negative consequences is common among college students who use marijuana. Indeed, in a recent study, most students who reported one or more days of use within the past 30 days reported at least some negative effects related to increased health risk behaviors, with 24.2% reported experiencing 1–3 negative consequences, 30.1% reported experiencing 4–8 negative consequences, 26.9% reported experiencing 9–18 negative consequences, and 9.6% reported experiencing 19 or more negative consequences in the past 30 days (Pearson et al., 2017). Only 9% reported the complete absence of any consequences. The most commonly reported consequences were driving a car while high, saying or doing embarrassing things, using on nights when not planning to use, or feeling tired the morning after use (Pearson et al., 2017). Beyond these immediate consequences, student users have shown longer-term negative consequences due to their marijuana use. For example, studies have shown that students who engage in marijuana use are more likely to be unemployed or under-employed post-graduation; particularly striking is that this finding held true for even infrequent marijuana users (Arria, Garnier-Dykstra, Cook, et al., 2013). Clearly, the literature has shown the negative impact marijuana use may have on individuals in both short-term immediate functioning, as well as longer-term impacts on cognitive functioning and mental health. Interventions

delivered during these years to reduce or cease use may have long-standing positive consequences on multiple domains of these individuals' lives.

Although research on student marijuana has focused almost exclusively on undergraduate populations (Cranford, Eisenberg, & Serras, 2009), there is clear evidence that marijuana use also represents a concern for graduate students. Despite lower overall use than undergraduates, research has shown that graduate students in particular (e.g., medical students, PA assistants, pharmacy students) ages 26 and older report higher marijuana use than the 4.8% national rate for adults (Bidwal, Ip, Shah, & Serino, 2014). The rates of use in adults ages 26 and older have consistently increased over the years, and this cohort has the largest rate of growth in any age group currently studied (Center for Behavioral Health Statistics and Quality, 2018). Consistent with the general population, marijuana is the most commonly used illegal drug among graduate students (Bidwal et al., 2014; Kenna & Wood, 2004). Importantly, graduate students who engage in substance use behavior tend to also experience higher risk for depressive symptoms, and other psychiatric symptomatology (Serras, Saules, Cranford, & Eisenberg, 2010). Indeed, graduate students may be more susceptible to particular risks for elevated use and negative marijuana consequences (e.g., stress) than the general adult population (Bidwal et al., 2014; Kenna & Wood, 2004). Graduate students have been reported to experience almost twice as much stress on measures as compared to age-matched peers (Bidwal et al., 2014); this may be due to the rigors of a graduate program, pressure by post-graduate expectations (e.g., obtaining a fellowship or residency), and/or poor sleep hygiene (Bidwal et al., 2014). Similar to undergraduates, graduate students who smoke marijuana

regularly are at risk for negative academic consequences; specifically, marijuana use while enrolled in graduate school has been shown to be negatively associated with odds of graduating from a program (Allen, Lilly, Beck, Vincent, & Arria, 2018).

Given the elevated rates of graduate students compared to their age-based peers, the evidence of increased risk of psychiatric illness, and potentially severe negative consequences, it would appear to be a population that could greatly benefit from interventions tailored to suit their needs. However, there is currently little literature available on marijuana use specific to this population let alone the efficacy of interventions to address it. While there are many similarities to undergraduate populations (e.g., rigorous academic requirements, social and academic pressures), graduate students are distinctly different in many domains, such as age, motivations for use (e.g., coping versus exploration/new personal explorations and experiences)(Cranford et al., 2009), and risk of greater negative consequences of use (e.g., failure to obtain employment), among others. Similarly, graduate students typically show a greater focus on personal responsibility, and career planning compared to undergraduates (Ferriman, Lubinski, & Benbow, 2009). For example, most undergraduates entering college are often supported by parents or family, are experimenting with new substances or experiences not previously available to them, are often living in college-provided housing, and have a broader network of college-provided support (e.g., orientations, social clubs). However, many graduate students are often in very different circumstances – being married or partnered, living in off-campus housing, greater personal financial responsibility (ACHA, 2018), and greater pressure to obtain post-graduate fellowships, residencies, and careers .

Given these differences, it is unclear whether graduate students who use marijuana may be influenced by the same intervention strategies that promote behavioral change in alcohol and substance use among undergraduates. Indeed, there are currently no empirically established approaches for addressing marijuana use among this population.

Screening and Brief Interventions

Although there are a number of negative consequences associated with marijuana use, the majority of individuals that use marijuana do not seek treatment (Caldeira et al., 2009; Compton, Thomas, Stinson, & Grant, 2007; Kessler et al., 2001; Stephens, Roffman, Fearer, Williams, & Burke, 2007). This is likely multifactorial in nature. College students are a unique population, as there is a shift in social, cultural, and environmental contexts associated with college life (Caldeira et al., 2009; Gayman, Cuddeback, & Morrissey, 2011). The literature has found that the majority of young adults with a history of substance use never seek help, and for those that did, lengthy delays were demonstrated before seeking treatment, ranging from 1 to 16 years from start of use (Gayman et al., 2011; Wang et al., 2005). Many studies have shown that change in substance use is motivated by a personal recognition that a problem exists, combined with a desire to change this behavior; this is consistent with the “readiness to change” concept in the transtheoretical model of change (Caldeira et al., 2009; Connors, DiClemente, Velasquez, & Donovan, 2013). Unfortunately, marijuana smokers typically have fairly low motivation to change (Stephens et al., 2004). Studies of marijuana screening with students (e.g., Palfai et al., 2014) have found that students who use marijuana typically express little readiness to change. This makes it unlikely that students

who use marijuana will seek out substance-specific treatment. Thus, it is important to find ways to increase treatment engagement for this population that may not be seeking it out.

One potential approach to engage these individuals is to use interventions that can be delivered in “opportunistic” settings through screening and brief intervention (SBI). Screening and brief intervention is a process that was developed in reaction to a 1980 World Health Organization Expert Committee’s call for the development of efficient methods to detect people with hazardous/harmful alcohol consumption before health and social consequences became pronounced (Babor & Higgins-Biddle, 2000; WHO, 1980). Screening is used to identify those whose use may put themselves at risk for harmful substance use. For those identified, screening is followed with a brief intervention, which is a treatment with a low intensity and short duration (typically 5-60 minutes), with minimal number of sessions, in order to provide early intervention before the development of significant substance related harm (Babor & Higgins-Biddle, 2000). SBIs allow clinicians to deliver low resource-dependent interventions that may have broad population impact. The US Substance Abuse and Mental Health Services Administration (SAMHSA) has provided numerous grants to states to study Screening, Brief Intervention and Referral to Treatment (SBIRT), and has found that these programs are effective ways to introduce a variety of services to extend care for substance use disorders in a range of users (Bray, Del Boca, McRee, Hayashi, & Babor, 2017).

Brief interventions for both alcohol and marijuana use among students typically use content tailored to students to increase motivation to change, while also providing

them with strategies to reduce harm and negative consequences. Personalized feedback on marijuana use norms, risks, costs, and effects of use is presented to students during the course of these interventions. These approaches which are often based, in part, on Social Norms Theory (Berkowitz & Perkins, 1986; Perkins, 2002) correct misperceptions of peer marijuana use to help students modify their standards of marijuana use. In addition, Motivational Interviewing (MI) (Miller & Rollnick, 1991, 2002, 2013) represents a central component of many SBIs as different strategies seek to increase motivation to change by exploring ambivalence about substance use, and possible inconsistencies between using substance use and the pursuit of important current goals.

Screening and brief interventions are particularly advantageous for those who are not specifically seeking substance specialty treatment, such as college students. The SBI approach allows clinicians to identify individuals who may be using at a problematic level and provide information and resources to promote change immediately following assessment. This is advantageous for many reasons; first, it may capture individuals who are not explicitly seeking treatment for marijuana use, or who are not aware of resources available to them to reduce their use. Due to the brief nature of the screening and intervention process, it is possible to screen a larger number of people that may benefit from interventions, and deliver interventions to a larger number of individuals. These brief interventions may be delivered in a wide variety of settings, which is particularly advantageous to reaching a large, diverse patient population.

Screening and Brief Intervention for College Students in Health Settings

The fact that SBIs can be examined in a variety of settings (e.g., community health centers, health fairs, emergency departments [EDs]) is a significant benefit. Screening and brief intervention has been used for hazardous drinking in a number of different medical settings (e.g., Fleming et al., 2010; Solberg, Maciosek, & Edwards, 2008), and there has been a shift towards using similar SBI in primary care to address substance use (Johnson & Seale, 2015). Work to date in college students has primarily been in SBIs for alcohol use. In colleges, these SBIs have been used in health centers, as a general college-wide screener, as a screener for first-year students, and as part of judicial/grievance hearings and proceedings (Barnett, Murphy, Colby, & Monti, 2007; Larimer, Cronce, Lee, & Kilmer, 2004). Students who drink heavily during high school tend to continue these patterns in college; even those that do not drink much in high school tend to increase their drinking over and above their non-college peers (Larimer et al., 2004). As a result, many campuses have implemented substance screening and training to provide education and/or intervention. These may take the form of email surveys, groups, in-person feedback, incorporation into orientation or residence halls, or other approaches. Involvement in fraternities or sororities is associated with higher rates of alcohol use (Presley, Meilman, & Leichliter, 2002), and some studies have showed the SBIs using a motivational-interviewing approach with fraternity men to have an impact on reducing alcohol use (Larimer et al., 2001). Athletics are also associated with higher rates of alcohol use (Baer, 2002; Bartholow, Sher, & Krull, 2003); approaching athletic teams has been another context in which screening and brief intervention for alcohol has

been used among college students (Cimini et al., 2015). Clearly, implementing SBIs in contexts in which alcohol or substance use may be elevated and in populations that would not seek treatment outside of these contexts have the possibility of catching and correcting alcohol and substance use before negative consequences continue to have short- or long-term negative consequences.

Screening and Brief Intervention for College Students in Student Health Centers

In addition to these contexts, SBIs have also been more extensively implemented in Student Health Centers (SHCs) (e.g., Amaro et al., 2010; Denering & Spear, 2012; Kypri et al., 2014) that are present at most universities. SHCs are a gateway for students seeking a number of health-related services, such as primary and urgent care, health and wellness counseling, and mental health services (e.g., Kypri, Langley, Saunders, Cashell-Smith, & Herbison, 2008; Martens et al., 2007), and are an ideal location to utilize SBIs. Further, previous studies suggest that students who seek services for physical or mental health may also be at higher risk for substance use (e.g., Nicholi, 1983; Polen, Sidney, Tekawa, Sadler, & Friedman, 1993). Given that students are often not seeking substance use treatment, this could be a way to engage them while they seek other medical care. Studies have shown that while SBIs were originally developed for use in Emergency Departments (EDs), screening and delivering brief interventions in SHCs may reach a higher proportion of risky/problematic drinkers that would otherwise be unseen or uncaptured (Ehrlich, Haque, Swisher-McClure, & Helmkamp, 2006).

Student health care services may be a particularly opportunistic setting in which to deliver SBIs (Schaus et al., 2009). Data from The American College Health

Association (ACHA), the leading professional organization for practitioners in college health, estimates that approximately 1,500 health services exist on college campuses providing medical and behavioral services to students (Turner & Keller, 2015). A large proportion of graduate students rely primarily on university insurance for their health care needs. Indeed, the Fall 2018 College Health Surveillance Network (CHSN), produced by the ACHA noted that 46.9% of graduate students reported having university-sponsored insurance. The high utilization of these services makes it a particularly good setting to conduct screening and brief intervention among students. Large percentages (greater than 50%) of these graduate students reported receiving information from their universities on a number of different health-related concerns, such as depression, anxiety, alcohol use, substance use, diet, and exercise (ACHA, 2018). In a 2015 analysis of all available CHSN data, over 800,000 individuals reported using the health centers for their care, comprising 4.17 million patient encounters. Further, a large proportion of the students surveyed (approximately 32%) used the health services at least once during a 12-month period. Additionally, graduate students tended to seek out services at higher rates than undergraduates overall, at a rate of 28% of enrolled obtaining services at a Student Health Center (SHC) vs. 22% of undergraduates (Turner & Keller, 2015). Rates by university were even higher for private universities.

While accessing services about their health, students may be more open to considering their own substance use and its relation to their health and well-being. An early study of SBI in a SHC showed that the majority (75%) students receiving alcohol-oriented SBIs in SHCs found SBIs to be helpful in exploring and/or reducing their

substance use (Ehrlich et al., 2006). The majority of students (92%) reported finding the information clear, and that SHCs were good locations to learn information about substance use (90%) (Ehrlich et al., 2006). Typically, services for substance use are only available via referrals from primary care providers, and these issues may not naturally arise during a visit to a SHC, depending on the nature of their primary appointment. Due to this fact, SBIs may allow for a more standardized method to screen a larger proportion of students that utilize SHCs, regardless of their initial reason for making an appointment or seeking other medical treatments.

Clearly, SBIs have potential significant promise for being a tool to utilize among college students for alcohol and substance disorders, and hold multiple advantages to more traditional screening methods. Namely, they can increase the number of students screened, reach students who may be using problematically but are not actively seeking treatment, increase dissemination and utilization of substance treatment resources, and decrease substance use in this population. However, given the variability in study design and findings to date, further and/or alternative investigations are needed to clarify these potential benefits. Despite the advantages, SBIs still have a number of drawbacks, including clinician burden (e.g., time spent face-to-face delivering screening and interventions), difficulty engaging students and demand on students' time, and missed opportunities to screen a larger number of students, depending on the availability of clinicians. Improvements in technology could be one avenue in which to combat some of these shortcomings.

Electronic Screening and Brief Interventions

The ubiquity of computers, cell phones, tablets, and the Internet has led to new ways to deliver SBI that can address some of the barriers of implementation of traditional face-to-face SBI. Electronic SBI (eSBI) are computer-, web-, and phone-based interventions that utilize the core principles of SBI, but offer a number of additional benefits. Online and web-based interventions are utilized in treatment for a number of reasons: ease of dissemination, high reliability and consistency, and increased privacy when seeking substance use treatment that that individuals may otherwise avoid seeking due to increased disclosure (Beich, Gannik, & Malterud, 2002; Ondersma, Chase, Svikis, & Schuster, 2005). Further, eSBI can offer more cost-effective interventions when compared to traditional face-to-face interventions, saving time on clinician training, effort, and time commitments/burden (Donoghue, Patton, Phillips, Deluca, & Drummond, 2014). The main cost of eSBI is incurred during development, with limited subsequent costs, resulting in increased economic efficiency and lowered cost burdens to institutions and treatment-seekers alike (Linke, Murray, Butler, & Wallace, 2007). Electronic SBI approaches can offer effective delivery of intervention in a variety of settings; for example, primary care facilities, emergency departments, student health centers, or even off-site/non-clinical locations. Given the numerous barriers to those that could benefit from interventions (e.g., clinician burden, low time availability for engaging in treatment, low accessibility to interventions/interventionists), this expands access to and utilization of care.

Studies have shown support for use of eSBI among college populations for reducing hazardous drinking. A meta-analysis by Carey et al. (2009) reviewed 35 studies that used eSBI in college populations, and found qualified support for the efficacy of these to reduce alcohol use and alcohol-related problems in college students.

Improvement over time varied across outcomes, with interventions having more effects on drinks/day and maximum drink per drinking occasion consumed at short-term (≤ 5 weeks). These results did not hold at longer-term outcomes. However, overall reduction in quantity consumed over time was present at longer-term assessments. Compared to no intervention, eSBIs reduced quantity and frequency of alcohol use over short- and long-term outcomes, with a small effect size ($d = 0.09 - 0.28$). These rates are similar to those found in the general population while utilizing eSBI for alcohol use. (Carey, Scott-Sheldon, Elliott, Bolles, & Carey, 2009).

Electronic Screening and Brief Interventions of College Student Marijuana Use

While there have been a number of studies that have used eSBI to date have focused on addressing alcohol use (e.g., Carey et al., 2009), relatively few studies have examined eSBI on marijuana use. Of the few recent studies have examined the use of eSBI for marijuana among college students, most found them to be feasible, but with limited efficacy (Amaro et al., 2010; Denering & Spear, 2012; Elliot & Carey, 2012; Lee, Neighbors, Kilmer, Larimer, 2010; Neighbors, Kilmer, Larimer, 2010; Palfai et al., 2014).

In the extant literature, only four studies specifically targeted marijuana use with eSBI, instead of substance use as a broader target (Elliot & Carey, 2012; Lee et al., 2010; Palfai et al., 2014; Riggs et al., 2018; Riggs, Romaine & Kavanaugh, 2018). Lee et al.

(2010) sought to evaluate a personalized feedback intervention for at-risk marijuana users transitioning to university. Students were randomly assigned to a web-based personalized feedback intervention (PFI) or control condition, and eligible participants were stratified into quartiles based on frequency of use in the past 3 months. The PFI was based on Motivational Interviewing (MI) principles, and participants could review immediate feedback online after completion of the survey regarding perceived and actual descriptive norms for their marijuana use, as well as pros and cons of marijuana use. Additionally, self-identified negative consequences related to social and academic arenas were included in the feedback. Finally, the feedback included tips for how to avoid using marijuana, and how to make the changes they identified wanting to make in their use by way of providing alternative activities on campus and in the community. While they did not find any overall effect of the intervention, they did find that readiness-to-change moderated the efficacy of the intervention on marijuana use those participants that were higher in contemplation substance of the Readiness-to-Change (Lee et al., 2010) at baseline. For the control group, there were no changes in marijuana use as a function of contemplation. In contrast, marijuana use at 3-months was significantly reduced among those in the intervention group who were higher on contemplation. These results were not observed at 6 months in either condition. Contemplation did not interact with treatment condition for marijuana-related problems at either 3- or 6-months. These findings provided some limited support that those higher on motivation-to-change may show greater responsiveness to the intervention in terms of marijuana use in the short terms.

Other studies have shown some evidence that web-based intervention may lead to a reduction in marijuana-related negative consequences (Palfai et al., 2014), as well as reducing perceived peer norms of marijuana use (Elliot & Carey, 2012; Palfai et al., 2014). Elliott & Carey's 2012 study utilized eSBI in an undergraduate college population to look at the effects of a commercially-available eSBI for college undergraduate students (eCHECKUPTOGO-marijuana) on marijuana use, descriptive norms (perceptions of others' use), and injunctive norms (perception of others' approval of use) at 1-month outcomes. Students were recruited from university psychology courses at a large private northeastern university for course credit. Participants in the eSBI condition received feedback on marijuana use, pros and cons, perceived norms of use, other valued activities, involvement with alcohol and cigarettes, and money spent on all substances. Their feedback included comparisons between descriptive norms and actual norms, annual money spent on substances, suggestions for campus resources that may benefit them, and possible steps to decrease use. Participants were included if they endorsed any lifetime use of marijuana. Participants receiving the intervention condition estimated lower perception of others' use (descriptive norms) than the control group and fewer believed friends disapproved of their choice to abstain (injunctive norms). Rates of use did not, however, differ between control and intervention conditions. Overall, this study found that the intervention provided some evidence in correcting marijuana-related norms but not use.

Riggs et al. (2018) utilized the commercially available eSBI for college undergraduate students (eCHECKUPTOGO-marijuana) in another short-term (6 week)

follow-up study comparing a modified eCHECKUPTOGO-marijuana to include personalized feedback (BF) and protective behavioral strategies (PBS). Undergraduate students were recruited in the fall semester of the school year via emails, fliers, social media advertisements, and peer referrals. Students were included in the study if they reported marijuana use of at least twice a week for non-medicinal purposes. This study was investigating the eSBI in a state where marijuana use was legal, and purposefully included a subset of all marijuana users they defined as “recreational users”. Those in the intervention condition completed off-site/at-home eCHECKUPTOGO-marijuana assessments, with PF and PBS. Those in the control condition received “Health Stress Management” (HSM) feedback (undefined in author’s publication). In the 6-week follow-up, the intervention condition showed reductions in many measures of frequency of use (hours “high” per week, days “high” per week, weeks “high” per month, and periods “high” per week), as compared to the control condition. They did not find reductions in one measure of frequency, hours “high” per day, as compared to the control group. The study found reductions in descriptive norms, but no reduction in injunctive norms at follow-up in the intervention group as compared to the control group.

Palfai et al. (2014) also used the commercially available eSBI for college undergraduate students (eCHECKUPTOGO-marijuana) compared with an assessment-only control group, but also assessed longer follow-up times (e.g., 3 months, 6 months), as well as effects on frequency of use. Students were screened in the waiting room of a SHC and those who reported marijuana use at least monthly use in the past 90 days were eligible. Those in the eSBI received personalized feedback on their marijuana use,

including costs, norms, risks, consequences, and alternative activities. Those in the control condition were given basic feedback on health information such as sleep, exercise, and nutrition. Frequency of days using marijuana was not influenced by the intervention. However, there was a small effect on reducing negative consequences for the eSBI group. The intervention was also associated with reducing students perceived peer marijuana use norms; no effect was found on readiness to change. These results suggest that reductions in consequences without a corresponding change in days used may be due to other reasons (e.g., contexts used, frequency of use, more effective coping strategies). The change in perceptions without change in frequency of use may also suggest that changing norms may not be sufficient to produce change in the amount of marijuana used. Taken together, more exploration of exploring other mediators and moderators may be of use. These results, taken together, suggests that the eSBI has utility in correcting misperceptions about others' use. However, there has been limited evidence from randomized controlled trials of the efficacy of eSBI on reducing marijuana use frequency to date.

Most studies of eSBIs with marijuana-using populations have utilized a single session of brief intervention. Although there is support in the alcohol literature of the impact of single session eSBIs among college students, the duration of these effects tend to be limited, as the magnitude of eSBI effects on college student alcohol use may diminish as early as six to eight weeks following an intervention (Carey, Scott-Sheldon, Elliott, Garey, & Carey, 2012; Carey et al., 2009; Walters, Vader, & Harris, 2007). Improvements over time vary across outcomes, with inconsistent findings for medium- to

long-term outcomes of 6-months or greater (Carey et al., 2009). Despite the promise of eSBI for college marijuana use, there is little evidence of single sessions to reduce marijuana use and consequences among undergraduate populations. Furthermore, it is unclear whether the same strategies of addressing marijuana use would have impact among graduate students as no study has yet addressed this issue among this population.

Booster Sessions

Given the mixed evidence for short-term benefits of eSBI on marijuana outcomes following interventions, it may be particularly important for investigators to develop methods to enhance the effects of interventions over time through alternative strategies such as booster sessions. Studies have shown that interventions are often superior to control conditions, but that interventions plus booster sessions are often superior to stand-alone intervention conditions, for example showing a dose/response effect that was significant for intervention+booster but not stand-alone interventions (Stein et al., 2009), and showing reduction in negative consequences and substance-related injuries in an intervention+booster conditions but not the stand-alone interventions (Longabaugh et al., 2001). Recent effectiveness trials with eSBIs for college student drinking have suggested that repeated feedback may be important to be effective over longer-term outcomes (Neighbors, Lewis, et al., 2010). Some studies have found support booster sessions in eSBI, though results have been limited, with some demonstrating prolonged effects up to one year (e.g., Longabaugh, 2001). A particular strength of electronic interventions, such as eCHECKUPTOGO-marijuana, is that it is easy to deliver repeated contacts with desired content in order to extend care (Humphreys & Tucker, 2002). Allowing students

to complete these electronic interventions on additional occasions may allow them to compare current and past use, and to consider how these changes over time may be related to costs, consequences, and goals. Access to intervention-relevant content on multiple occasions may be an important part of interventions that seek to promote health behavior change over time. Given the multiple negative outcomes associated with use among students, it is important to identify effective, feasible, and acceptable interventions.

Moderators of the Intervention

Due to the variability in outcomes across studies, examining moderators of interventions has become an increasing focus of researchers. By identifying potential variables or processes that may be contributing to variability across studies, it allows further tailoring and refining of interventions to optimize treatment efficacy. Identification of these factors may serve to identify those who may most benefit from specific approaches, as well as to inform the development of more effective intervention approaches.

Some of the more common moderators examined in eSBI studies are quantity of alcohol/substance consumed, frequency of days used and days of heavy use, patient satisfaction, in-person versus computer-based interventions, additional substance-related negative consequences, mandated- vs. treatment-seeking populations, norms (injunctive and descriptive), readiness to change (using the Readiness to Change Questionnaire (RTCQ), and settings of interventions.

The majority of substance use eSBI studies of moderators have been conducted with alcohol outcomes, likely due to the fact that there are more alcohol eSBI studies available to date. Many studies have found heavier drinking associated with factors linked to poorer response to treatment, such as in higher negative attitudes towards eSBI and less engagement in interventions. In general, eSBIs for heavier users have been less efficacious than traditional SBIs (Fankhaenel et al., 2018), and study participants tend to show greater responsiveness to in-person versus electronic interventions (Baumann et al., 2018). However, other studies have found greater reduction in moderate to heavy drinkers (as compared to mild drinkers) that engaged in eSBI as compared to traditional SBIs, depending on the setting of the intervention (e.g., inpatient/ED settings versus outpatient settings) (Amaro et al., 2010; Fernandez et al., 2019).

Many different settings have been examined in moderation analyses, such as emergency departments (EDs) (e.g., Horn, Crandall, Forcehimes, French, & Bogenschutz, 2017; Saitz, 2015); fraternities, sororities, and workplaces (Kuntsche, Kuntsche, Thrul, & Gmel, 2017) However, none of these studies have found clear evidence for specific setting moderators of alcohol brief interventions (McClatchey, Boyce, & Dombrowski, 2017).

While moderators of intervention in SBI for alcohol have focused mostly on frequency/quantity used and settings of interventions, investigators have also explored psychological moderators including norms and readiness-to-change (DeJong & Linkenbach, 1999; Merrill, Wardell, & Read, 2015; Neighbors, Geisner, & Lee, 2008). For both alcohol and marijuana use, most students overestimate use (i.e., “descriptive

norms”) and approval (i.e., “injunctive norms”) by their peers, and thus see their own use as less problematic (Borsari & Carey, 2003). By correcting these misperceived norms, students are thought to gain perspective on their use, and are then more likely to reduce use and change attitudes about substance use (Borsari & Carey, 2003). Research and public health perspectives postulate that college students may routinely overestimate peer use and approval of use, which is inaccurate. These inaccurate perceptions can be associated with increased risk for personal use (ACHA, 2018). Evidence of the importance of social norms in alcohol and marijuana use among young adults has two important implications. First, providing norms to individuals engaged in eSBIs that are specific to their peer group (e.g., college-specific samples versus US-wide campus samples; undergraduate samples versus graduate samples) may serve to influence alcohol and marijuana use behavior. Second, those who tend to have the largest overestimate of norms may be most likely to be influenced by interventions that include components that correct these overestimates.

The literature has demonstrated a consistent relationship between overall (descriptive and injunctive) drinking norms and drinking behavior, with overestimation of norms being associated with heavier drinking and a greater number of negative consequences (Borsari & Carey, 2001; Larimer et al., 2004; Lewis & Neighbors, 2004; Lewis et al., 2010; Neighbors, Lewis, Bergstrom, & Larimer, 2006). Descriptive norms research has focused mostly on frequency and quantity of alcohol use (Borsari & Carey, 2001, 2003; Lewis & Neighbors, 2004; Neighbors et al., 2006), whereas research on injunctive drinking norms has focused on severity of alcohol use (e.g., drinking enough

alcohol to pass out, drinking alcohol daily) and alcohol-related negative consequences (Baer, 1994; Carey et al., 2006; Chawla et al., 2007; Larimer et al., 2004). Research in both descriptive and injunctive norms has shown that individuals' greater association with group norms (e.g., same gender, race, sorority/fraternity status) has a stronger relation to drinking status and outcomes in studies (Lee, Geisner, Patrick, & Neighbors, 2010; Neighbors, LaBrie, et al., 2010; Neighbors, Lewis, et al., 2010; Neighbors et al., 2006).

Research specific to marijuana use in college students has found support for descriptive norms (of peers) and injunctive norms (of peers and parents' approval) being related reductions in frequency and consequences of use (Buckner, 2013; Buckner, Walukevich, Lemke, & Jeffries, 2018). However, these studies were cross-sectional in nature, and therefore not able to speak to the impact of these on changes in frequency of use over time. Elliott and Carey (2012) examined the role of injunctive and descriptive norms in a study comparing intervention (eCHECKUPTOGO-marijuana) to a control group for short-term (1 month) outcomes. They found preliminary evidence for utility of the intervention in correcting misperceptions, with those in the intervention group estimating lower descriptive norms than the control group at 1-month follow-up. However, these changes did not effect changes in frequency of use at follow-up.

Readiness- to-change (RTC) has been examined in many studies of alcohol SBIs/eSBIs. Readiness to Change is a component of the Transtheoretical Model (Prochaska & DiClemente, 1983), an integrative, biopsychosocial model of conceptualizing the process of behavior change. Stages of Change are defined as Pre-

contemplation (not ready for change), Contemplation (getting ready for change), Preparation (ready to change), Action (actively making changes), and Maintenance (maintaining changes already in motion and/or those that have been established). The changes can happen linearly, though that is not always the case; additionally, individuals can cycle through the stages multiple times in the course of behavior modification. It is believed that, as individuals move through the stages of change, they may be more or less receptive to receiving information or making changes in their behavior. Generally, as they progress through the stages denoted above, individuals are more likely to make a change in a behavior(s). Results in alcohol eSBI have varied when examining RTC as a moderator of interventions, with some finding no impact of RTC (Maisto et al., 2001), while others found RTC as a significant predictor of outcomes (Amaro et al., 2010; Merrill et al., 2015). Other studies have examined RTC as a moderator while breaking it down into individual scales to more closely monitor potential moderator effects. Using individual scales of the RTC questionnaire, some studies have found that participants reporting higher levels on even the earliest stage of change (i.e., Pre-contemplation) showed more reductions in weekly drinking when exposed to information provided in an intervention (Grossbard et al., 2016; Maisto et al., 2001). This suggests that increasing awareness alone may be enough to reduce risky substance use behaviors. Other studies have suggested a curvilinear relationship with RTC and outcomes, suggesting the “optimal” level of RTC to be before those in the median range of the measure (Cadigan, Martens, Arterberry, Smith, & Murphy, 2013). Currently, there is wide variability and no clear consensus for how RTC may moderate alcohol-related interventions.

In the few studies of eSBIs for marijuana, there has been suggestive evidence that RTC may be a potential moderator; however, different components of RTC have been identified as important in different studies. Earlier studies (e.g., Lee et al., 2010) found that, while not statistically significant, students higher in the Contemplation subscale of the RTC questionnaire had better outcomes and follow-up on frequency of use and consequences when exposed to an intervention condition. Studies of both Palfai et al. (2016) and Lee et al. (2010) found that RTC may moderate the impact of in SBIs on marijuana outcomes, though for different subcomponents. Palfai et al.'s 2016 publication utilized data from the pilot study conducted in 2014 in order to examine the role of RTC as a moderator of interventions. The authors found that those in the intervention condition who were high on the Action subscale of the RTC Questionnaire experienced greater reductions in frequency, as compared to those lower on the Action subscale. In the Action stage, an individual has taken action (s) and/or has begun to modify behaviors related to the target outcome. In addition to the modification of behavior, there is an enhanced commitment to change (McClellan, Schneider, & Perney, 1998). Taken together, this hypothesizes that an individual would experience greater outcomes in an intervention than those in a different stage of change. Indeed, a significant interaction between Action and intervention was observed on frequency of marijuana use at 3-month outcomes. Among those high on the Action subscale, those who received the intervention smoked less frequently than those in the control condition at 3-months. In this study, the role of Contemplation (measured by problem recognition) was not found to moderate the intervention. Lee et al. (2010), on the other hand, found that participants high on the

Contemplation subscale had significantly fewer days of marijuana use at 3-month outcomes compared to those with lower contemplation scores among those in the intervention condition; this finding was not observed among those in the control condition. While in Contemplation, individuals spend time and energy into thinking of ways to solve the problem (e.g., questioning, researching) but this is distinct from actually taking action to effect behavior change (McClellan et al., 1998). Despite the inconsistencies regarding scales of the RTCQ, findings from these studies suggest that RTC may be important to consider when considering the efficacy of eSBI for marijuana use.

CHAPTER TWO: THE PRESENT STUDY

Overview

Given the health, academic, and interpersonal consequences associated with marijuana use among graduate students, it is important to identify efficacious, feasible, interventions that are readily integrated into graduate student lives and acceptable for those who use them. Although investigators have begun to address this issue among undergraduates, there have been no studies conducted for graduate students. Moreover, the limited support to date for eSBI for marijuana over extended (6 months or greater) outcomes suggests that single dose intervention approaches may need to be enhanced through modifications such as repeated delivery of information and feedback (e.g., “booster sessions”).

This study addressed these issues through a pilot randomized controlled trial on the effects of a repeated web-based marijuana intervention (eCHECKUPTOGO-

marijuana) on marijuana use and consequences among graduate and professional students on marijuana use. The study was conducted within a Student Health Services (SHS) Center as this represents a highly utilized, “opportunistic context” in which to identify marijuana users through screening and delivering interventions.

Primary Research Questions

The primary aim of this study was to test the efficacy of an electronic screening and brief intervention approach to reduce marijuana use and consequences among graduate students presenting to a health services center on campus.

Hypotheses

Primary Hypothesis

Hypothesis 1

Graduate students randomized to the Brief Intervention (BI) condition will show greater reductions in number of days of marijuana use and negative consequences over the 6-month outcome time-period than those in the Assessment Only (AO) condition, controlling for baseline use and consequences.

Secondary Hypotheses

Hypothesis 2

Graduate students in the intervention condition (BI) will show significantly fewer days of marijuana use and number of negative consequences at 3-month follow-up than those in the assessment only (AO) condition, controlling for baseline use and consequences.

Hypothesis 3

The intervention (BI) will be more efficacious (i.e., fewer days of marijuana use and fewer negative consequences) among individuals that have higher estimates of descriptive norms of marijuana use at baseline compared to those who had lower estimates of norms.

Hypothesis 4

The intervention (BI) will be more efficacious (i.e., fewer days of marijuana use and fewer negative consequences) for individuals who are high on the Action scale of the Readiness to Change Questionnaire at baseline compared to those who are lower on the Action scale.

CHAPTER THREE: METHODS**Subject Selection and Recruitment****Participants**

Participants were 49 graduate students who presented to SHS and reported using marijuana at least monthly over the past 90 days (Mean number of days used = 35.61, SD = 33.03). Because the efficacy of this eSBI approach was not known, those who marijuana-specific ASSIST scores indicated a high likelihood of substance risk (i.e., marijuana ASSIST \geq 27) were not enrolled in the trial. The study was approved by the Boston University Institutional Review Board and informed consent was obtained for both screening and study participation.

Recruitment

Screening took place at Student Health Services (SHS) at Boston University (BU). Boston University is a private university with a large graduate and doctoral student population of over 15,000 individuals (BU Facts & Stats, 2018). Exact statistics for utilization of SHS are not available; however, all students are automatically enrolled in university-issued health insurance as a default, unless they can prove they have other outside (private) insurance that meets the minimum requirements by the State of Massachusetts for health insurance coverage. The SHS accepts university-issued insurance; they provide all services to any student at BU. If a student does not have the university-issued insurance, services are still available to students, though rates for services are determined and managed through their private insurances. During the school year, SHS is open 8:30am-4:30pm Monday-Friday, with shortened hours on Saturday for “urgent” visits. Primary Care and Behavioral Health have 24/7 on-call services for emergencies or urgent matters. Students are permitted to have appointments on a “walk-in” basis, though they’re encouraged to make appointments either online or by phone prior to needing to see a clinician. SHS provides services for incoming students (e.g., immunization compliance), for the BU community (e.g., flu shot clinics at SHS and around campus), and for current undergraduate and graduate students in primary care, behavioral medicine, wellness and prevention, athletic training, and sexual assault and response. While SHS does not have substance use treatment providers in the clinic, providers can connect BU students to substance use treatment in the community, provide details on how to obtain substance-free university housing, and link students to a

“Substance Free Student Network”, a student-run weekly support group for students interested in talking about and supporting other students through substance use. Of note, these services are only obtained through referrals by SHS doctors and staff for students expressly seeking substance use treatment, or those whose clinicians feel they may benefit from exploring these issues more fully. SHS has clinicians for each service area, and are able to refer students out to community providers for specialty services and/or ongoing treatments (e.g., extended psychiatric care for longer durations).

Upon entry to the waiting room or shortly after being seated, students who visited SHS were asked by a researcher if they would be willing to complete a one-minute screening questionnaire on health behaviors. Participation in screening was voluntary. Those that identified themselves as graduate students and agreed to participate were presented with a 9-item screening measure (described below) using a tablet computer. Those who reported at least monthly marijuana use in the past 90 days were identified as being potentially eligible for the study. These participants were approached to participate in the study which was described to them as an electronic study on student health behaviors.

Measures

Screening Measures

Initial Screener. A 9-item screening instrument was used to help determine eligibility; the measure included questions on gender, degree program, frequency of physical activity/exercise, dieting, satisfaction with eating patterns, self-assessment of stress, sleep, cigarette use, alcohol use, and cannabis use. Cannabis frequency was based

on the NIDA-modified version of the Alcohol, Smoking, and Substance Involvement Test (ASSIST) (Humeniuk et al., 2008), while alcohol use frequency was based on the Alcohol Use Disorders Identification Test (AUDIT) (Babor, de la Fuente, Saunders, & Grant, 1992). The other health-related questions were based on questions used in national health risk surveys (Harris et al., 2009). Participants were included if they selected “monthly” for marijuana use in the past 3 months (90 days). See Appendix A for instrument questions. See Appendix B for the Welcome Screen following completion of the screener for those that were eligible. See Appendix C for the additional instructions students were given at the 3-month booster session.

NIDA-Modified ASSIST—Marijuana. Study participants completed the remaining marijuana items from the NIDA-modified ASSIST (NIDA, 2002) in addition to the initial screening question to assess eligibility. The ASSIST has been validated in primary care populations. Questions included were about use, problems, and dependence symptoms in the previous 3 months. Further, summary scores provided an indication of level of substance use risk (i.e., low, moderate, high). The ASSIST has been shown to have high internal consistency (Cronbach's alpha scores of 0.77 and above), good to excellent test–retest reliability), high concurrent validity with positive correlations of 0.59 to 0.89 ($p = 0.001$) between the ASSIST and other similar instruments, and high discriminative validity to discriminate between non-problematic use (low risk), abuse (moderate risk), and dependence (high risk) (Mdege & Lang, 2011). Sensitivity of the ASSIST in previous reviews has been shown to be from 54% to 97% and specificity ranged from 50% to 96%, depending on the illicit drug (Mdege & Lang, 2011). Items

assessed for past 90 days of use, and items had varying weights by question for frequency and severity. The item was accompanied by a 3-month calendar starting from the date the participant was completing the assessment to provide anchors. Total scores ranged from 0 – 39, with total scores of 0 - 3 (low risk), 4 – 26 (moderate risk), and 27+ (high risk). For this study, students that scored ≥ 27 were excluded and provided with referrals for treatment. Items were standardized with a Z composite score for calculating internal consistency. For this study, the standardized Cronbach's alpha = 0.76, which is in the acceptable range for internal consistency. See Appendix D for instrument questions.

Assessments

Frequency of Marijuana Use - 90 Days. Number of days using marijuana in the past 90 days was assessed by the question, “During the past 90 days, on how many days did you use any kind of marijuana, blunts, or hashish?” This question has been adapted for use among adolescents and young adults (Lee et al., 2013). Total scores ranged from 0 – 90. The item was accompanied by a 3-month calendar starting from the date the participant was completing the assessment to provide anchors. See Appendix E for instrument questions.

Marijuana-Related Consequences. The Marijuana Problems Scale (Stephens, Roffman, & Curtin, 2000; Stephens, Roffman, & Simpson, 1994) was used to assess marijuana related negative consequences. It is composed of 19 items to assess the extent to which individuals have experienced problems related to their marijuana use in a variety of domains (e.g., interpersonal, physical, cognitive, legal, financial) over the past 90 days. Items were scored 0 (No Problem) to 2 (Serious Problem). Number and severity

of consequences was compiled as a total score, which ranged from 0 - 38. For this study, the Cronbach's alpha = 0.77, which is in the acceptable range for internal consistency. See Appendix F for instrument questions.

Readiness to Change Questionnaire (RTCQ). This 12-item measure modified for marijuana use (Stephens et al., 2007) was used to assess the level of motivation to change marijuana use. It has good internal consistency and test-retest reliability and has been used both as a measure of stage of change as well as a continuous measure of motivation (Budd & Rollnick, 1996; Stephens et al., 2007). Predictive validity is high, with stages of change correlating significantly to drinking outcomes (Heather, Rollnick, & Bell, 1993). Four questions comprise each of the scales, Pre-contemplation (e.g., "My marijuana smoking is ok as it is"), Contemplation (e.g., "I think I should cut down on my marijuana smoking"), and Action (e.g., "Anyone can talk about wanting to do something about marijuana smoking, but I am actually doing something about it"). Studies have reported internal consistency of the scale as follows: Pre-contemplation = 0.73, Contemplation = 0.80, Action = 0.85. Rest-retest reliability is: Precontemplation = 0.82, Contemplation = 0.86, Action = 0.78. Concurrent validity is predictive of orderly movement from one stage of change to the next (Heather, Gold, & Rollnick, 1991). Traditional scoring of this measure has item ranges from -2 (strongly disagree) to +2 (strongly agree), corresponding to minimum scale scores of -8, and maximum scale scores of +8. Total Readiness to Change for this scoring was a minimum of 8 and a maximum of 24. This study utilized a scoring of 1 (strongly disagree) to 5 (strongly agree) for individual items, corresponding to minimum scale scores of 4, and maximum

scale scores of 20. Total Readiness to Change for this study was a minimum of -12 and a maximum score of 36. For this study, the Cronbach's alpha for internal consistency is as follows: Pre-contemplation = 0.70, Contemplation = 0.82, Action = 0.79. All of these are within the acceptable ranges for internal consistency. The continuous measure of motivation to change used in this study was computed by subtracting the mean Pre-contemplation score from the sum of the Contemplation and Action scores (Budd & Rollnick, 1996).

Perceived Marijuana Norms. This measure assessed perceptions of marijuana use among college students, and has been modified to assess gender and university-specific questions to assess descriptive norms (Baer, Stacy, & Larimer, 1991; Lewis & Clemens, 2008). Each item was rated on a scale of 0 - 100%:

- 1) What percentage of Boston University students of your gender use marijuana more than you?
- 2) What percent of Boston University students use marijuana at least once a month?
- 3) What percent of Boston University students do not use marijuana at all in a typical month?

The composite variable of norms consists of a mean of the 3-items with Question #3 reverse-scored. Items were standardized for the composite index before the mean was calculated. For this study, the Cronbach's alpha = 0.82, which is in the acceptable range for internal consistency. See Appendix G for instrument questions.

Student Satisfaction Ratings. The Client Satisfaction Questionnaire (CSQ) - 8 (Larsen, Attkisson, Hargreaves, & Nguyen, 1979), a measure of participant satisfaction,

was modified and included at the 6-month follow-up assessment. The measure was modified to reflect the current study (i.e., not treatment-seeking, unaware of specific intervention to be delivered). The modified scale consisted of 5 Likert-scale items (e.g., “How easy was it to understand the assessment questions & feedback?”, 1 – Not at All, to 5 – Very). The original CSQ-8 was normed on a sample of $N > 8,000$. The original CSQ-8 showed reliability of $\alpha = 0.83 - 0.93$ (mode $\alpha = 0.86$ and 0.87). Predictive validity has been hypothesized and demonstrated by those participants with higher CSQ scores more so than non-completers. For this study, the internal consistency Cronbach’s $\alpha = 0.87$, which is in the acceptable range. Individual items range from 1 (Not at All) to 5 (Very); total scores range from 5 – 25, and a total average score was compiled for this study, ranging from 1 (Not at All Satisfied) to 5 (Very Satisfied).

Engagement in Additional Treatment. Participants completed a series of questions at the 6-month follow-up assessment regarding their engagement in additional (i.e., outside the context of this intervention) treatment-seeking for drug use and other health-related behaviors over the previous 6-month duration. These questions were asked in order to see if engagement in the intervention increased action related to substance use change. The questionnaire asked if students sought additional information through three different mediums: (1) online (e.g., “In the past 6 months, have you sought additional online information about drug use?”); (2) weblinks provided by Boston University (e.g., “In the past 6 months, have you sought additional information through BU weblinks about drug use?”); and (3) services available through BU SHS (“In the past 6 months, have you sought information/counseling through BU Services about drug use?”). These

questions were asked for drug use, nutrition, exercise, smoking, and alcohol use, for a total of 15 questions. Items were coded as 0 (No) to 1 (Yes).

Experimental Conditions

Assessment Only (AO): Students in this condition completed a series of questions about marijuana use and other health-related behaviors. They then received minimal electronic feedback based on their responses to questions on sleep, diet, and physical activity. Feedback was provided on recommended hours of sleep, frequency of exercise, and consumption of fruit and vegetables as compared to the answers they submitted. No feedback on marijuana use was provided in this condition.

Brief Intervention (BI): Students in this condition received eCHECKUPTOGO-Marijuana, a commercially available electronic intervention that is used widely in universities and colleges in the US and Canada (San Diego State Research Foundation, 2014). They received the intervention on two occasions, at baseline and following the 3-month follow-up outcome assessment (as a booster session). This electronic intervention consisted of an assessment section followed by personalized feedback about marijuana use, including costs, descriptive norms, risks, consequences, and potential alternative activities. Students were also provided with a series of harm- and frequency-reduction strategies (e.g., deciding which days not to use, leaving a party early). This “booster” session of eCHECKUPTOGO-marijuana provided repeated exposure to intervention content to reinforce learning and explicitly encouraged students to compare their current marijuana use and consequences to their previous patterns of use, as well as to consider progress on the pursuit of important life goals and activities.

Procedures

After completing the screening questionnaire, eligible students (defined by graduate students with use of marijuana at least monthly) were notified on the tablet that indicated eligibility to the researcher, who then provided a more comprehensive overview of the nature of what the study entailed. If a student chose to participate, they were consented to the study, and completed a registration process of choosing a username and password. Students were taken to a private room in SHS where they then completed the electronic baseline assessment measures which included the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). Students with scores of ≥ 27 were provided with information about their score and were given referrals for treatment available through BU available to them. These participants were excluded from further participation in the study (i.e., not randomized to condition). They were compensated and debriefed. Following baseline, students who were eligible following assessment were randomized to either the “Assessment Only” (AO) condition, or “eCHECKUPTOGO-marijuana + booster intervention” “Brief Intervention” (BI) condition. Following completion of baseline procedures, participants were reminded that they would be contacted at 3- and 6-month timepoints to complete electronic assessments. Those in the BI condition also completed the booster eCHECKUPTOGO-marijuana at the 3-month timepoint following the web-based assessment. Students were contacted with reminder emails and calls as necessary to complete the electronic assessments at 3- and 6-months at a location of their own choosing. Students were compensated \$25 for participation in

baseline assessment procedures, \$25 for the 3-month, and \$50 for the 6-month assessments.

CHAPTER FOUR: DATA ANALYSIS

Data Preparation

Descriptive statistics including frequency distributions were completed for all independent and dependent variables, demographic variables, and potential moderators at baseline. Data screening was utilized to check for missing values and assess assumptions of normality in distributions of data (Bentler, 1995; Jöreskog, 1993). Potential covariates (e.g., gender) were examined by group and in association with outcomes to determine whether they needed to be adjusted in analyses. To parallel the previous study of eCHECKUPTOGO-marijuana, the primary hypothesis of AO and BI on marijuana use and negative consequences was analyzed using latent growth modeling. Data were analyzed using Mplus (7), a latent variable software program (Muthén & Muthén, 2012). The Maximum Likelihood Estimator (MLR) was used to accommodate missing data in the two models. For the primary analysis, statistical significance of parameter estimates was evaluated for each analysis. Conditional latent growth models (LGMs) in which the slope was regressed on the intervention covariate an intercept were used in all analyses. Intervention condition was coded as an indicator variable (0,1) with 1 representing the active intervention condition. Latent growth models (Muthén & Curran, 1997) were specified to examine the influence of intervention on frequency of marijuana use and marijuana-related negative consequences. Prior to fitting conditional models with the intervention condition covariate, unconditional latent growth models were fit in each set

of analyses to establish an acceptable (e.g., good-fitting) temporal model, as well as to serve as a baseline for computing the effect sizes. Slope factor loadings were specified respectively as follows for baseline (T1), 3 months (T2), and 6 months (T3): 0, * (i.e., freely estimated), and 1 (as temporal change was not expected to be linear). The specification centers the intercept on the baseline time-point and the mean of the Slope factor provides estimates of the amount of change over the 6-month period. To test the conditional effect at the 3-month outcomes, Slope factor loadings were re-specified respectively as follows for baseline (T1), 3 months (T2), and 6 months (T3): 0, 1 *.

All remaining moderator and post hoc analyses were conducted using a multiple linear regression framework using SPSS 26. Baseline values of the relevant marijuana variable was entered on the first step and dummy coded intervention condition was entered on the second step. Because of the small sample size in the pilot, the main focus of analyses were to estimate effect sizes. Effect size estimates were determined based on R-squared change from the step in which the intervention was entered. To provide preliminary data regarding the impact of moderators that were most readily interpretable, the intervention effects were tested and plotted at high versus low values based on median splits. Although significance testing was utilized, the main focus of the outcome was to estimate the effect size of the intervention on relevant outcomes at 3- and 6-months.

Power Considerations

Sample size requirements were originally calculated based on the estimates for sufficient power (power = 0.8, level of significance $p < 0.05$) to identify medium-to-large

($f^2 = 0.25$) effect of the intervention (Cohen, 1988). However, due to the lower-than-expected rate of eligible participants, only 79 participants were enrolled. Effect size estimates for the intervention effect on frequency of days used in the past 90 and marijuana-related consequences were calculated. Due to the small sample size, moderator analyses must be interpreted with caution and provide preliminary data about the impact of these moderator variables on intervention efficacy.

Results

Screening and Enrollment

A total of 4,263 individuals were approached to be assessed for eligibility. Of those, 3,483 responded to the research assistant request and 1,225 identified themselves as a graduate student. A total of 701 graduate students completed screening. The Consort Diagram (Table 1) shows the flow of participants through the trial. Of the initial 701 that completed the screening, 107 were eligible, 79 were enrolled, 52 completed baseline, and 49 were randomized. Students were not randomized until they completed the baseline. The most common reasons for students not completing baseline were not being interested in participating, and/or not willing to come back to complete the baseline assessment. Three students were excluded after completing baseline due to ASSIST scores that were ≥ 27 . Those students received information on university and local resources on substance use and help in reducing their substance use. The remaining 49 randomized were then sorted into the Assessment Only (AO) condition ($n = 25$) or Brief Intervention (BI) condition ($n = 24$).

In the AO condition, 24 completed the 3-month assessment and 25 completed the 6-month assessment. ¹In the BI condition, 21 completed the 3-month assessment, and one was excluded at this time because of an ASSIST score of ≥ 27 . A total of 20 subjects provided data for the 6-month outcome in the BI condition. To provide a conservative estimate of the intervention effect, data from the excluded participant was carried forward for the 6-month outcome assessment¹.

Baseline Descriptive Characteristics

A summary of study participant characteristics by group can be found in Table 2. The racial composition of the sample was 78% White; 10% Asian; 4% Black/African American; 4% Native Hawaiian or Other Pacific Islander; and 4% Multiracial or Other. There were no significant differences between groups on the demographic variables of age [$F(3, 145) = 0.51$ $p = 0.67$], gender [$\chi^2(3) = 0.37$ $p = 0.95$], or indices of race [White vs . Other] [$\chi^2(12) = 15.52$ $p = 0.21$]. Similarly, no differences between groups on marijuana use variables were observed. The intervention condition (BI) and control condition (AO) did not differ between consequences, frequency of use, readiness to change, or norms at baseline (see Table 2). The BI condition reported a mean of 3.17 (SD = 3.21) consequences at baseline, while the AO condition reported 2.12 (SD = 2.17) consequences. Frequency of use (in the past 90 days) for the BI condition was 39.21 (SD = 32.93) and for the AO condition was 32.16 (SD = 33.42). Readiness to Change (RTC) Total for the BI condition was 5.17 (SD = 9.39) and for the AO condition was 2.44 (SD =

¹ Multiple imputation was also used as an additional means to address missing data with minimal change in findings described below.

7.79). Values for the individual scales of the RTCQ scales did not differ between groups. For the BI condition, the values of the subscales were: Pre-contemplation 14.71 (SD = 3.20), Contemplation 9.08 (SD = 4.02), and Action 10.80 (SD = 3.64). For the AO condition, the values of the subscales were: Pre-contemplation 15.36 (SD = 2.75), Contemplation 8.04 (SD = 3.01), and Action 9.76 (SD = 4.19). In the BI condition, norms values at baseline were: “What percent of BU students use marijuana more than you?” 23.58 (SD = 20.08), “What percent of BU students use marijuana at least once a month?” 46.04 (SD = 24.62), “What percent of BU students have not used marijuana in the past 3 months?” 45.21 (SD = 21.14), composite Z score (mean of items, with last question reverse-scored, and all items standardized) = -0.06. In the AO condition, norms values at baseline were: “What percent of BU students use marijuana more than you?” 25.80 (SD = 17.28), “What percent of BU students use marijuana at least once a month?” 45.76 (SD = 23.49), and “What percent of BU students use marijuana more than you?” 39.96 (SD = 18.69), composite (mean of items, with last question reverse-scored, and all items standardized) = 0.06.

Primary Analyses

Primary Aim (Aim #1).

Graduate students randomized to the Brief Intervention (BI) condition will show greater reductions in number of days of marijuana use and negative consequences over the 6-month outcome time-period than those in the Assessment Only (AO) condition, controlling for baseline use and consequences.

Descriptive Statistics of Frequency of Use and Consequences at 6 Months.

At 6 months, the BI condition had a frequency of use of 25.62 days (SD = 30.94) in the past 90 days. The AO condition had a frequency of use of 29.16 days (SD = 36.21) in the past 90 days. At 6 months, the BI condition reported consequences at 2.10 (SD = 3.13) (scale range 0 - 38), and the AO condition reported consequences at 1.52 (SD = 1.98) (scale range 0 - 38).

Effect of Intervention on Marijuana Outcomes.

The conditional latent growth model (LGM) suggested that the intervention influenced marijuana use over time. The LGM provided suggestive evidence of an intervention effect on the frequency of use, $B = -9.30$ [$se = -0.27$], $p = 0.10$ over the course of 6 months as it showed a small to medium effect ($f^2 = 0.09$) on marijuana use frequency, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively). See Figure 1.

The conditional latent growth model (LGM) did not provide suggestive evidence of an intervention effect on consequences of use $B = 0.11$ [$se = 0.03$], $p = 0.86$, over the course of 6 months. The intervention showed a negligible effect ($f^2 = 0.002$) on consequences, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively). See Figure 2.

Secondary Analyses

Secondary Aim (Aim #2).

Graduate students in the intervention condition (BI) will show significantly fewer days of marijuana use and number of negative consequences at 3-month follow-up

compared to those in the assessment only (AO) condition, controlling for baseline use and consequences.

Descriptive Statistics of Frequency of Use and Consequences of Use at 3 Months.

At 3 months, the BI condition had a frequency of use of 27.33 days (SD = 25.17) in the past 90 days. The AO condition had a frequency of use of 31.58 days (SD = 34.21). At 3 months, the BI condition reported consequences at 2.14 (SD = 2.37), and the AO condition reported consequences at 1.46 (SD = 1.74).

Effect of Intervention on Marijuana Outcomes.

The conditional latent model (LGM) provided suggestive evidence of an intervention effect on the frequency of use. $B = -9.641$ [$se = -0.16$], $p = 0.03$ over the course of 3 months. The intervention showed a small- to medium-effect ($f^2 = 0.10$) on marijuana use frequency, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively). See Figure 1.

The conditional latent model (LGM) did not provide evidence of an intervention effect on consequences of use, $B = -6.54$, [$se = -0.10$], $p = 0.27$, over the course of 3 months. There was evidence of a small effect size ($f^2 = 0.022$) on consequences, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively). See Figure 2.

Moderators of Intervention Effects

In addition to the main effects of intervention, the current study examined two variables as potential moderators based on previous research, descriptive norms, and the Action subscale of the Readiness-to-Change measure.

Secondary Aim (Aim #3).

The intervention (BI) will be more efficacious (i.e., fewer days of marijuana use and fewer negative consequences) among individuals that have higher estimates of descriptive norms of marijuana use at baseline compared to those who had lower estimates of norms.

Norms as a Moderator of Intervention Effects.

The multiple regression analyses did not provide evidence of a moderating effect of descriptive norms of marijuana use on marijuana frequency at 3 months, controlling for baseline marijuana use frequency, $B = 1.95$ [$se = 7.35$], $t = 0.26$, $p = 0.79$. See Table 3.

The multiple regression analyses did not provide evidence of a moderating effect of descriptive norms of marijuana use on marijuana frequency at 6 months, controlling for baseline marijuana use frequency, $B = 8.72$ [$se = 8.28$], $t = 1.05$, $p = 0.30$. See Table 4.

The multiple regression analyses did not provide evidence of a moderating effect of descriptive norms of marijuana use on negative consequences at 3 months, controlling for baseline negative consequences, $B = 0.68$ [$se = 0.65$], $t = 1.05$, $p = 0.30$. See Table 5.

The multiple regression analyses did not provide evidence of a moderating effect of descriptive norms of marijuana use on negative consequences at 6 months, controlling for baseline negative consequences, $B = 1.91$ [$se = 0.98$], $t = 1.95$, $p = 0.06$. See Table 6.

It is important to note, that because this is a pilot study with a small sample size, it was not unexpected that the interaction was not significant. In order to more fully examine the impact of the role of moderation of norms in interaction with the intervention, we conducted simple slopes analyses at the high and low levels of the variable to give a preliminary test of these hypotheses. The Norms scale was dichotomized in order to test the interaction between level of descriptive norms (High versus Low) and Intervention Condition.

Results did not show significant change for frequency of use at 3 months for either low or high estimates of norms. For those with low estimates of norms, $B = -10.95$ [$se = 8.40$], $p = 0.20$; for those with high estimates of norms, $B = -8.89$ [$se = 6.53$], $p = 0.18$. See Table 7. See Figure 3 for simple slopes linear regression analyses.

Results did not show significant change of frequency of use at 6 months for either low or high estimates of norms. For those with low estimates of norms, $B = -14.04$ [$se = 9.93$], $p = 0.17$; for those with high estimates of norms, $B = 0.61$ [$se = 8.16$], $p = 0.94$. See Table 8. See Figure 4 for simple slopes linear regression analyses.

Results did not show significant change for consequences of use at 3 months for either low or high estimates of norms. For those with low estimates of norms, $B = -0.79$ [$se = 0.479$], $p = 0.10$; for those with high estimates of norms, $B = 0.84$ [$se = 0.88$], $p = 0.35$. See Table 9. See Figure 5 for simple slopes linear regression analyses.

Results did not show significant change for consequences of use at 6 months for either low or high estimates of norms. For those with low estimates of norms, $B = -1.37$ [$se = 0.71$], $p = 0.06$; for those with high estimates of norms, $B = 2.19$ [$se = 1.26$], $p = 0.09$. See Table 10. See Figure 6 simple slopes linear regression analyses.

Secondary Aim (Aim #4).

The intervention (BI) will be more efficacious (i.e., fewer days of marijuana use and fewer negative consequences) for individuals who are high on the Action scale of the Readiness to Change Questionnaire at baseline compared to those who are lower on the Action scale.

Action Scale Score from the Readiness to Change Questionnaire as a Moderator of Intervention Effects.

The multiple regression analyses did not provide evidence of a moderating effect of high Action scale scores use on marijuana frequency at 3 months, controlling for baseline marijuana use frequency, $B = -7.47$ [$se = 4.98$], $t = -1.50$, $p = 0.14$. See Table 12.

The multiple regression analyses did not provide evidence of a moderating effect of high Action scale scores use on marijuana frequency at 6 months, controlling for baseline marijuana use frequency, $B = -2.35$ [$se = 6.43$], $t = -0.37$, $p = 0.72$. See Table 13.

The multiple regression analyses did not provide evidence of a moderating effect of high Action scale scores use on negative consequences of marijuana at 3 months, controlling for baseline negative consequences, $B = -0.50$ [$se = 0.38$], $t = -1.34$, $p = 0.19$. See Table 14.

The multiple regression analyses did not provide evidence of a moderating effect of high Action scale scores use on negative consequences of marijuana at 6 months, controlling for baseline negative consequences, $B = 0.19$ [$se = 0.73$], $t = 0.27$, $p = 0.79$. See Table 15.

It is important to note, that because this is a pilot study with a small sample size, it was not unexpected that the interaction was not significant. In order to more fully examine the impact of the role of moderation of norms in interaction with the intervention, we tested simple effects at the high and low levels of the variable to give a preliminary test of these hypotheses. The Action scale of the RTC scale was dichotomized in order to test the interaction between level of the Action scale of the RTC scale (High versus Low) and Intervention Condition.

Results showed that the intervention shows statistically significant reductions in frequency of use among those high in Action at 3 months, but not those who were low, controlling for baseline frequency. For those who were low on the Action scale, $B = -2.67$ [$se = 5.51$], $p = 0.63$; for those who were high on the Action scale, $B = -17.75$ [$se = 8.01$], $p = 0.03$. See Table 16. See Figure 7 for simple slopes linear regression analyses.

Results did not show statistically significant reductions in frequency of use among those high in Action at 6 months for either high or low values, controlling for baseline consequences. For those who were low on the Action scale, $B = -1.85$ [$se = 7.02$], $p = 0.79$; for those who were high on the Action scale, $B = -13.49$ [$se = 9.07$], $p = 0.14$. See Table 17. See Figure 8 for simple slopes linear regression analyses.

Results did not show statistically significant reductions in consequences among those high in Action at 3 months for either high or low values, controlling for baseline consequences. For those who were low on the Action scale, $B = 0.84$ [$se = 0.68$], $p = 0.22$; for those who were high on the Action scale, $B = -0.75$ [$se = 0.77$], $p = 0.34$. See Table 18. See Figure 9 for simple slopes linear regression analyses.

Results did not show statistically significant reductions in consequences among those high in Action at 6 months for either high or low values, controlling for baseline consequences. For those who were low on the Action scale, $B = 0.53$ [$se = 0.1.10$], $p = 0.63$; for those who were high on the Action scale, $B = 0.18$ [$se = 0.98$], $p = 0.85$. See Table 19. See Figure 10 for simple slopes linear regression analyses.

Post Hoc Exploratory Analyses

Additional analyses were performed to further investigate the effects of the BI on outcomes as hypothesized. In these analyses, the issue of intervention influence on proximal indices of behavior change (i.e., readiness to change, norms) was examined. The literature has demonstrated that both of these constructs may precede behavior change, even if other outcomes (e.g., frequency of use) may not be significantly affected (e.g., Palfai et al., 2016).

Descriptive Statistics of Norms Individual Score and Composite Score at 3 and 6 Months.

In the BI condition, norms values at 3 months were: “What percent of BU students use marijuana more than you?” at 17.86 (SD = 20.72), “What percent of BU students use marijuana at least once a month?” 27.52 (SD = 15.85), and “What percent of

BU students have not used marijuana in the past 3 months?" 60.48 (SD = 20.49). For analyses, composite scores were generated based on standardized scores at each time-point. Composite scores in the BI condition at 3 months was -0.40 (SD = 0.66).

In the AO condition, norms values at 3 months were: "What percent of BU students use marijuana more than you?" 30.75 (SD = 23.67), "What percent of BU students use marijuana at least once a month?" 44.83 (SD = 21.80), and "What percent of BU students use marijuana more than you?" 41.71 (SD = 20.54). For analyses, composite scores were generated based on standardized scores at each time-point. Composite scores in the AO condition at 3 months was 0.35 (SD = 0.82).

In the BI condition, norms values at 6 were: "What percent of BU students use marijuana more than you?" at 20.80 (SD = 20.66), "What percent of BU students use marijuana at least once a month?" 24.30 (SD = 13.33), and "What percent of BU students have not used marijuana in the past 3 months?" 63.25 (SD = 16.33). For analyses, composite scores were generated based on standardized scores at each time-point. Composite scores in the BI condition at 6 months was -0.41 (SD = 0.59).

In the AO condition, norms values at 6 months were: "What percent of BU students use marijuana more than you?" 28.68 (SD = 23.76), "What percent of BU students use marijuana at least once a month?" 42.36 (SD = 21.37), and "What percent of BU students use marijuana more than you?" 41.44 (SD = 21.88). For analyses, composite scores were generated based on standardized scores at each time-point. Composite scores in the AO condition at 6 months was 0.33 (SD = 0.68).

Descriptive Statistics of Action Scale Score and Total Readiness to Change Scores at 3 and 6 Months.

For individual items, this study utilized a scoring of 1 (strongly disagree) to 5 (strongly agree), corresponding to minimum scale scores of 4, and maximum scale scores of 20. Total Readiness to Change is equal to (Action scale score + Contemplation scale score) – Pre-contemplation scale score. Total Readiness to Change for this study was a minimum of -12 and a maximum score of 36. Action scale scores range from 1-5 and have a minimum score of 4 and a maximum of 20.

In the BI condition at 3 months, Action scores were 10.38 (SD = 3.73), and overall Readiness to Change scores were 3.48 (SD = 9.65). In the AO condition at 3 months, Action scores were 10.99 (SD = 4.48), and overall Readiness to Change scores were 4.04 (SD = 7.14).

In the BI condition at 6 months, Action scores were 10.00 (SD = 4.26), and overall Readiness to Change scores were 3.70 (SD = 10.99). In the AO condition at 6 months, Action scores were 10.52 (SD = 4.42), and overall Readiness to Change scores were 2.72 (SD = 6.04). See Table 11 for subscale scores and overall Readiness to Change scores.

Effect of Intervention on Norms Composite Score and Action Scale Score at 3 and 6 Months.

One-way analysis of variances (ANOVAs) were conducted to examine the effect of the BI vs AO effects on norms at 3 and 6 months, controlling for baseline norms. Controlling for baseline norms, the BI significantly impacted norms at 3 months $F(1, 43)$

= 14.51, $p = 0.00$, $\eta_p^2 = 0.26$, when compared to the AO group. Controlling for baseline norms, the BI significantly impacted norms at 6 months, $F(1, 43) = 13.99$, $p = 0.001$, $\eta_p^2 = 0.25$, when compared to the AO group. However, controlling for 3-month norms, the BI did not significantly impact norms at 6 months, $F(1, 41) = 3.26$, $p = 0.08$, $\eta_p^2 = 0.08$. These results indicated that at 3 months, the intervention (BI) accounted for 26% of variability in norms, and at 6 months, the intervention (BI) accounted for 25% of variability in norms, controlling for baseline levels of norms, with those in the BI showing greater reductions in norms than those in the AO. It also suggests that the intervention had the greatest impact on changing norms from baseline to 3-months, than from 3-month to 6-month follow-ups. This is consistent with primary outcomes of changes in frequency in the BI group being most effective from baseline to 3-months.

Controlling for baseline levels of Action on the RTC scale, the BI did not significantly impact Action scores at 3 months, $F(1, 43) = 0.69$, $p = 0.41$, $\eta_p^2 = 0.02$, nor at 6 months, $F(1, 43) = 0.42$, $p = 0.52$, $\eta_p^2 = 0.10$. Controlling for 3-month levels of Action on the RTC scale, the BI did not significantly impact Action scores at 6 months, $F(1, 41) = 0.000$, $p = 0.995$, $\eta_p^2 = 0.000$. These results indicated that group difference (BI vs AO) did not account for variability in 3- and 6-month follow-up levels of Action on the RTCQ.

Effect of the Intervention on Satisfaction Ratings

Participants showed comparable ratings in each condition. Data was not normally distributed, so a non-parametric test was conducted in order to determine any significant differences between the groups. The Mann-Whitney U Test showed that none of the

items were significantly different between the BI and AO group (all $p \geq 0.05$, two-tailed significance). Results are presented in Table 21. These findings showed that students experienced the two conditions as comparable in terms of its applicability, utility, and satisfaction with the experience.

Effect of the Intervention on Substance-Related and Other Health-Related Information/Services Sought

Analyses were conducted to explore whether engagement in the intervention increased interest in information related to substance change, outside and beyond the scope of this intervention. Graduate students sought additional information online for drug use at $n = 3$ (15.8%) in the BI group, and $n = 4$ (16.0%) in the AO group. Students sought information through BU-provided weblinks at $n = 2$ (10.5%) in the BI group, and $n = 1$ (4.0%) in the AO group. Students sought information/counseling through BU SHS at $n = 1$ (5.3%) in the BI group, and $n = 1$ (4.0%) in the AO group. Chi-square tests and Fischer's exact tests were conducted; no significant differences were found between the BI and AO groups for any of the drug items, or other health-related items for seeking additional information/services. Full results of information sought by intervention group are presented in Table 22.

CHAPTER FIVE: DISCUSSION

The current study was designed to examine the feasibility of conducting an eSBI trial to reduce marijuana use among graduate students presenting to a SHC and provide an estimate of the effect sizes of the intervention compared to control on marijuana use frequency and marijuana-related consequences. Marijuana use has been associated with a

variety of physical, psychological, social, and academic consequences among students. While studies have shown that graduate students do not use marijuana as frequently as undergraduates, the consequences for career development and well-being may be even more impactful. Studies of screening and brief intervention (SBIs and eSBIs) for marijuana use have been utilized in undergraduate populations. However, there are no studies that have examined the utility of SBIs or eSBIs specifically for graduate students. This study served as a pilot study for eSBIs in graduate students who use marijuana. Graduate students participated in universal screening in a SHC and those who reported at least monthly marijuana use were randomized to either an electronic intervention or control condition. Assessments of marijuana use and consequences were taken at baseline, 3- and 6-month outcomes, as were the measures of descriptive norms and readiness to change (RTC) as potential moderators.

Primary Findings

The primary hypothesis was that graduate students in the eSBI condition would show greater reductions in the number of days of marijuana use and negative consequences over the 6-month outcome time-period than those in the Assessment Only (AO) condition, controlling for baseline use and consequences. Results suggested a small-to-medium effect ($f^2 = 0.09$) of the intervention on marijuana use frequency outcome at 6 months, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively). There was no evidence for an intervention effect on negative consequences at 6 months, however ($f^2 = 0.002$). Although preliminary, these results are significant and novel for eSBIs for

marijuana, both in establishing reductions in use at initial outcomes (3 months), as well as sustained effects on frequency of use for longer durations of times (6 months). These results are the first to find these prolonged effects on frequency of use using an eSBI for marijuana. Further, they are the first results for an eSBI in marijuana use in graduate students, a population that is at similar risk to undergraduate college students.

Previous research with eSBIs for marijuana use in college students have shown decrease in frequency of use at 3 months compared to controls; however, these differences were not observed at a 6-month follow-up (Lee et al., 2013). Other studies on eSBI for marijuana did not find any change in frequency at 3 months or 6 months (Palfai et al., 2014). The results of the current study suggest that eCHECKTOGO-marijuana may impact the frequency of marijuana use for graduate students over the 6-month time period. Such extended effects have generally not been observed in the eSBI literature for marijuana (e.g., Lee et al., 2013), nor for alcohol/substance-related eSBIs broadly among university students, which have been shown to have diminished effects as soon as six to eight weeks following an eSBI (e.g., K. B. Carey et al., 2012; Carey et al., 2009; Walters et al., 2007).

Results for intervention effects on negative consequences roughly paralleled previous work. Lee et al. (2013) found a trend towards reduced consequences at 3-months, though results were not significant. There were no intervention effects on consequences at the 6-month follow-up. Palfai et al. (2016) did find a small effect for reduction in negative consequences at 3 months ($f^2 = 0.04$), though the result was not statistically significant ($p > 0.05$). When authors examined only students completing the

eSBI at the SHC (as compared to those completing off-site), results were increased to a medium effect size ($f^2 = 0.12$), though results were still just outside of statistical significance ($p = 0.06$).

With no extant literature on graduate students' responsiveness to eSBIs, these findings show promise for the utilization and implementation of eSBIs in SHCs for reducing marijuana use in this population. Additional secondary analyses were conducted to investigate potential effects of the intervention at shorter outcomes (i.e., 3 months) and to explore potential moderators of effects.

Secondary Findings

The secondary hypothesis was that graduate students in the eSBI condition would show greater reductions in the number of days of marijuana use and negative consequences at the 3-month outcome time-period than those in the Assessment Only (AO) condition, controlling for baseline frequency and consequences. At 3 months, results suggested an intervention effect on the frequency of use ($f^2 = 0.10$). This is a small- to medium- effect size on marijuana use frequency, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively). At 3 months, there was no evidence for an intervention effect on negative consequences ($f^2 = 0.02$). Results fell below what would be considered a small effect size, using Cohen's (1988) general guidelines for f^2 .

As negative consequences are generally seen as the result of higher substance use, it would be hypothesized that a decrease in frequency would also result in a decrease in consequences. There are a number of studies that support this in the alcohol literature

(e.g., Longabaugh, 2001). However, that was not the case for this pilot study. The literature is also widely variable in findings on the relationship between frequency and negative consequences, with some studies finding results of reductions in frequency but not on consequences specifically for marijuana (Amaro et al., 2010), and others finding no reduction in frequency of use, but on marijuana negative consequences specific to the settings of eSBIs in SHCs (Palfai et al., 2014). There have been several hypotheses in the literature to explain the variability, such as the change in frequency not being large enough to impact consequences; not changing patterns of use of substances at times that may be more problematic (e.g., weekdays, before exams) to times that wouldn't have as many negative outcomes (e.g., weekends, school vacations); harm reduction plans that were not tailored or specific to an individual's needs; relying on marijuana for short-term coping skills (e.g., stress management) that may have longer-term negative consequences on mental health; or a number of yet-unexplored possibilities. Research would significantly benefit from examining these in future iterations of studies with graduate students.

While the effect of the intervention decreased over the duration of the follow-ups, this is consistent with the literature on eSBIs for alcohol. The majority of the literature shows that eSBI's effects tend to decrease over time (Longabaugh et al., 2001; Stein et al., 2009), often in as little as four weeks after the intervention. Due to these decreases over time, many eSBIs for alcohol have started to include booster sessions, which show better outcomes than using interventions alone (e.g., Longabaugh et al., 2001, Stein et al., 2009), and can prolong intervention effects for up to 1 year, in some settings (e.g.,

Longabaugh et al., 2001). The prolonged effect of on frequency outcomes in this intervention was hypothesized to be attributed to the booster session. Some studies in eSBI for alcohol found eSBI+booster to have better outcomes on reduction in drinking frequencies than eSBI alone (Longabaugh et al., 2001). However, in this study, outcomes were not measured prior to administering the booster session at 3 months, and therefore sustained effects on frequency of use at 6 months could not be definitively linked to booster sessions. In this pilot study for eSBI+booster in graduate students who use marijuana, the greatest rate of change in frequency (as measured by latent growth modeling) occurred in the first 3 months of the intervention, prior to the administration of the booster session components and putative mechanisms of change of the intervention (e.g., normative feedback, readiness to change). Rates of change decreased by the 6 month point, which is where effects due to the booster session would be hypothesized to be observed. Another possible explanation for the majority of rate of change coming in the first 3 months of the intervention, as well as the longer sustained effects on frequency at 6 months, could be due to the fact that this sample was a graduate student population. Further work would be well served to disentangle this question in graduate student populations.

Additional secondary analyses were conducted in order to examine putative mechanisms of change by the moderators of descriptive norms and Readiness to Change (RTC) in order to more fully understand the outcome measures at 3- and 6-months.

Moderators

Additional analyses were conducted to investigate the moderating role descriptive norms (i.e., the estimate of peers' normative marijuana use) on outcomes. It was hypothesized that individuals with higher estimates of descriptive norms (i.e., elevated to their own use and/or actual use by peers) at baseline would have greater reductions in frequency of use and negative consequences of use than individuals with low descriptive norms (i.e., estimated lower than their own use and/or actual use by peers). The analyses failed to show significant effects for either frequency or consequences at 3- or 6-month follow-ups. It is surprising that norms did not seem to moderate the effect of the intervention on outcomes (i.e., frequency of use, consequences). Perceptions of norms have been identified as risk factors for marijuana use and misuse (Kilmer et al., 2007; Neighbors et al., 2008). The literature details the importance of norms in moderating intervention effects, and highlights the importance of the association with norms associated most closely to participating individuals (e.g., other graduate students, campus-specific data) as opposed to distal norms statistics (e.g., undergraduate students). For this pilot study, students were provided with campus-specific norms of graduate student use. However, students' estimated usage differed little from actual normative values. It is possible that because of the small difference between perceived and actual norms, there wasn't discrepancy between the two to motivate and/or facilitate change. Studies from undergraduate populations were provided normative values of campus-specific use in previous studies of eSBI for marijuana, and norms were found to moderate the relationship of the intervention in these studies (Palfai, 2016).

Another point to consider in regards to null findings of norms, is that this study did not measure nor examine the role of injunctive norms. Indeed, positive associations have been shown between perceptions of injunctive norms (i.e., approval of use) and marijuana use (Buckner, 2013; Buckner et al., 2018; Elliot & Carey, 2012; Riggs et al., 2018). It is possible that graduate students may have ideas of others' approval of use that may more greatly impact their current marijuana use. Whether these are different or similar to undergraduates is yet to be established (e.g., peers, parents', partner's, colleagues, advisors). Qualitative questions about importance of others' perceptions of use, as well as listing sources of others' approval that may be of importance to them, could help establish a base to measure impact of injunctive norms. Quantifying importance of these sources of injunctive norms would then provide a way to provide more meaningful feedback to students in interventions. Measuring and providing these in future studies would help identify and/or quantify the importance of injunctive norms' effects on use.

Additional analyses were also conducted to investigate the moderating role of Readiness to Change (RTC), specifically those with high baseline scores on the "Action" subscale of the RTC questionnaire. It was hypothesized that individuals high on the Action subscale of the RTC questionnaire at baseline would experience greater reductions in frequency of use and negative consequences, compared to individuals with low scores on the Action subscale at baseline. The analyses showed an effect of high scores on the Action subscale of the RTC questionnaire at 3-months to show greater reductions in frequency of use; no significant changes were found at 3-months for

consequences of use. The analyses failed to show significant effects for high scores on the Action subscale for either frequency or consequences at 6 months. Findings of those high on the Action scale and reductions in frequency of use is consistent with the literature (Palfai et al., 2016). However, it is surprising that these results did not hold the same effect on 6-month outcomes. It is possible that these are similarly at risk for deterioration in effects as with other outcome measures with eSBI. The extant literature did not provide follow-ups at longer durations in time (e.g., past 3 months), so it is unknown how this study would compare to similar studies in undergraduates or graduates with longer follow-up assessments. Finally, there is tremendous variability the role of RTC as moderators in eSBIs for substance use and alcohol use, with some studies finding results for intervention effective in the early stages of change (i.e., Pre-contemplation) (Maisto et al., 2001), in moderate stages of RTC (i.e., Contemplation) (Lee et al., 2010), or in the case of studies most similar to this pilot study, for those in the Action stage (Palfai et al., 2014). Further research on the variability in RTC in moderating outcomes is needed in order to identify which stage(s) of change may be most important in the role of these eSBIs.

Post Hoc Findings

Post Hoc analyses were conducted to investigate the role of the effect of the intervention on the constructs of norms and readiness to change. This was conducted to (1) examine the lack of significant findings of the intervention on consequences at 3- and 6-months and (2) further examine the lack of significant findings for norms acting as a moderator in the intervention. Previous studies have found that SBIs/eSBIs may have

proximal outcomes on measures that may precede change, such as changing perceptions of descriptive norms, or on increasing individuals' readiness to change. It is believed that changes in either of these may precede changes in frequency, or in associated negative consequences of use. In order to examine this in this pilot study, ANOVAs were run to examine effects on the proposed moderators of RTC and norms. Significant effects were found on norms, but not on readiness to change. Analyses demonstrated that, while controlling for baseline perceptions of norms, the BI was more effective at changing descriptive norms at both the 3- and 6-month follow-ups, accounting for 25% (3 month) and 26% (6 month) of the variability in norms. This is a significant finding and contribution of this study, and falls in line with the ideology of change in misperceived norms as a mechanism of change in SBIs/eSBIs (Borsari & Carey, 2003). It is possible that some of the lack of findings in this pilot study (e.g., no changes in consequences at 3- or 6-month follow-ups) could be accounted for by changes in norms of study participants as a proximal measure, with more distal measures of outcomes (e.g., frequency of use, negative consequences) not being captured in the follow-up period of this intervention. Indeed, in other studies had similar outcomes with changes in descriptive norms, but no change in frequency of use (Elliot & Carey, 2012).

Controlling for baseline levels of Action on the RTC scale, the BI did not significantly impact Action scores at 3- or 6-months. Some studies have found that exposing study participants to SBIs has been enough to impact substance use outcomes at even the earliest stages of change (i.e., Pre-contemplation) (Maisto et al., 2001), suggesting that interventions can influence participants' readiness-to-change. However,

the extant literature on changes in RTC in eSBI for marijuana has not yet examined this. Future studies should examine the role of interventions on RTC.

Graduate Students

Graduate students are a novel population for examining eSBIs. This study served as the first to examine eSBI for graduate student marijuana users. Graduate users have been shown to use at levels higher than age-matched peers (Bidwal et al., 2014; Kenna & Wood, 2004), and are at the same risks for negative consequences, even at low levels of use (Allen et al., 2018). Regardless of the compelling argument for implementation of eSBIs for this population, it also is important to note the lack of empirical data of exactly how graduate students may differ from undergraduate students in regards to responsiveness to eSBIs. While the two populations have many things in common (e.g., rigorous academic requirements, social and academic pressures), they are distinctly different in many domains, such as age, motivations for use (e.g., coping versus exploration/new personal explorations and experiences), risk of greater negative consequences of use (e.g., failure to obtain employment), concurrent use of other substances (ACHA, 2018), and others yet unknown. All of these differences may account in differential response to interventions, and may explain some of the differences in study recruitment and outcomes in findings of this particular study. Age could contribute significantly to differential use of substances in this population; often, as one ages they are more likely to be more financially independent, have greater responsibilities (e.g., family, housing), and may be further developmentally than their undergraduate counterparts. Reasons for use or patterns of use may differ for all of these reasons. This

correlates closely to the greater risk of potential negative consequences (e.g., loss of or failure to start a career). Graduate student motivations for substance use is largely unknown, and without empirical support, with the exception of a few findings in related studies (e.g., Cranford et al., 2009; Ferriman et al., 2009). Graduate populations often show lower use of other illegal substances than undergraduate populations, as was the case with those included in this study (see Table 20). Use, or lack thereof, of other substances may impact patterns of use of marijuana. Without knowing what specifically drives graduate students to use, it is impossible to optimize treatments to target those motivations. Future studies of eSBIs for graduate students would benefit from a greater qualitative exploration of how this population differs from undergraduates, and, as a result, what mechanisms of change may be most beneficial to include in eSBIS.

Feasibility

Given the low number of students identifying substance use as a problem, yet 1/3 reporting experiencing problems as a result of their use (Ondersma, Gryczynski, Mitchell, O'Grady, & Schwartz, 2016), increasing the feasibility and ease of implementation for graduate students in particular is necessary in order to capture as many individuals as possible that could benefit from eSBI. Implementing interventions in opportunistic settings, such as student health centers, community clinics, doctors' offices, hospitals, in which persons regularly seek care for other health issues may allow researchers and clinicians to reach those that otherwise would not seek out treatment. When considering this form of treatment implementation, it is imperative to consider the time constraints on those in medical professions (Kypri & Lee, 2009; Marsch & Borodovsky, 2016) (Kypri

& Lee, 2009; Schaus et al., 2009). Thus, it is important to have an intervention that is both quick to use for a patient, but also for increased use by healthcare professionals while minimizing additional time requirements.

Compared to previous similar studies that enrolled undergraduate students (e.g., Palfai et al., 2014) that screened undergraduate students, this study required a larger number of individuals screened to identify graduate students who were marijuana users. As expected, there was a much lower rate of marijuana use among this sample, requiring extensive screening to identify participants. A total of 4,263 individuals were assessed for eligibility. Of those, 701 (approximately 16% of the total number of students that were approached) were graduate students that were asked to participate in the initial screening. After these graduate students completed a brief, one-minute screener on a tablet presented by a researcher, they were notified if they were eligible for study. Of this initial 701, only 107 (15%) were eligible for participation in the study; these numbers are slightly lower than the current use reported by the ACHA (18.8%) and NSDUH (20.8%). However, once students were identified as eligible, they showed a high interest in participating, with 74% agreeing to be enrolled. This has implications for recruitment and enrollment in future studies. One of the benefits of eSBI is low clinician-burden; however, the necessity of screening large proportions of students to obtain targeted enrollment may be in opposition to this. Automatization of screening procedures by pairing them with student check-ins when visiting SHC may solve this problem. Currently, students at the SHC in which this study was conducted are able to check in to appointments by entering information on a tablet in the entrance to the clinic; adding an

additional screen in which students could complete a brief screener would allow to screen more potential participants, with lowered clinician burden.

In addition to the general overall acceptability of the intervention for graduate students, the study had high retention rates; these rates were higher than similar studies conducted with undergraduates. Of those enrolled 66% completed the baseline assessment; both the AO and BI groups had 95% completion rates at 6 months. Comparatively, in the study on undergraduate students, there was a higher completion of baseline completion (96%), but a higher overall loss of participants through the end of the study (84%). Thus, if eligible graduate students can be reached from the general population, the pilot suggests that eSBIs for this population are both feasible and acceptable. Further, graduate students who were enrolled often cited reasons for participating such as “understanding the need for the study/researcher” for requirements of a PhD program, as they often had the same or similar requirements for programs they themselves were enrolled in. It’s possible that this identification and connection to the research process accounted for higher completion rates in this graduate student study.

Graduate students rated the study on different measures of satisfaction; overall, they rated the intervention highest in ease of understanding, with BI = 4.37 (SD = 0.76) and AO = 4.08 (SD = 0.95), with a rating of 5 being the highest. Their overall ratings were similar to similar previous interventions with undergraduates; the BI condition rated their overall satisfaction as a 3.24 (SD = 0.94) and AO as 3.34 (SD = 0.93). Those in the BI condition had comparable ratings for “usefulness” and “applicability” than those in the AO condition (see Table 21). It is possible that due to the differences outlined above,

components of the intervention may not have been as pertinent to their individual experiences in their marijuana use. Future studies may wish to expand upon the overall “satisfaction” rating with accompanying qualitative feedback in addition to the existing quantitative ratings, so that researchers may have a more thorough understanding of what elements of the intervention were more or less appealing, or more or less motivating for completion of the study.

Finally, the current study explored the question of whether the intervention influenced information or health service seeking related to substance use. Groups did not differ between their seeking of additional treatment for drug use; a total of 7 (15.9%) sought additional information about drug use online, 3 (6.8%) sought additional information that was provided to them via in the eSBI in “weblinks” that directed them to information on substance use information and/or counseling, and 2 (4.5%) sought information/counseling directly through BU SHS for substance use (please see Table 22). Thus, the eSBI did not appear to promote the search for further information related to change in marijuana use or increase the desire for services in this area.

Limitations

Given the small sample size, findings may be limited. A larger study may be able to provide more findings, including moderators of the intervention. This was anticipated, given that this was a pilot study. Recruitment of graduate students was difficult, requiring a large number of screenings ($n = 701$) to find eligible participants ($n = 107$). Of those screened, a large number (66%) completed the baseline; those randomized to the intervention showed incredibly high rates of completion at 6-months (95% for AO and

BI). One of the benefits of eSBI and SBI is that it can have a high impact while using low resources (e.g., office space, clinician time). Comparatively to traditional office visits, SBI and eSBI can provide services that may be equivalent to these traditional services, hence the importance of continued work on developing these interventions. With continued improvements in technology, eSBIs could be more automated to screen all students to enter SHCs, thus reaching larger proportions of substance-using students who otherwise wouldn't seek out treatment.

Given that this study was conducted in a novel population, there was a lack of extant data on the differences between graduate students and undergraduate's motivations to use and patterns of use. This may have contributed to the differences in outcomes in this study, when compared to similar studies conducted in undergraduates. Future studies would benefit from greater exploration of the qualitative differences in the graduate student population in order to more fully understand how to optimize and tailor eSBIs to this population.

Another limitation of this study is that there was better compliance with completing 3- and 6-month follow-ups in the AO condition. Thus, findings must be interpreted with caution. It is unclear why this may have been; students were followed up with (largely automated) reminders of participation in the 3- and 6-month surveys. Of those responsive to these reminders, the majority did complete the assessments. The remaining students who were not able to be reached, largely did not complete the assessments. Future studies may benefit from following up with participants on acceptability after each study link was sent to participants, or from allowing students to

give qualitative feedback (in addition to the quantitative feedback) in order to optimize study completion.

Finally, this study was conducted at a private urban university in the Northeast, featuring a state-of-the-art SHC. Most of the study participants were White males; as such, study results may not generalize to populations as a whole, or on other campuses.

Strengths

This study had significant strengths. First, it was described as a study to examine graduate student health behaviors and substance use, rather than an intervention for marijuana. This may have allowed for a more representative sample to be collected that is indicative of student substance use. Additionally, the study allowed for minimal burden on study staff, as well as participants, with the majority of study contact occurring online. This may increase dissemination and integration into future clinical practices. Furthermore, this is a novel study for a population that reports higher marijuana use than their age-based peers; this indicates a need for an intervention that has been demonstrated to be feasible and efficacious in reducing use amongst graduate students.

Future Directions

This study was conducted to examine the feasibility of an eSBI for marijuana-smoking graduate students; the preliminary analyses were conducted to examine effect sizes of the intervention. While feasibility and preliminary efficacy for reduction of frequency of use was established, these results were based on a small sample ($n = 49$). Future studies are necessary to test potential replication of results. Conducting larger-

scale studies with greater sample sizes would also allow to test for statistical significance of any demonstrated effect sizes of interventions.

Future studies may be conducted with graduate students in order to identify if they respond differently to treatment than their undergraduate counterparts. Given that this is a novel population to study, there are many unknown factors in reasons/motivations for use, and thus, the most effective treatments to utilize in this sample. Studies need to determine differences and similarities to undergraduates in terms of motivations to use and/or reduce substance use, importance and definition of descriptive norms (e.g., to differentiate between graduate student “peers” versus other age-matched, non-student “peers”), importance and definition of injunctive norms (e.g., whose perceptions of approval of use is most salient to use [peers, partners, parents academic advisors/mentors, etc.]), basic patterns of use, variability in patterns of use by academic time period (e.g., beginning of the semester, during exams or dissertations, summer breaks), and importance and definition of consequences of use. Many of these issues could be examined in future studies by more qualitative and/or idiographic examinations of graduate students on these variables and processes in order to better understand graduate students as a more collective group.

Graduate students were defined in this study as an overall cohort and collective group. However, even within this population there is tremendous variability in graduate student status. Types of graduate programs differ in academic demands and structure, which has the potential to impact students’ use, and therefore the potential impact of interventions. Within graduate students, future studies of larger sample sizes would

benefit from collecting additional information on graduate student program status (e.g., Medical School, Nursing School, Public Policy, etc.), as well as relative progress within that program (e.g., if in Medical School, are they taking courses, or are they completing rotations?).

While these differences between undergraduate students and graduate students have not yet been comprehensively examined, replication studies in undergraduates parallel to this pilot study would also be of interest. Previously, undergraduate students found some reductions in frequency in shorter-term (4 - 6 weeks) follow-ups (e.g., Elliot & Carey, 2012; Riggs et al., 2018). However, these reductions in frequency were not detected at longer follow-ups. In this study, reductions in frequency were demonstrated in longer follow-ups at both 3- and 6-month outcomes. Examining differences in these two patient populations and in study design would allow to further understand the disparity in duration of effects of the intervention. This study utilized a booster session, which was hypothesized to prolong the effect of the intervention at 6-months. However, for reasons discussed above (e.g., rates of change, timing of data collection at outcome assessments), sustained reductions in frequency cannot be conclusively drawn to be related to the booster session. Differences at the 6-month outcomes could be due to student status alone (i.e., graduate students versus undergraduate students). There are currently no undergraduate eSBI+booster studies in the literature. If undergraduate studies with booster sessions found similar sustained outcomes, more conclusions could be drawn on the effect of booster session in these interventions.

This pilot study was conducted in a SHC. Studies in undergraduates found differential outcomes in eSBIS for marijuana dependent on location, specifically for those conducted in SHC versus off-site locations (Palfai et al., 2016). Studies of other eSBIs have been implemented in a variety of settings, such as EDs, inpatient medical settings, outpatient settings, student orientations, etc. Future studies to examine the effect of setting of intervention on the effect of eSBIs in graduate students who use marijuana are needed.

It is also important to consider the changing legal stances on marijuana regulation, considering how this may affect rates of use in this population, motivations for use, shifting ideas of normative use in different stages of legality (e.g., medically prescribed, small quantities allowed by State law), and potential changes in perceptions of what “negative consequences” may be (e.g., reduced fear of legal repercussions, decreased opposition in finding employment opportunities while using marijuana). Indeed, recent studies in college students in locations where recreational marijuana use has been legalized longer than the state of Massachusetts (e.g., Colorado), suggest consistent connections to problematic behavior previously identified in other college student populations, such as impulsivity, negative personal and academic consequences, and psychiatric symptoms (e.g., depression, social anxiety) (Phillips et al., 2018). It is important to note that the data collected for this pilot study was done after the legalization of possessing small amounts of marijuana in Massachusetts in 2012. However, data was collected before the first marijuana dispensaries for providing purchase of marijuana for recreational needs began selling in 2018. It is likely that with increased access to legal

methods of obtaining marijuana, those at risk for abusing marijuana may increase frequency of use. How this effects number of persons reporting use as a problem is at this time unknown. Future studies should monitor rates of frequency of use and negative consequences in order to see if this has changed as a result of any changes in legalization.

Conclusions

This study provided preliminary evidence for the utility of an eSBI to reduce frequency of use for graduate students who use marijuana. This study is a novel contribution to the literature, as there is evidence of graduate students using at elevated levels compared to age-matched peers, but no empirical studies on interventions in this population. Future studies need to be conducted to draw more conclusive findings on efficacy, moderators, and putative mechanisms of change. These should focus on learning more about graduate student substance use (e.g., motivations, patterns of use), tailoring interventions to graduate students' specific needs, increasing the sample size in order to better examine moderators and mediators of the intervention, and to parse out what components of interventions may be more effective in reducing frequency of use as well as consequences.

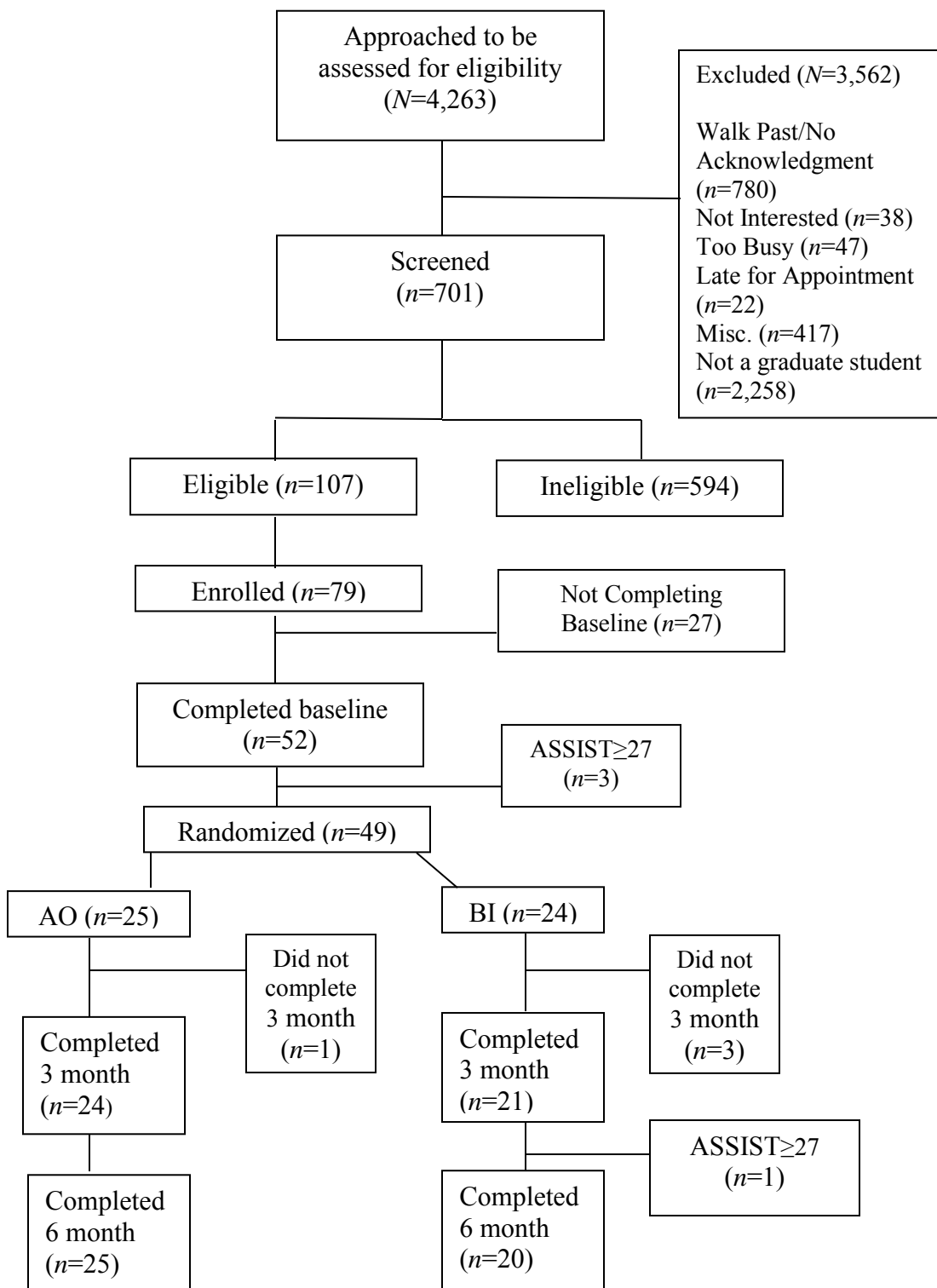
Table 1 Consort Diagram

Table 2 Baseline Description of Sample: Overall and by Experimental Condition

	Total N=49	BI N=24	AO N=25
Age M (SD)	26.21 (2.62)	26.27 (2.20)	26.15 (3.02)
Gender, male (n) (%)	24 (49.0%)	11 (45.8%)	13 (52.0%)
Age (SD)	25.53 (2.42)	25.63 (2.28)	25.44 (2.58)
Race/Ethnicity Composition			
Hispanic/Latino	8 (16.3%)	4 (16.7%)	4 (16.0%)
American Indian/Alaskan Native	2 (4.1%)	1 (4.2%)	1 (4.0%)
White	38 (77.6%)	19 (79.2%)	19 (76.0%)
Black	2 (4.1%)	0 (0.0%)	2 (8.0%)
Asian	5 (10.2%)	2 (8.3%)	3 (12.0%)
“Other”	2 (4.1%)	1 (4.2%)	1 (4.0%)
MarjDay^a (SD)	35.61 (33.03)	39.21 (32.93)	32.16 (33.42)
MJ-CNSQ^b (SD)	2.63 (2.75)	3.17 (3.21)	2.12 (2.17)
MARJASSIST^c (SD)	10.35 (5.91)	11.25 (7.14)	9.48 (4.42)
RTC-Total^d (SD)	3.78 (8.63)	5.167 (9.39)	2.44 (7.79)
Pre- contemplation^e (SD)	15.04 (2.96)	14.71 (3.20)	15.36 (2.75)
Contemplation^f (SD)	8.55 (3.54)	9.08 (4.02)	8.04 (3.01)
Action^g (SD)	10.27 (3.92)	10.80 (3.64)	9.76 (4.19)
BUMarjMore^h (SD)	24.71 (18.55)	23.58 (20.08)	25.80 (17.28)
BUMarjMonthⁱ (SD)	45.90 (23.80)	46.04 (24.62)	45.76 (23.49)
BUNoMarji (SD)	42.53 (19.89)	45.21 (21.14)	39.96 (18.69)
ZNorm^k (SD)	-0.0001 (0.86)	-0.06 (0.89)	0.06 (0.84)

Note: BI = Brief Intervention; AO = Assessment Only

^aMarjDay – Number of days using marijuana in the past 90 days [Range 1 - 90]

^bMJ-CNSQ - Number of marijuana-related negative consequences in the past 90 days [Range 0 - 38]

^cMARJASSIST – NIDA-modified Alcohol, Smoking, and Substance Involvement Test (Assist) – Marijuana section [Range 0-39; 0-3 Low Risk, 4-26 Moderate Risk; 27+ High Risk]

^d*RTC-Total* – Readiness to Change Total Score [Range: -12 to +36]

^e*Pre-contemplation subscale of RTC* - [Total Range: 4 - 20]

^f*Contemplation subscale of RTC* - [Total Range: 4 - 20]

^g*Action subscale of RTC* - [Total Range: 4 - 20]

^h*BUMarjMore* - What % of BU students use marijuana more than you? [Range 0-100]

ⁱ*BUMarjMonth* - What % of BU students use marijuana at least once a month? [Range 0-100]

^j*BUNoMarj* - What % of BU students have not used marijuana at all in the past 3 months? [Range 0-100]

^k*ZNorm* – Composite score of means of 3 norms questions, with last question reverse-scored; items are standardized.

Table 3 Regression Table for Norms at 3 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSMJFQ	0.69	97.39	1, 43	0.83	0.00
Step 2					
Main Effects					
INTV	0.03	1.98	2, 41	-0.16	0.06
ZNORM				-0.33	0.70
Step 3					
Interaction					
Effects					
ZNORMxINTV	0.001	0.125	1, 40	0.04	0.73

Note:

BSMFJ = Baseline Marijuana Frequency

INTV = Intervention

ZNORM = Norms composite score using a Z score to compute

Table 4 Regression Table for Norms at 6 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSMJFQ	0.63	75.25	1, 44	0.79	0.00
Step 2					
Main Effects					
INTV	0.01	0.80	2, 42	-0.11	0.26
ZNORM				-0.06	0.50
Step 3					
Interaction					
Effects					
ZNORMxINTV	0.01	1.69	1, 41	0.17	0.20

Note:

BSMFJ = Baseline Marijuana Frequency

INTV = Intervention

ZNORM = Norms composite score using a Z score to compute

Table 5 Regression Table for Norms at 3 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSCNQ	0.48	40.03	1, 43	0.69	0.00
Step 2					
Main Effects					
INTV	0.001	0.03	2, 41	0.02	0.85
ZNORM				0.02	0.88
Step 3					
Interaction					
Effects					
ZNORMxINTV	0.02	1.80	1, 40	0.21	0.19

Note:

BSCNQ = Baseline Negative Consequences

INTV = Intervention

ZNORM = Norms composite score using a Z score to compute

Table 6 Regression Table for Norms at 6 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSCNQ	0.29	17.71	1, 44	0.54	0.00
Step 2					
Main Effects					
INTV	0.01	0.26	2, 42	0.06	0.66
ZNORM				-0.06	0.63
Step 3					
Interaction					
Effects					
ZNORMxINTV	0.11	7.56	1, 41	0.47	0.01

Note:

BSCNQ = Baseline negative consequences

INTV = Intervention

ZNORM = Norms composite score using a Z score to compute

Table 7 Regression Table for Norms (High/Low Split) at 3 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSMJFQ	0.69	92.68	1, 42	0.83	0.00
Step 2					
Main Effects					
INTV	0.03	2.22	2, 40	-0.17	0.05
NORM				-0.06	0.50
HILO					
Step 3					
Interaction					
Effects					
NORM	0.00	0.04	1, 39	0.03	0.84
HILOxINTV					

Note:

BSMFJ = Baseline Marijuana Frequency

INTV = Intervention

NORM HILO = Dichotomized high/low split of composite norms score

Table 8 Regression Table for Norms (High/Low Split) at 6 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSMJFQ	0.63	71.85	1, 43	0.79	0.00
Step 2					
Main Effects					
INTV	0.02	1.23	2, 41	-0.11	0.25
NORM				-0.11	0.27
HILO					
Step 3					
Interaction Effects					
NORM	0.01	1.39	1, 40	0.18	0.25
HILO \times INTV					

Note:

BSMFJ = Baseline Marijuana Frequency

INTV = Intervention

NORM HILO = Dichotomized high/low split of composite norms score

Table 9 Regression Table for Norms (High/Low Split) at 3 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSCNQ	0.49	40.86	1, 42	0.70	0.00
Step 2					
Main Effects					
INTV	0.001	0.02	2, 40	0.01	0.99
NORM				0.03	0.83
HILO					
Step 3					
Interaction Effects					
NORM	0.04	3.27	1, 39	0.33	0.08
HILO \times INTV					

Note:

BSCNQ = Baseline negative consequences

INTV = Intervention

NORM HILO = Dichotomized high/low split of composite norms score

Table 10 Regression Table for Norms (High/Low Split) at 6 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSCNQ	0.29	17.85	1, 43	0.54	0.00
Step 2					
Main Effects					
INTV	0.004	0.11	2, 41	0.06	0.68
NORM				0.03	0.80
HILO					
Step 3					
Interaction Effects					
NORM	0.11	7.76	1, 40	0.55	0.01
HILO \times INTV					

Note:

BSCNQ = Baseline negative consequences

INTV = Intervention

NORM HILO = Dichotomized high/low split of composite norms score

Table 11 Marijuana Readiness to Change – Subscale Scores and Total Score

	Brief Intervention	Assessment Only
Pre-contemplation Score		
3 Month	N=21 15.14 (SD=3.28)	N=24 15.5 (SD=3.59)
6 Month	N=20 15.05 (SD=3.47)	N=25 15.44 (SD=2.87)
Contemplation Score		
3 Month	N=21 8.24 (SD=3.86)	N=24 8.58 (SD=3.19)
6 Month	N=20 8.75 (SD=4.02)	N=25 7.64 (SD=2.89)
Action Score		
3 Month	N=21 10.38 (SD=3.73)	N=24 10.99 (SD=4.48)
6 Month	N=20 10.00 (SD=4.26)	N=25 10.52 (SD=4.42)
Overall RTC Score		
3 Month	N=21 3.48 (SD=9.65)	N=24 4.04 (SD=7.14)
6 Month	N=20 3.70 (SD=10.99)	N=25 2.72 (SD=6.04)

Note:

Overall RTC Score = (Contemplation Score + Action Score) – Pre-contemplation Score
 [Range: Items 1 -5, 1=Strongly Disagree, 2=Disagree, 3=Unsure, 4=Agree, 5=Strongly Agree; Total Range 4 - 20]
 [Overall RTC Score Range: -12 to 36]

Table 12 Regression Table for Action Scores at 3 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSMJQ	0.69	97.39	1, 43	0.83	0.00
Step 2					
Main Effects					
INTV	0.04	2.88	2, 41	-0.17	0.04
RTCACTION				0.11	0.19
Step 3					
Interaction Effects					
RTCACTIONxINTV	0.01	2.10	1, 40	-0.37	0.16

Note:

BSMJQ = Baseline marijuana use frequency

INTV = Intervention

RTCACTION = Action score on RTC Questionnaire

Table 13 Regression Table for Action Scores at 6 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSMJQ	0.63	75.25	1, 44	0.79	0.00
Step 2					
Main Effects					
INTV	0.03	1.97	2, 42	-0.12	0.21
RTCACTION				0.15	0.11
Step 3					
Interaction Effects					
RTCACTION \times INTV	0.001	0.13	1, 41	-0.10	0.72

Note:

BSMJQ = Baseline marijuana use frequency

INTV = Intervention

RTCACTION = Action score on RTC Questionnaire

Table 14 Regression Table for Action Scores at 3 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSCNQ	0.48	40.03	1, 43	0.69	0.00
Step 2					
Main Effects					
INTV	0.001	0.02	2, 41	0.02	0.85
RTCACTION				-0.01	0.92
Step 3					
Interaction Effects					
RTCACTION \times INTV	0.01	1.05	1, 40	-0.36	0.31

Note:

BSCNQ = Baseline marijuana consequences

INTV = Intervention

RTCACTION = Action score on RTC Questionnaire

Table 15 Regression Table for Action Scores at 6 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSCNQ	0.29	17.71	1, 44	0.54	0.00
Step 2					
Main Effects					
INTV	0.01	0.15	2, 42	0.07	0.60
RTCACTION				0.01	0.93
Step 3					
Interaction Effects					
RTCACTION \times INTV	0.001	0.07	1, 41	0.11	0.79

Note:

BSCNQ = Baseline marijuana consequences

INTV = Intervention

RTCACTION = Action score on RTC Questionnaire

Table 16 Regression Table for Action Scores (High/Low Split) at 3 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSMJFQ	0.69	97.39	1, 43	0.83	0.00
Step 2					
Main Effects					
INTV	0.03	2.12	2, 41	-0.17	0.05
ACTHILO				0.05	0.52
Step 3					
Interaction					
Effects					
ACTHILOxINTV	0.01	2.17	1, 40	-0.22	0.15

Note:

BSMJFQ = Baseline marijuana frequency

INTV = Intervention

ACTHILO = Action subscale dichotomously split high/low

Table 17 Regression Table for Action Scores (High/Low Split) at 6 Months, Frequency Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSMJFQ	0.63	75.24	1, 44	0.79	0.00
Step 2					
Main Effects					
INTV	0.03	2.00	2, 42	-0.11	0.23
ACTHILO				0.15	0.10
Step 3					
Interaction					
Effects					
ACTHILOxINTV	0.01	0.89	1, 41	-0.15	0.36

Note:

BSMJFQ = Baseline marijuana frequency

INTV = Intervention

ACTHILO = Action subscale dichotomously split high/low

Table 18 Regression Table for Action Scores (High/Low Split) at 3 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control Variables					
BSCNQ	0.48	40.03	1, 43	0.69	0.00
Step 2					
Main Effects					
INTV	0.001	0.02	2, 41	0.02	0.85
ACTHILO				0.01	0.93
Step 3					
Interaction Effects					
ACTHILOxINTV	0.04	3.03	1, 40	-0.34	0.09

Note:

BSCNQ = Baseline marijuana consequences

INTV = Intervention

ACTHILO = Action subscale dichotomously split high/low

Table 19 Regression Table for Action Scores (High/Low Split) at 6 Months, Consequences Outcomes

Variable	ΔR^2	ΔF	df	β	p
Step 1					
Control					
Variables					
BSCNQ	0.29	17.71	1, 44	0.54	0.00
Step 2					
Main Effects					
INTV	0.01	0.16	2, 42	0.07	0.60
ACTHILO				0.02	
Step 3					
Interaction					
Effects					
ACTHILOxINTV	0.001	0.06	1, 41	-0.06	0.80

Note:

BSCNQ = Baseline marijuana consequences

INTV = Intervention

ACTHILO = Action subscale dichotomously split high/low

Table 20 Other Substance Use – Past Days Used in Previous 90 Days; Individual Item Scores and Composite Score

	Brief Intervention	Assessment Only
Tobacco3M		
Baseline	N=24 1.88 (SD=2.29)	N=25 1.36 (SD=1.93)
3 Months	N=21 1.67 (SD=2.15)	N=24 1.42 (SD=1.91)
6 Months	N=21 1.80 (SD=2.33)	N=25 1.36 (SD=1.87)
Alcohol3M		
Baseline	N=24 3.79 (SD=1.28)	N=25 3.96 (SD=0.73)
3 Months	N=21 4.19 (SD=1.36)	N=24 3.62 (SD=1.10)
6 Months	N=21 4.15 (SD=1.31)	N=25 3.84 (SD=0.75)
Cocaine3M		
Baseline	N=24 0.25 (SD=0.68)	N=25 0.40 (SD=0.82)
3 Months	N=21 0.19 (SD=0.60)	N=24 0.42 (SD=0.83)
6 Months	N=21 0.10 (SD=0.45)	N=25 0.64 (SD=1.11)
Amphetamines3M		
Baseline	N=24 0.62 (SD=1.44)	N=25 1.52 (SD=1.39)
3 Months	N=21 0.29 (SD=1.31)	N=24 0.38 (SD=0.88)
6 Months	N=21 0.30 (SD=0.73)	N=25 0.68 (SD=1.55)
Inhalants3M		
Baseline	N=24 0.00 (SD=0.00)	N=25 0.08 (SD=0.40)
3 Months	N=21 0.19 (SD=0.60)	N=24 0.00 (SD=0.00)
6 Months	N=21 0.00 (SD=0.00)	N=25 0.08 (SD=0.40)
Sedatives3M		
Baseline	N=24 0.83 (SD=1.86)	N=25 0.24 (SD=0.66)

3 Months	N=21 0.48 (SD=1.08)	N=24 0.17 (SD=0.82)
6 Months	N=21 0.40 (SD=1.05)	N=25 0.36 (SD=0.86)
Hallucinogens3M		
Baseline	N=24 0.33 (SD=0.76)	N=25 0.16 (SD=0.55)
3 Months	N=21 0.10 (SD=0.44)	N=24 0.00 (SD=0.00)
6 Months	N=21 0.10 (SD=0.45)	N=25 0.08 (SD=0.40)
Opioids3M		
Baseline	N=24 0.25 (SD=1.22)	N=25 0.00 (SD=0.00)
3 Months	N=21 0.19 (SD=0.60)	N=24 0.08 (SD=0.41)
6 Months	N=21 0.00 (SD=0.00)	N=25 0.2 (SD=0.71)
Total All other Substances		
Baseline	N=24 7.96 (SD=4.69)	N=25 6.72 (SD=4.32)
3 Months	N=21 7.29 (SD=4.14)	N=24 6.08 (SD=3.28)
6 Months	N=21 6.85 (SD=3.33)	N=25 7.24 (SD=3.87)

Note:

[Days Used, Range = 1 - 90]

Table 21 Satisfaction Ratings

	Brief Intervention N=19*	Assessment Only N=25
Easy to Understand	4.37 (SD=0.761)	4.08 (SD=0.954)
Useful	2.89 (SD=1.370)	3.04 (SD=1.369)
Interesting	3.05 (SD=1.268)	3.12 (SD=1.201)
Applicable	2.68 (SD=1.250)	3.00 (SD=1.041)
Satisfaction	3.21 (SD=0.976)	3.48 (SD=1.122)
Overall Rating	3.24 (SD=0.944)	3.34 (SD=0.930)

Note:

*Please note, one participant did not complete the satisfaction rating scale

[Range = 1-5, 1 = Not at all, 2 = Somewhat, 3 = Moderately, 4 = Quite, 5 = Very]

Table 22 Percentages of Participants Who Sought Information/Services Related to Substance Use and Other Health Behaviors in Past 6 Months

	Total N=44	BI N=19*	AO N=25
Drugs			
Online Information	7 (15.9%)	3 (15.8%)	4 (16.0%)
Information through BU-provided weblinks	3 (6.8%)	2 (10.5%)	1 (4.0%)
Information/Counseling through BU Services	2 (4.5%)	1 (5.3%)	1 (4.0%)
Alcohol			
Online Information	3 (6.8%)	2 (10.5%)	1 (4.0%)
Information through BU-provided weblinks	3 (6.8%)	2 (10.5%)	1 (4.0%)
Information/Counseling through BU Services	2 (4.5%)	1 (5.3%)	1 (4.0%)
Smoking			
Online Information	3 (6.8%)	1 (5.3%)	2 (8.0%)
Information through BU-provided weblinks	1 (2.3%)	0 (0.0%)	1 (4.0%)
Information/Counseling through BU Services	0 (0.0%)	0 (0.0%)	0 (0.0%)
Nutrition			
Online Information	21 (47.7%)	7 (36.8%)	14 (56.0%)
Information through BU-provided weblinks	4 (9.1%)	1 (5.3%)	3 (12.0%)
Information/Counseling through BU Services	2 (4.5%)	1 (5.3%)	1 (4.0%)
Exercise			
Online Information	18 (40.9%)	8 (42.1%)	10 (40.0%)
Information through BU-provided weblinks	4 (9.1%)	2 (10.5%)	2 (8.0%)
Information/Counseling through BU Services	4 (9.1%)	2 (10.5%)	2 (8.0%)

Note: BI = Brief Intervention; AO = Assessment Only; Fisher's Exact Tests did not find any difference between any items in the BI vs. AO groups.

*Please note, one participant did not complete the Additional Treatment survey

Figure 1 Conditional Latent Growth Model - Effect of Intervention on Frequency of Use at 3- and 6-Month Outcomes

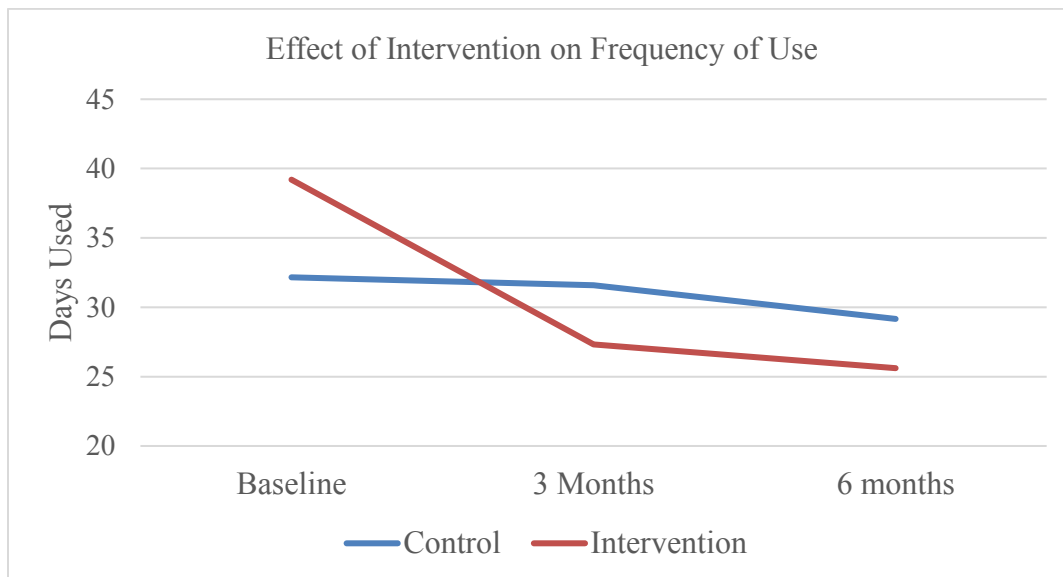


Figure 2 Conditional Latent Growth Model - Effect of Intervention on Consequences of Use at 3- and 6-Month Outcomes

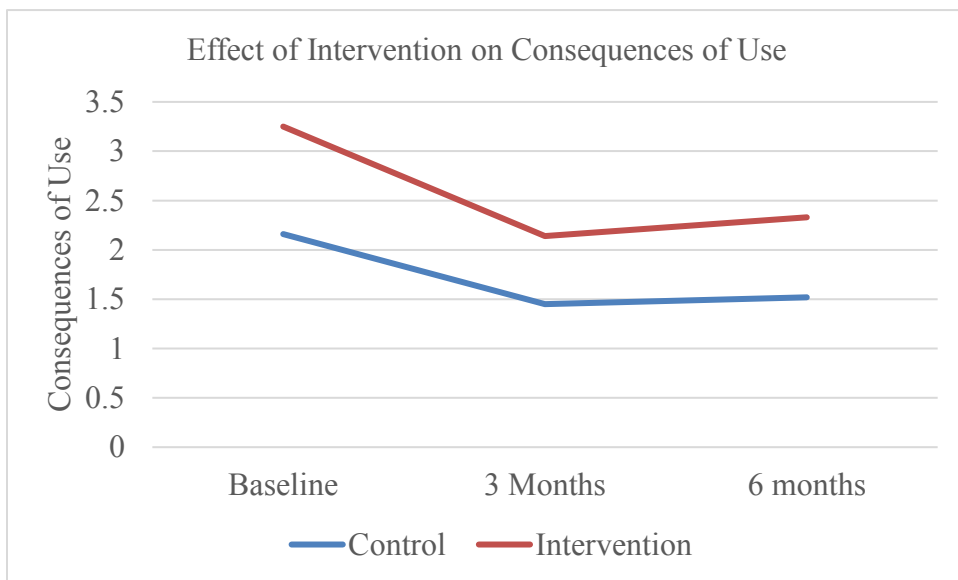


Figure 3 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Frequency of Use at 3-Months

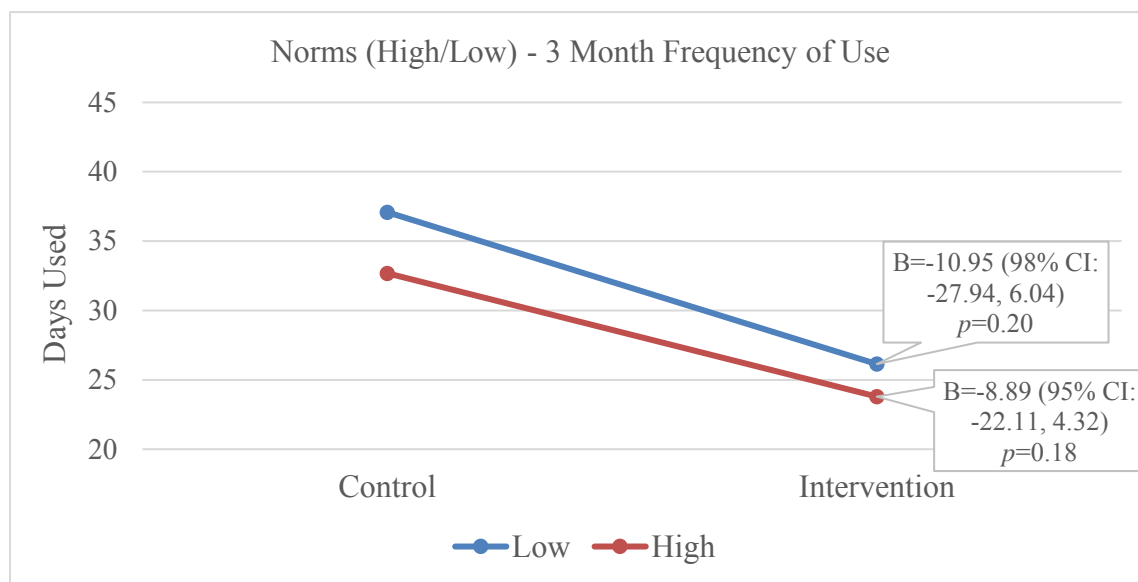


Figure 4 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Frequency of Use at 6-Months

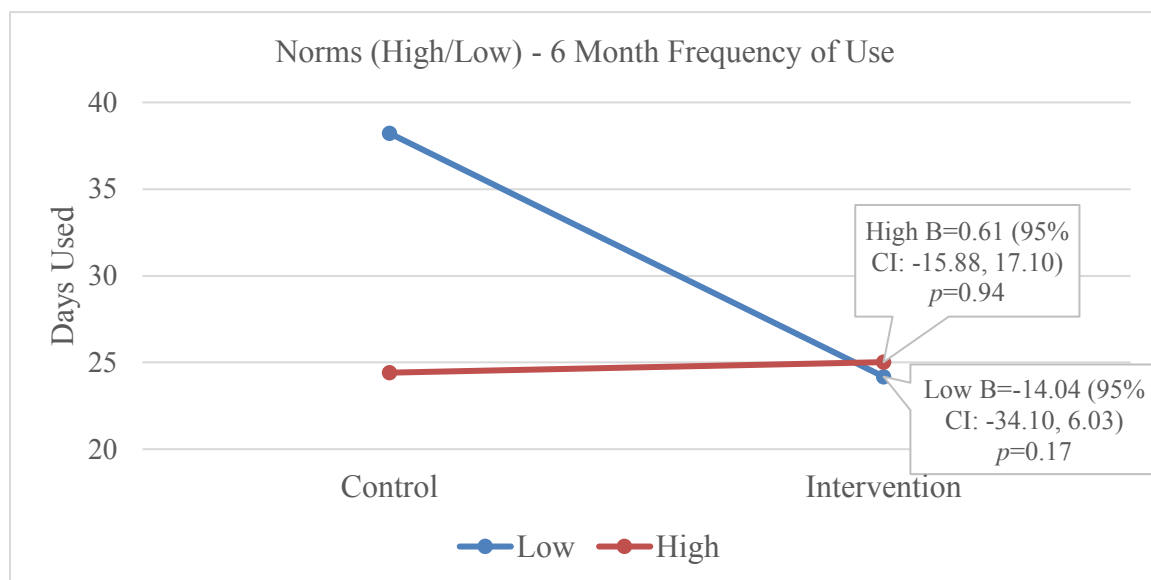


Figure 5 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Consequences of Use at 3-Months

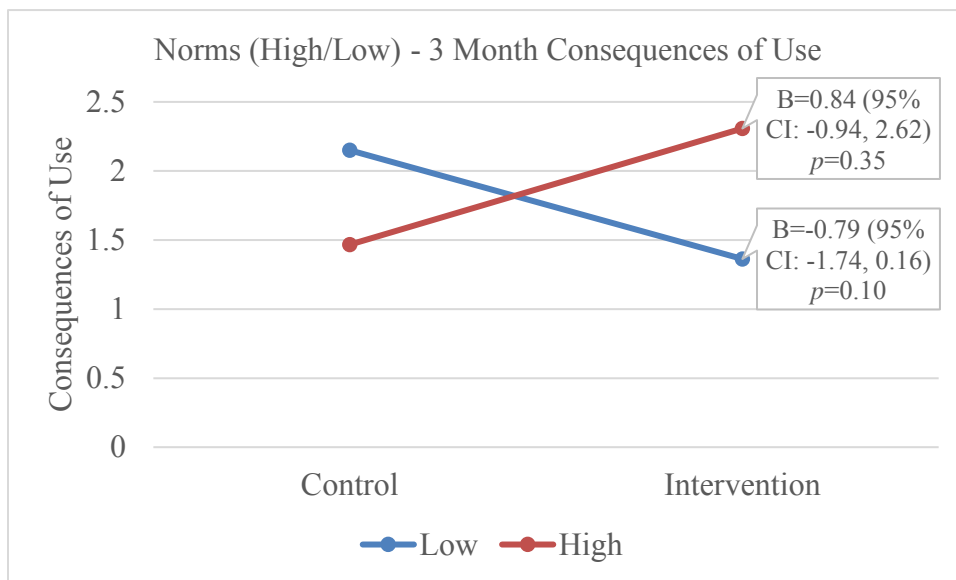


Figure 6 Simple Slopes Linear Regression Moderator Analyses – Effect of Norms (Dichotomized High/Low Split) on Consequences of Use at 6-Months

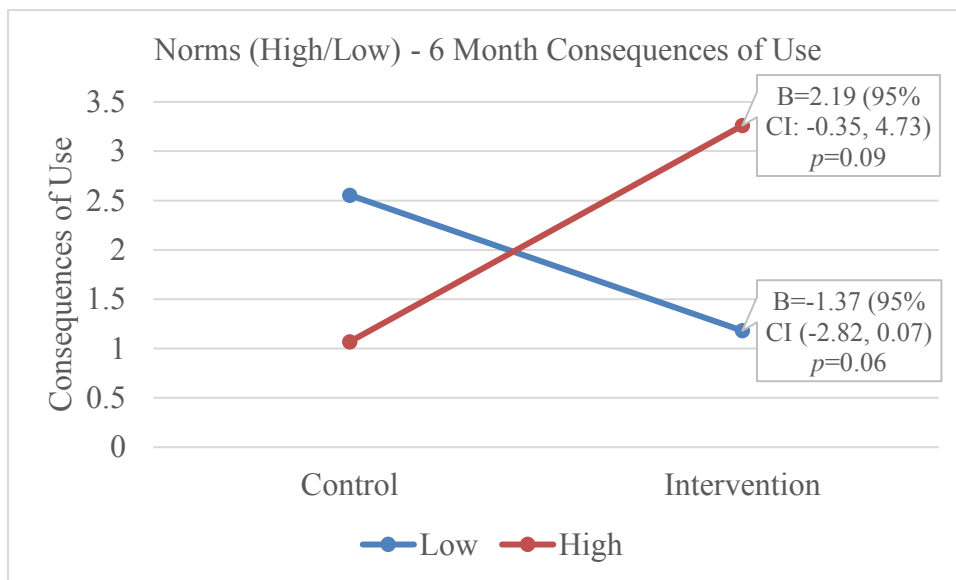


Figure 7 Simple Slopes Linear Regression Moderator Analyses – Effect of Action subscale of RTC Questionnaire (Dichotomized High/Low Split) on Frequency of Use at 3-Months

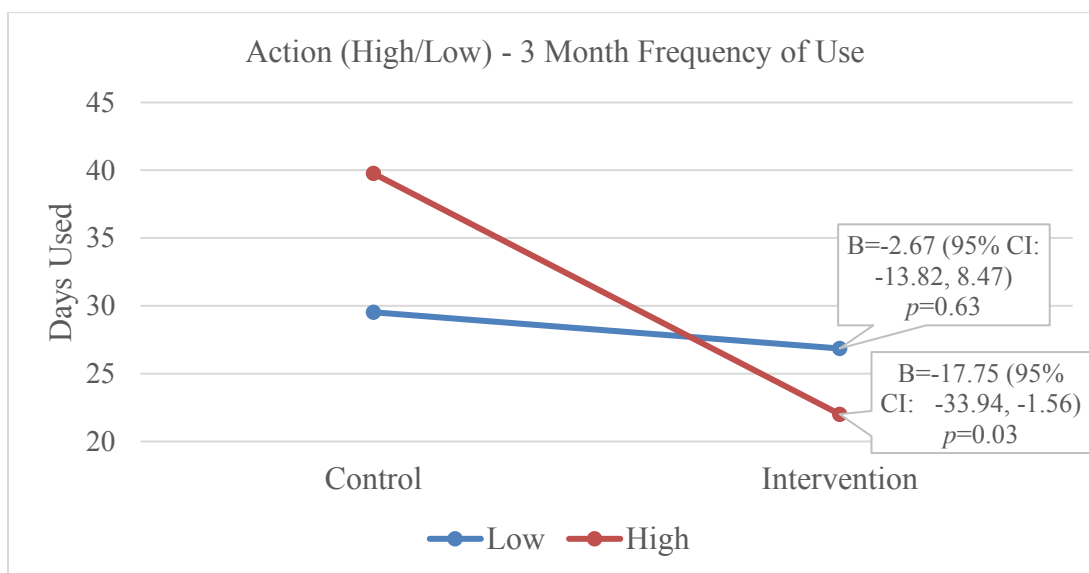


Figure 8 Simple Slopes Linear Regression Moderator Analyses – Effect of Action subscale of RTC Questionnaire (Dichotomized High/Low Split) on Frequency of Use at 6-Months

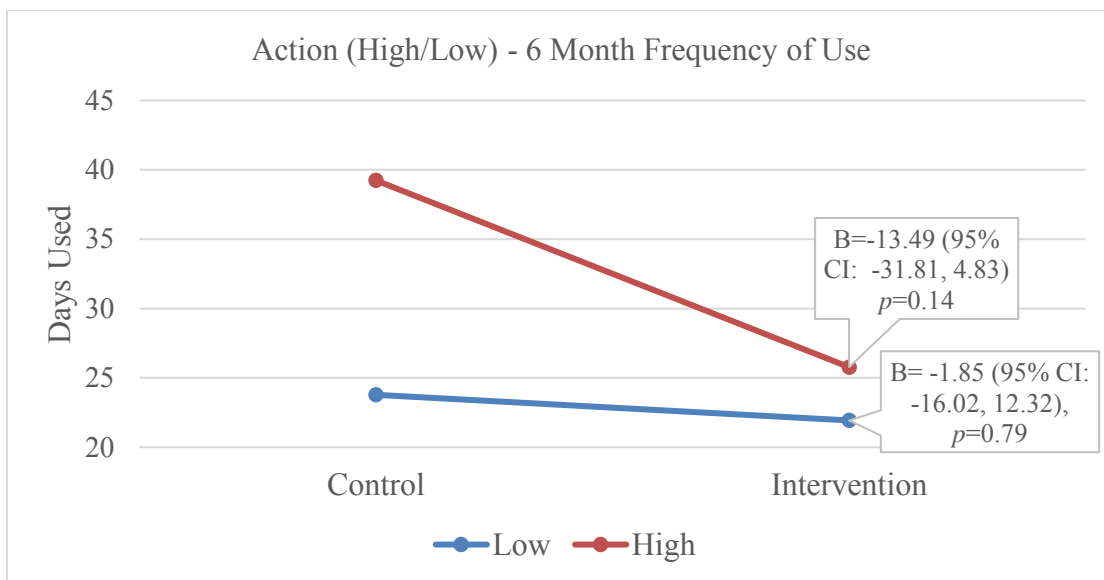


Figure 9 Simple Slopes Linear Regression Moderator Analyses – Effect of Action subscale of RTC Questionnaire (Dichotomized High/Low Split) on Frequency of Use at 3-Months

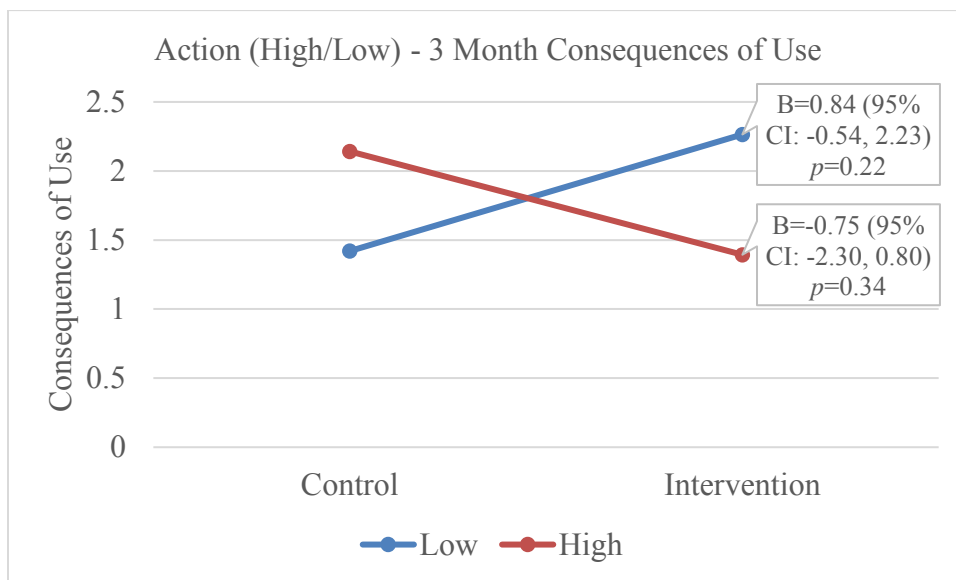
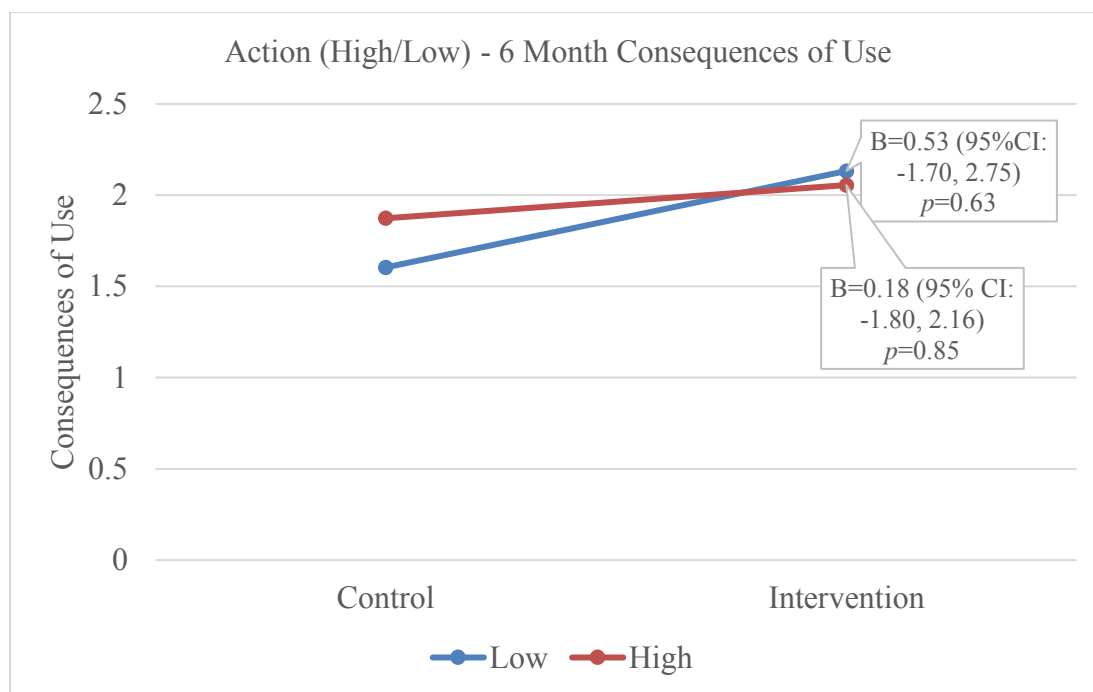


Figure 10 Simple Slopes Linear Regression Moderator Analyses – Effect of Action subscale of RTC Questionnaire (Dichotomized High/Low Split) on Consequences of Use at 6-Months



APPENDICES

Appendix A – Initial Screener

Welcome to the BU Student Health Behaviors Study. We will ask you a series of questions about different health behaviors (e.g., diet, exercise, substance use, alcohol use). Completion of these questions is completely voluntary; no information will be collected regarding your name or information. Completion of these questions will take approximately 1 minute. In order to complete, please verify that:

- 1) You are 18 years of age or older
[Select “yes” or “no”]
- 2) You have read this information about the study and choose to complete these initial survey questions
[Select “yes” or “no”]

Pre-Screener

- 1) What is your gender?
[M=male, F=female]
- 2) On how many days per week do you typically exercise?
[Open-ended question, numerical response]
- 3) In the past year, how often have you been on a diet?
[1=never, 2=rarely, 3=sometimes, 4=most of the time, 5=always]
- 4) How satisfied are you with your current eating patterns?
[1=very satisfied, 2=moderately satisfied, 3=somewhat satisfied, 4=somewhat dissatisfied, 5=moderately dissatisfied, 6=very dissatisfied]

- 5) In the last month, how often have you been nervous or “stressed”?
[1=never, 2=almost never, 3=sometimes, 4=fairly often 5=very often]
- 6) Do you currently smoke cigarettes?
[1=no, 2=yes]
- 7) How often do you have a drink containing alcohol?
[1=never, 2=monthly or less, 3=2-4 times/month, 4=2-3 times/week, 5=4+ times/week]
- 8) In the past 30 days, how often have you had 4+(if female)/5+(if male) drinks on one given occasion?
[Open response, numerical value]
- 9) In the past 3 months, how often have you used cannabis?
[1=never, 2=once or twice, 3=monthly, 4=weekly, 5=daily]

Appendix B - Welcome Screen

Welcome to the Student Health Study. You will be asked to complete a series of questions about your health-related behaviors. Your assessment set will consist of a series of general questions about health but mainly questions about alcohol and substance use. Please take your time and answer the questions as accurately as possible.

Following the study assessment phase you may be asked to complete additional questions and will receive some feedback information regarding your own health behaviors. Please understand that while some of these questions may have some overlap with previous questions they are distinct. We ask that you take your time and read each question before answering. The entire process will take about 30 minutes to complete.

Please enter the username and password that you created for the study to login.

Enter username _____

Enter password _____

Appendix C – Booster Session Introduction Screen

Note: these instructions were only included for the 3-month booster session prior to completion of study measures.

IMPORTANT: WHILE YOU COMPLETE THE SURVEY FOR THE SECOND PART, PLEASE CONSIDER HOW YOUR CURRENT RESPONSES COMPARE TO YOUR RESPONSES FROM THREE MONTHS AGO. IN WHAT WAYS HAVE THEY CHANGED AND HOW HAVE THEY STAYED THE SAME? HAVE YOU MET YOUR OWN PERSONAL STANDARDS FOR THESE BEHAVIORS AND OUTCOMES? IN WHAT WAYS HAVE YOU SUCCEEDED AND WHAT DO YOU HOPE TO CHANGE?

Appendix D – NIDA-Modified ASSIST

The remaining items ask more detailed questions about alcohol and substance use. These are questions about both use patterns and your beliefs and perceptions about alcohol and substance use. Please take your time as you consider these questions

On how many of the past 30 days did you smoke cigarettes?
_____ days [FIELD NAME: Smoke30, Drop Down Box with choices 0-30 days]

NOTE:

If Smoke30 = 0 → Skip next question and GO TO PAGE 6

If Smoke30 ≥ 1 → Display:

During the past 30 days, on the days that you smoked, how many cigarettes did you smoke per day? _____ cigarettes [FIELD NAME: CigsDay, Drop Down Box with choices 1-39, 40+]

[eToke Assessment Page 5: Alcohol Involvement, Part 1]

How often do you have a drink containing alcohol? A drink is a 12 oz. bottle or can of beer, a 12 oz. wine cooler, a 4 oz. glass of wine, or one shot (1 ¼ oz.) or mixed drink.

[FIELD NAME: OftenDrink, Drop Down Box with choices:

Never (code 0)

Monthly or less (code 1)

2 to 4 times a month (code 2)

2 to 3 times a week (code 3)

4 or more times a week (code 4)]

NOTE:

If OftenDrink = 0 → GO TO PAGE 9

If OftenDrink ≥ 1 → GO TO PAGE 6

[eToke Assessment Page 6: Alcohol Involvement, Part 2]

How many drinks containing alcohol do you have on a typical day when you are drinking? **[FIELD NAME: TypicalDay, Drop Down Box with choices:**

- 1 or 2 (code 0)**
- 3 or 4 (code 1)**
- 5 or 6 (code 2)**
- 7 to 9 (code 3)**
- 10 or more (code 4)]**

How often do you have six or more drinks on one occasion? **[FIELD NAME: SixMore, Drop Down Box with choices:**

- Never (code 0)**
- Less than monthly (code 1)**
- Monthly (code 2)**
- Weekly (code 3)**
- Daily or almost daily (code 4)]**

How often during the last year have you found that you were not able to stop drinking once you had started? **[FIELD NAME: NotStop, Drop Down Box with choices:**

- Never (code 0)**
- Less than monthly (code 1)**
- Monthly (code 2)**
- Weekly (code 3)**
- Daily or almost daily (code 4)]**

How often during the last year have you failed to do what was normally expected of you because of drinking? **[FIELD NAME: FailToDo, Drop Down Box with choices:**

- Never (code 0)**
- Less than monthly (code 1)**
- Monthly (code 2)**
- Weekly (code 3)**
- Daily or almost daily (code 4)]**

How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session? **[FIELD NAME: FirstDrink, Drop Down Box with choices:**

- Never (code 0)**
- Less than monthly (code 1)**

Monthly (code 2)
Weekly (code 3)
Daily or almost daily (code 4)]

How often during the last year have you had a feeling of guilt or remorse after drinking? **[FIELD NAME: GuiltDrink, Drop Down Box with choices:**

- Never (code 0)**
- Less than monthly (code 1)**
- Monthly (code 2)**
- Weekly (code 3)**
- Daily or almost daily (code 4)]**

How often during the last year have you been unable to remember what happened the night before because of your drinking? **[FIELD NAME: UnableRemember, Drop Down Box with choices:**

- Never (code 0)**
- Less than monthly (code 1)**
- Monthly (code 2)**
- Weekly (code 3)**
- Daily or almost daily (code 4)]**

Have you or someone else been injured because of your drinking? **[FIELD NAME: InjuredDrink, Drop Down Box with choices:**

- No (code 0)**
- Yes, but not in the last year (code 2)**
- Yes, during the last year (code 4)**

Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down? **[FIELD NAME: DrinkConcern, Drop Down Box with choices:**

- No (code 0)**
- Yes, but not in the last year (code 2)**
- Yes, during the last year (code 4)**

[eToke Assessment Page 7: Drinking in the Past Month, Part 1]

The next set of questions refer to drinking over the **PAST MONTH**

How **often** in the **past month** did you drink alcohol? [FIELD NAME: Drink30, Drop Down Box with choices 0-18, 19 or more times]

NOTE:

If Drink30 = 0 → GO TO PAGE 9

If Drink30 ≥ 1 → GO TO PAGE 8

[eToke Assessment Page 8: Drinking in the Past Month, Part 2]

NOTE: Call in Gender from Prescreener

If Gender = 1 (Male) → Ask:

In the **past 30 days**, how many times have you had **5 or more** drinks on a given occasion? **[FIELD NAME: Binge30, Drop Down Box with choices 0-18, 19 or more times]**

If Gender = 2 (Female) → Ask:

In the **past 30 days**, how many times have you had **4 or more** drinks on a given occasion? **[FIELD NAME: Binge30, Drop Down Box with choices 0-18, 19 or more times]**

In the **past month**, when you were drinking alcohol, how many drinks did you **usually** have on any **one** occasion? **[FIELD NAME: UsualDrink30, Drop Down Box with choices 1-18, 19 or more drinks]**

Think of the occasion you drank the **most** this **past month**. How much did you drink? **[FIELD NAME: MostDrink30, Drop Down Box with choices 1-18, 19 or more drinks]**

On a given **weekend evening**, how much alcohol do you typically drink? Estimate for the **past month**. **[FIELD NAME: WeekendDrink30, Drop Down Box with choices 1-18, 19 or more drinks]**

[eToke Assessment Page 10: Marijuana Involvement, Part 2]**NOTE: The codes for the response choices are different in this section****NOTE: Generate 3 month calendar based on current date and display on page (pop-up?)****In the past three months**, how often have you used cannabis (marijuana, pot, grass, hash, etc.)? **[FIELD NAME: OftenMarj, Drop Down Box with choices:**

- Never (code 0)**
- Once or Twice (code 2)**
- Monthly (code 3)**
- Weekly (code 4)**
- Daily or Almost Daily (code 6)]**

In the past three months, how often have you had a strong desire or urge to use cannabis (marijuana, pot, grass, hash, etc.)? **[FIELD NAME: DesireMarj, Drop Down Box with choices:**

- Never (code 0)**
- Once or Twice (code 3)**
- Monthly (code 4)**
- Weekly (code 5)**
- Daily or Almost Daily (code 6)]**

During the past three months, how often has your use of cannabis (marijuana, pot, grass, hash, etc.) led to health, social, legal or financial problems? **[FIELD NAME: ProbMarj, Drop Down Box with choices:**

- Never (code 0)**
- Once or Twice (code 4)**
- Monthly (code 5)**
- Weekly (code 6)**
- Daily or Almost Daily (code 7)]**

In the past three months, how often have you failed to do what was normally expected of you because of your use of (marijuana, pot, grass, hash, etc.)? **[FIELD NAME: FailMarj, Drop Down Box with choices:**

- Never (code 0)**
- Once or Twice (code 5)**
- Monthly (code 6)**
- Weekly (code 7)**
- Daily or Almost Daily (code 8)]**

Has a friend or relative or anyone else **ever** expressed concern about your use of cannabis (marijuana, pot, grass, hash, etc.)? [**FIELD NAME: ConcernMarj, Drop Down Box with choices:**

No, never (code 0)

Yes, but not in the past three months (code 3)

Yes, in the past 3 months (code 6)

Have you ever tried and failed to control, cut down or stop using cannabis (marijuana, pot, grass, hash, etc.)? [**FIELD NAME: ControlMarj, Drop Down Box with choices:**

No, never (code 0)

Yes, but not in the past three months (code 3)

Yes, in the past 3 months (code 6)

Appendix E - Frequency of Marijuana Use – 90 Days**[eToke Assessment Page 9: Marijuana Involvement, Part 1]**

During the past 90 days, on how many days did you use any kind of marijuana, blunts, or hashish? _____ days [FIELD NAME: MarjDays, Text Box, only allow digits from 0 to 90]

NOTE: Call in STUDYARM from Prescreener.

If STUDYARM = 1 (eToke Trial) → GO TO PAGE 10, REGARDLESS OF RESPONSE TO MARJDAYS

If STUDYARM = 2 (Health Trial) and MARJDAYS > 0 (or NULL) → GO TO PAGE 10

If STUDYARM = 2 (Health Trial) and MARJDAYS = 0 → GO TO PAGE 13

Appendix F - Marijuana-Related Consequences

NOTE: Arrange questions as a grid, with radio buttons for responses

Has marijuana use caused you ...	No Problem	Minor Problem	Serious Problem
CODE	0	1	2
Problems between you and your partner [PROBPART]			
Problems in your family [PROBFAM]			
To neglect your family [NEGLECTFAM]			
Problems between you and your friends [PROBFRIENDS]			
To miss days at work or miss classes [MISSDAYS]			
To lose a job [LOSEJOB]			
To have lower productivity [LOWPROD]			
Medical problems [MEDPROBS]			
Withdrawal symptoms [WITHDRSYMP]			
Blackouts or flashbacks [BLACKOUTS]			
Memory loss [MEMLOSS]			
Difficulty sleeping [DIFFSLEEP]			
Financial difficulties [FINANCEDIFF]			
Legal problems [LEGALPROBS]			
To have lower energy level [LOWENERGY]			
To feel bad about your use [FEELBAD]			
Lowered self-esteem [SELFESTEEM]			
To procrastinate [PROCRASTINATE]			
To lack self-confidence [LACKCONF]			

Note:

[Total Score Range: 0-38]

Appendix G - Marijuana Norms

For each of the following, estimate how common you believe these behaviors are (Enter a number between 0-100):

What percent of Boston university students (of your gender) use marijuana MORE frequently than you do? **[FIELD NAME: BUMarjMore, text box, only allow numbers from 0 to 100]** %

What percent of Boston University students (of your gender) use marijuana AT LEAST ONCE A MONTH? **[FIELD NAME: BUMarjMonth, text box, only allow numbers from 0 to 100]** %

What percent of Boston University students (of your gender) HAVE NOT USED marijuana at all IN THE PAST 3-MONTHS **[FIELD NAME: BUNoMarj, text box, only allow numbers from 0 to 100]** %

Appendix H – Manuscript for Publication

Electronic Screening and Brief Intervention to Reduce Marijuana Use and Consequences Among Graduate Students Presenting to a Student Health Center: A Pilot Study

Tracie M. Goodness^{a,*}, & Tibor P. Palfai^a

^a *Department of Psychology, Boston University, 900 Commonwealth Ave., Boston, MA 02215, United States*

^{*} *Corresponding author, Tel. 617-353-9610, email: tgoodnes@bu.edu*

Highlights

- Tested a web-based electronic Screening and Brief Intervention (eSBI) for graduate college student marijuana users.
- Results showed feasibility of implementing eSBI in a student health center.
- The intervention showed efficacy in changes in marijuana use frequency.
- The intervention showed changes in marijuana descriptive norms.

Keywords:

- Marijuana
- Intervention
- Graduate student
- College student
- Student Health

ABSTRACT: This pilot study sought to test the feasibility of screening graduate students for marijuana use in Student Health Services (SHS). As the majority of students do not seek treatment for their marijuana use, electronic screening and brief intervention (eSBI) has been used to reach students in “opportunistic” settings (e.g., primary care). Despite promise for reducing hazardous drinking, the impact of eSBI for marijuana use has been mixed, and has focused on undergraduates. There is little known about whether such approaches may influence graduate student marijuana use and consequences. Graduate students were screened during their visit to a Student Health Center. Those with monthly or greater marijuana use were eligible. Forty-nine students completed assessments and were randomly assigned to an eSBI intervention (BI [eCHECKUPTOGO-marijuana]) or assessment only (AO). Participants completed measures of marijuana use frequency and negative consequences at baseline, 3- and 6-months. Readiness-to-change and descriptive norms were examined as potential moderators. Latent growth modeling was used to provide effect size estimates for the influence of the intervention on 6-month outcomes. Effect size estimates showed a small-to-medium effect of BI on marijuana use frequency at 6-months; there was no evidence of the BI on consequences. Secondary analyses

suggested that those with higher levels of readiness-to-change showed greater responsiveness to the intervention. Results suggest that BI may hold promise as a method to reduce marijuana use among graduate students who present to primary care settings. Future research should test the efficacy of this approach in a full-scale randomized controlled trial.

1. Introduction

Marijuana is one of the most frequently used substances among those in emerging adulthood (ages 18-25) (Johnston, 2013). Despite lower overall use than undergraduates, research has shown that graduate and professional students (e.g., medical students, pharmacy students) ages 26 and older report higher marijuana use than the 4.8% national rate for adults (Bidwal, Ip, Shah, & Serino, 2014). Similar to undergraduates, graduate students who smoke marijuana regularly are at risk for negative academic consequences; specifically, marijuana use while enrolled in graduate school has been shown to be negatively associated with odds of graduating from a program (Allen, Lilly, Beck, Vincent, & Arria, 2018). Given the elevated rates of graduate students compared to their age-based peers and attendant consequences, it would appear that graduate students would benefit from interventions to address marijuana use. However, there is currently little literature available on marijuana use specific to this population let alone the efficacy of interventions to address it.

Efforts to construct secondary prevention and intervention approaches for graduate students must consider that few students identify their marijuana use as problematic, let alone seek treatment (Stephens, Roffman, Fearer, Williams, & Burke, 2007). One potential approach to engage these individuals is to use interventions that can be delivered in “opportunistic” settings through screening and brief intervention (SBI), such as student health centers, where a large proportion of students who use substances make contact with university services. The use of automated or electronic SBI (eSBI) such as computer-based interventions offer a number of additional benefits, such as ease of dissemination, high reliability and consistency, and increased privacy when seeking substance use treatment that that individuals may otherwise avoid seeking due to increased disclosure (Beich, Gannik, & Malterud, 2002; Ondersma, Chase, Svikis, & Schuster, 2005).

While there have been a number of studies that have used eSBI to date have focused on addressing alcohol use (e.g., Carey et al., 2009), relatively few studies have examined eSBI on marijuana use. Currently, only four studies specifically targeted marijuana use with eSBI (Elliot & Carey, 2012; Lee, Neighbors, Kilmer, & Larimer, 2010; Palfai et al., 2014; Riggs et al., 2018; Riggs Romaine & Kavanaugh, 2018). Some have shown reductions in frequency at short-term outcomes, ranging from 6 weeks to 3 months (Lee et al., 2010; Riggs et al., 2018), while others have demonstrated reductions in marijuana-related negative consequences (Palfai et al., 2014) and perceived norms of marijuana use (Elliot & Carey, 2012; Palfai et al., 2014). Of these studies, many utilized sub-sections of undergraduate students: incoming freshman (Lee et al., 2010), undergraduates taking psychology courses (Elliot & Carey, 2012), and undergraduates living on-campus or those exposed to social media advertisements (Riggs et al., 2018).

Only one was conducted for all undergraduate students in a Student Health Center (Palfai et al., 2014).

Given the mixed evidence for short-term benefits of eSBI on marijuana outcomes following interventions, it may be important for investigators to use interventions that include repeated feedback sessions. Recent effectiveness trials with eSBIs for college student drinking have suggested that repeated feedback may be important to be effective over longer-term outcomes (Neighbors et al., 2010). A particular strength of electronic interventions, such as eCHECKUPTOGO-marijuana, is that it is easy to deliver repeated contacts with desired content in order to extend care (Humphreys & Tucker, 2002).

1.8 Primary Goals of Pilot Study

The primary goals of this pilot study were to (1) assess the feasibility of implementing and testing the effect of an electronic screening and brief intervention approach for graduate student marijuana users presenting to a Student Health Services Center (SHS) and (2) estimate the effect sizes of the intervention for reducing marijuana use and consequences over a 6-month time frame. The primary hypothesis was that graduate student marijuana users who were exposed to an eCHECKUPTOGO intervention would show evidence of greater reductions in marijuana use frequency and marijuana-related consequences compared to a control group.

2. Methods

2.1 Participants

Participants were graduate students who presented to SHS and reported using marijuana at least monthly over the past 90 days. The study was approved by the Boston University Institutional Review Board and written informed consent was obtained for study participation.

2.2 Intervention Conditions/Independent Variables

Students were randomized after completing a baseline screening assessment (described below), to two conditions: “Assessment Only” (AO) and “Brief Intervention” (BI). In the AO condition, students completed a series of questions about marijuana use and other health-related behaviors. They then received minimal electronic feedback based on their responses to questions on sleep, diet, and physical activity. Feedback was provided on recommended hours of sleep, exercise, and diet, compared to the answers submitted. No feedback on marijuana use was provided. In the BI condition, students received the eCHECKUPTOGO-marijuana eSBI, a commercially available electronic intervention that is used widely in universities and colleges in the US and Canada (San Diego State Research Foundation, 2014). They received the intervention on two occasions, at baseline and following the 3-month follow-up outcome assessment (as a booster session). This electronic intervention consisted of an assessment section followed by personalized feedback about marijuana use, including costs, descriptive norms, risks, consequences, and potential alternative activities. Students were also provided with a series of harm- and frequency-reduction strategies. This “booster” session provided repeated exposure to intervention content to reinforce learning and explicitly encouraged

students to compare their current marijuana use and consequences to their previous patterns of use, as well as to consider progress on the pursuit of important life goals and activities.

2.3 Measures

2.3.1 Screening Measure

A 9-item screening instrument was used to help determine eligibility; the measure included questions on gender, degree program, frequency of physical activity/exercise, dieting, satisfaction with eating patterns, self-assessment of stress, sleep, cigarette use, alcohol use, and cannabis use. Cannabis use frequency was assessed with the NIDA-modified version of the Alcohol, Smoking, and Substance Involvement Test (ASSIST) (Humeniuk et al., 2008). Participants were eligible to complete the baseline assessments if they reported “monthly” or greater marijuana use in the past 3 months (90 days) and identified as a graduate/professional student.

2.3.2 NIDA-modified ASSIST-Marijuana

Participants who were enrolled in the study completed the marijuana specific scale of the ASSIST (NIDA, 2010) to assess eligibility. The ASSIST marijuana items are questions about use, problems, and dependence symptoms in the previous 3 months. Cronbach’s alpha for this sample was 0.76, which is in the acceptable range for internal consistency. As the efficacy of this approach was not known, those whose marijuana-specific ASSIST scores indicated a high likelihood of substance dependence (i.e., Marijuana ASSIST ≥ 27) were not enrolled in the trial.

2.3.3 Frequency of marijuana use – 90 Days

Number of days using marijuana in the past 90 days was assessed by the question, “During the past 90 days, on how many days did you use any kind of marijuana, blunts, or hashish?” This question has been adapted for use among adolescents and young adults (Lee et al., 2013). Total scores ranged from 0 – 90. The item was accompanied by a 3-month calendar starting from the date the participant was completing the assessment to provide anchors.

2.3.4 Marijuana-related Consequences

The Marijuana Problems Scale (Stephens, Roffman, & Curtin, 2000; Stephens, Roffman, & Simpson, 1994) was used to assess marijuana related negative consequences. It is composed of 19 items to assess the extent to which individuals have experienced problems related to their marijuana use in a variety of domains (e.g., interpersonal, physical, cognitive, legal, financial) over the past 90 days. Items were scored 0 (No Problem) to 2 (Serious Problem). Number and severity of consequences was compiled as a total score, which ranged from 0 - 38. For this study, the Cronbach’s alpha = 0.77, which is in the acceptable range for internal consistency.

2.3.5 Readiness to Change Questionnaire (RTCQ)

This 12-item measure modified for marijuana use (Stephens et al., 2007) was used to assess the level of motivation to change marijuana use. It has good internal consistency and test–retest reliability and has been used both as a measure of stage of change as well as a continuous measure of motivation (Budd & Rollnick, 1996; Stephens et al., 2007). Predictive validity is high, with stages of change correlating significantly to drinking outcomes (Heather, Rollnick, & Bell, 1993). For this study, the Cronbach’s alpha for internal consistency is as follows: Pre-contemplation = 0.70, Contemplation = 0.82, Action = 0.79. All of these are within the acceptable ranges for internal consistency.

2.3.6 Perceived Marijuana Norms

This measure is modified from those used to assess perceptions of alcohol use among college students (Baer, Stacy, & Larimer, 1991; Lewis & Clemens, 2008). Gender and university specific questions to assess descriptive norms of marijuana use were presented to students, “What percent of [male/female] students at the University have smoked marijuana in the past month?” and “What percent of [male/female] students at the University have not smoked marijuana in the past 3 months?” This item was reverse scored (i.e., to recode the item as percent who have smoked) and the mean rating (0–100) was used as the composite measure of norms in analyses. Coefficient alpha for the composite measure was 0.82, which is in the acceptable range for internal consistency.

2.4 Procedures

After completing the screening questionnaire on the tablet, students were notified about their eligibility and provided a description of the study. Students who chose to participate, were consented and then completed the electronic baseline assessment. Students with ASSIST scores of ≥ 27 were provided with information about their score and given referrals for treatment available through BU available to them. These participants were excluded from further participation in the study (i.e., not randomized to condition). Following baseline, eligible students were randomized to either the “Assessment Only” (AO) condition, or “eCHECKUPTOGO-marijuana + booster intervention” “Brief Intervention” (BI) condition. Following completion of baseline, participants were reminded that they would be contacted at 3- and 6-months to complete electronic assessments. Those in the BI condition also completed the booster eCHECKUPTOGO-marijuana at the 3-month timepoint following the assessment. Students were contacted with reminder emails and calls as necessary to complete the electronic assessments at 3- and 6-months at a location of their own choosing. Students were compensated \$25 for participation in baseline assessment procedures, \$25 for the 3-month, and \$50 for the 6-month assessments.

2.5 Data Analysis

Latent growth modeling was used to provide preliminary effect size estimates on the influence of the intervention on marijuana use and negative consequences. Data were analyzed using Mplus (7), a latent variable software program (Muthén & Muthén, 2012). The Maximum Likelihood Estimator (MLR) was used to accommodate missing data in

the two models. For the primary analysis, statistical significance of parameter estimates was evaluated for each analysis. Conditional latent growth models (LGMs) in which the slope was regressed on the intervention covariate an intercept were used in all analyses. Intervention condition was coded as an indicator variable (0,1) with 1 representing the active intervention condition. Prior to fitting conditional models with the intervention condition covariate, unconditional latent growth models were fit in each set of analyses to establish an acceptable (e.g., good-fitting) temporal model, as well as to serve as a baseline for computing the effect sizes. Slope factor loadings were specified respectively as follows for baseline (T1), 3 months (T2), and 6 months (T3): 0, * (i.e., freely estimated), and 1 (as temporal change was not expected to be linear). The specification centers the intercept on the baseline time-point and the mean of the Slope factor provides estimates of the amount of change over the 6-month period. To test the conditional effect at the 3-month outcomes, Slope factor loadings were re-specified respectively as follows for baseline (T1), 3 months (T2), and 6 months (T3): 0, 1 *.

3. Results

3.1 Screening, enrollment, and participation

Voluntary screening took place in the waiting room of SHS. A research assistant approached students when they entered. Of the 1,225 who identified themselves as graduate students, 701 completed screening. The Consort Diagram (Table 1) shows the flow of participants through the trial. Of the 701 that completed the screening, 107 were eligible, 79 were enrolled, 52 completed baseline, and 49 were randomized to one of the study conditions (AO condition $n = 25$; BI condition $n = 24$). In the AO condition, 24 completed the 3-month assessment and 25 completed the 6-month assessment. In the BI condition, 21 completed the 3-month assessment, and one was excluded at this time because of an ASSIST score of ≥ 27 , leaving a total of 20 subjects provided data for the 6-month outcomes. To provide a conservative estimate of the intervention effect, data from this excluded participant was carried forward for the 6-month outcome assessment.

3.2 Baseline descriptive statistics

A summary of study participant characteristics by group can be found in Table 2. The racial composition of the sample was 78% White; 10% Asian; 4% Black/African American; 4% Native Hawaiian or Other Pacific Islander; and 4% Multiracial or Other. There were no significant differences between groups on the demographic variables of age [$F(3, 145) = 0.51$ $p = 0.67$], gender [$\chi^2(3) = 0.37$ $p = 0.95$], or indices of race [White vs. Other] [$\chi^2(12) = 15.52$ $p = 0.21$]. Similarly, no differences between groups on marijuana use variables were observed.

The intervention condition (BI) and control condition (AO) did not differ between consequences, frequency of use, readiness to change, or norms at baseline (see Table 2). The BI condition reported a mean of 3.17 (SD = 3.21) consequences at baseline, while the AO condition reported 2.12 (SD = 2.17) consequences. Frequency of use (in the past 90 days) for the BI condition was 39.21 (SD = 32.93) and for the AO condition was 32.16 (SD = 33.42). There were no significant differences between intervention groups

on baseline categorical variables as assessed by chi-squared analyses and t-tests for continuous variables.

3.3 Intervention effect size analyses

3.3.1 Number of days using marijuana in the past 90-days

Analyses conducted in conditional latent growth modeling (LGM) suggested that the intervention influenced marijuana over the 6-month time-frame. At 6 months, LGM showed that the intervention showed a small to medium effect ($f^2 = 0.09$) on marijuana use frequency, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively), $B = -9.30$ [$se = 0.27$], $p = 0.10$. See Figure 1. At 3 months, LGM also showed evidence of a small to medium effect ($f^2 = 0.10$) on marijuana use frequency, $B = -9.641$ [$se = -0.16$], $p = 0.03$.

3.3.2 Marijuana-related negative consequences

Analyses conducted in LGM provided little evidence in change in consequences over 6 months ($f^2 = 0.002$), $B = 0.11$ [$se = 0.03$], $p = 0.86$. See Figure 2. Similar findings were observed over the course of 3-months ($f^2 = 0.022$), $B = -6.54$, [$se = -0.10$], $p = 0.27$. There was evidence of a small effect size) on consequences, using Cohen's (1988) general guidelines for f^2 (i.e., 0.02, 0.15, and 0.35 as estimates of small, medium and large effects, respectively) at 6 months. Thus, the conditional models suggest that the intervention did not influence marijuana-related consequences.

4. Discussion

The current study was designed to examine the feasibility of conducting an eSBI trial for marijuana use among graduate students who presented to a SHC and to provide preliminary effect size estimates of the influence of the eCHECKUPTOGO intervention on marijuana use and consequences. Screening, recruitment, and study procedures were successfully implemented in this study as planned indicating the feasibility of implementing these procedures in a larger scale trial. Results suggested a small-to-medium intervention effect on the frequency of marijuana use over the 6-month outcome. Although preliminary, these results suggest that the eCHECKUPTOGO program provided to graduate students with a booster session at 3-months may result in change in marijuana use over 6-months. Further, this is the first test of an eSBI for marijuana use among graduate/professional students, a population that is at risk for harm but rarely studied in alcohol and substance use interventions in university settings. In contrast to previous work with undergraduates (Palfai et al., 2014), this study provided initial support for the benefit of eCHECKUPTOGO on marijuana frequency over the 6-month period. Although this may be due to the booster session provided in this study as part of the intervention, the 3-month data suggest that it may be more likely that this represents a difference in responsiveness to the intervention among graduate students. The 3-month outcomes suggested a small-to medium effect on frequency of use following the initial intervention for graduate/professional students in this sample which was not observed

with undergraduates. Despite suggestive evidence for an effect on frequency of use, there was no evidence for an intervention effect on negative consequences.

This study was not without limitations; while feasibility of the intervention approach was established, these effect size estimates were based on a small sample ($n = 49$). Future larger-scale studies are necessary to establish the efficacy of this approach for graduate students. Second, the specific benefit of the booster session could not be identified from the design used in the current study. Dismantling studies to examine the specific benefits of the booster component should be conducted to better understand the minimal efficacious components of this eSBI approach. Finally, it is important to note that this study was conducted at a private urban university in the Northeast, featuring a state-of-the-art SHC. Most of the study participants were White males; as such, study results may not generalize to graduate student populations broadly, or to those at other universities.

Despite these limitations, this study had a number of significant strengths. First, it was described as a study to examine graduate student health behaviors and substance use, rather than an intervention for marijuana. This may have allowed for a more representative sample to be collected that is indicative of student substance use. Additionally, the study allowed for minimal burden on study staff, as well as participants, with the majority of study contact occurring online. Furthermore, this is a novel study for a population that reports higher marijuana use than their age-based peers; this indicates a need for an intervention that has been demonstrated to be feasible and efficacious in reducing use amongst graduate students.

5. Conclusion

This study provided preliminary evidence for the utility of an eSBI to reduce frequency of use for graduate students who use marijuana. This study is a novel contribution to the literature, as there is evidence of graduate students using at elevated levels compared to age-matched peers, but no empirical studies on interventions in this population. Future fully scaled studies need to be conducted in order to establish the efficacy of this approach, clarify critical intervention components, and identify moderators, and putative mechanisms of change.

Role of Funding Sources

This research was supported in part by a grant from the National Institute on Drug Abuse, R34 DA029227-01A1 to the second author.

This research was supported by a Clara Mayo Memorial Research Fellowship from the Department of Psychological and Brain Sciences, Boston University, to the first author.

Contributors

All authors have contributed to the research and manuscript preparation.

Tracie M. Goodness contributed to project implementation, literature review, analyses, and manuscript preparation.

Tibor P. Palfai contributed to all facets of the study including design, analyses, and manuscript preparation.

Conflict of Interest

There are no conflicts of interest to declare.

Acknowledgments

We would like to acknowledge the Director and Staff of the Student Health Services who supported the implementation of this project.

References

- Allen, H. K., Lilly, F., Beck, K. H., Vincent, K. B., & Arria, A. M. (2018). Graduate degree completion: Associations with alcohol and marijuana use before and after enrollment. *Addictive behaviors reports*, 9, 100156-100156. doi:10.1016/j.abrep.2018.100156
- Baer, J. S., Stacy, A., & Larimer, M. (1991). Biases in the perception of drinking norms among college students. *Journal of Studies on Alcohol*, 52(6), 580-586.
- Beich, A., Gannik, D., & Malterud, K. (2002). Screening and brief intervention for excessive alcohol use: Qualitative interview study of the experiences of general practitioners. *BMJ: British Medical Journal*, 325(7369), 870-870. doi:10.1136/bmj.325.7369.870
- Bidwal, M. K., Ip, E. J., Shah, B. M., & Serino, M. J. (2014). Stress, Drugs, and Alcohol Use Among Health Care Professional Students: A Focus on Prescription Stimulants. *J Pharm Pract*. doi:10.1177/0897190014544824
- Budd, R. J., & Rollnick, S. (1996). The structure of the Readiness to Change Questionnaire: A test of Prochaska & DiClemente's transtheoretical model. *British Journal of Health Psychology*, 1(Part 4), 365-376. doi:10.1111/j.2044-8287.1996.tb00517.x
- Elliot, J. C., & Carey, K. B. (2012). Correcting exaggerated marijuana use norms among college abstainers: A preliminary test of a preventive intervention. *Journal of Studies on Alcohol and Drugs*, 73(6), 976-980.
- Heather, N., Rollnick, S., & Bell, A. (1993). Predictive validity of the Readiness to Change Questionnaire. *Addiction*, 88(12), 1667-1677. doi:10.1111/j.1360-0443.1993.tb02042.x
- Humeniuk, R., Ali, R., Babor, T. F., Farrell, M., Formigoni, M. L., Jittiwutikarn, J., . . . Simon, S. (2008). Validation of the Alcohol, Smoking And Substance Involvement Screening Test (ASSIST). *Addiction*, 103(6), 1039-1047. doi:10.1111/j.1360-0443.2007.02114.x
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. . (2013). *Monitoring the Future national survey results on drug use, 1975-2012*. Ann Arbor, University of Michigan: Institute for Social Research.
- Lee, C. M., Kilmer, J. R., Neighbors, C., Atkins, D. C., Zheng, C., Walker, D. D., & Larimer, M. E. (2013). Indicated prevention for college student marijuana use: A

- randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 81(4), 702-709. doi:10.1037/a0033285
- Lee, C. M., Neighbors, C., Kilmer, J. R., & Larimer, M. E. (2010). A brief, web-based personalized feedback selective intervention for college student marijuana use: A randomized clinical trial. *Psychology of Addictive Behaviors*, 24(2), 265-273. doi:10.1037/a0018859
- Lewis, T. F., & Clemens, E. (2008). The influence of social norms on college student alcohol and marijuana use. *Journal of College Counseling*, 11(1), 19-31. doi:10.1002/j.2161-1882.2008.tb00021.x
- Muthén, L. K., & Muthén, B. O. (2012). MPLus: statistical analysis with latent variables--User's guide.
- National Institute on Drug Abuse (NIDA) (2010). Screening for drug use in general medical settings: A resource guide for providers. Retrieved from <http://www.drugabuse.gov/nidamed/resguide/resourceguide.pdf>
- Neighbors, C., Lewis, M. A., Atkins, D. C., Jensen, M. M., Walter, T., Fossos, N., . . . Larimer, M. E. (2010). Efficacy of web-based personalized normative feedback: A two-year randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 78(6), 898-911. doi:10.1037/a0020766
- Ondersma, S. J., Chase, S. K., Svikis, D. S., & Schuster, C. R. (2005). Computer-based brief motivational intervention for perinatal drug use. *Journal of Substance Abuse Treatment*, 28(4), 305-312. doi:10.1016/j.jsat.2005.02.004
- Palfai, Saitz, R., Winter, M., Brown, T. A., Kypri, K., Goodness, T. M., . . . Lu, J. (2014). Web-based screening and brief intervention for student marijuana use in a university health center: pilot study to examine the implementation of eCHECKUP TO GO in different contexts. *Addict Behav*, 39(9), 1346-1352. doi:10.1016/j.addbeh.2014.04.025
- Riggs, N. R., Conner, B. T., Parnes, J. E., Prince, M. A., Shillington, A. M., & George, M. W. (2018). Marijuana eCHECKUP TO GO: Effects of a personalized feedback plus protective behavioral strategies intervention for heavy marijuana-using college students. *Drug and Alcohol Dependence*, 190, 13-19. doi:10.1016/j.drugalcdep.2018.05.020
- Riggs Romaine, C. L., & Kavanaugh, A. (2018). Risks, benefits, and complexities: Reporting race & ethnicity in forensic mental health reports. *The International Journal of Forensic Mental Health*. doi:10.1080/14999013.2018.1531094
- San Diego State University Research Foundation, 2009. Marijuana eCHECKUP TO GO (eCTG) for Universities and Colleges. Retrieved from. http://www.echeckuptogo.com/usa/programs/coll_mj.php.
- Stephens, R. S., Roffman, R. A., & Curtin, L. (2000). Comparison of extended versus brief treatments for marijuana use. *Journal of Consulting and Clinical Psychology*, 68(5), 898-908. doi:10.1037/0022-006X.68.5.898
- Stephens, R. S., Roffman, R. A., Fearer, S. A., Williams, C., & Burke, R. S. (2007). The Marijuana Check-up: Promoting change in ambivalent marijuana users. *Addiction*, 102(6), 947-957. doi:10.1111/j.1360-0443.2007.01821.x

Stephens, R. S., Roffman, R. A., & Simpson, E. E. (1994). Treating adult marijuana dependence: A test of the relapse prevention model. *Journal of Consulting and Clinical Psychology, 62*(1), 92-99. doi:10.1037/0022-006X.62.1.92

Table 1 Consort Diagram

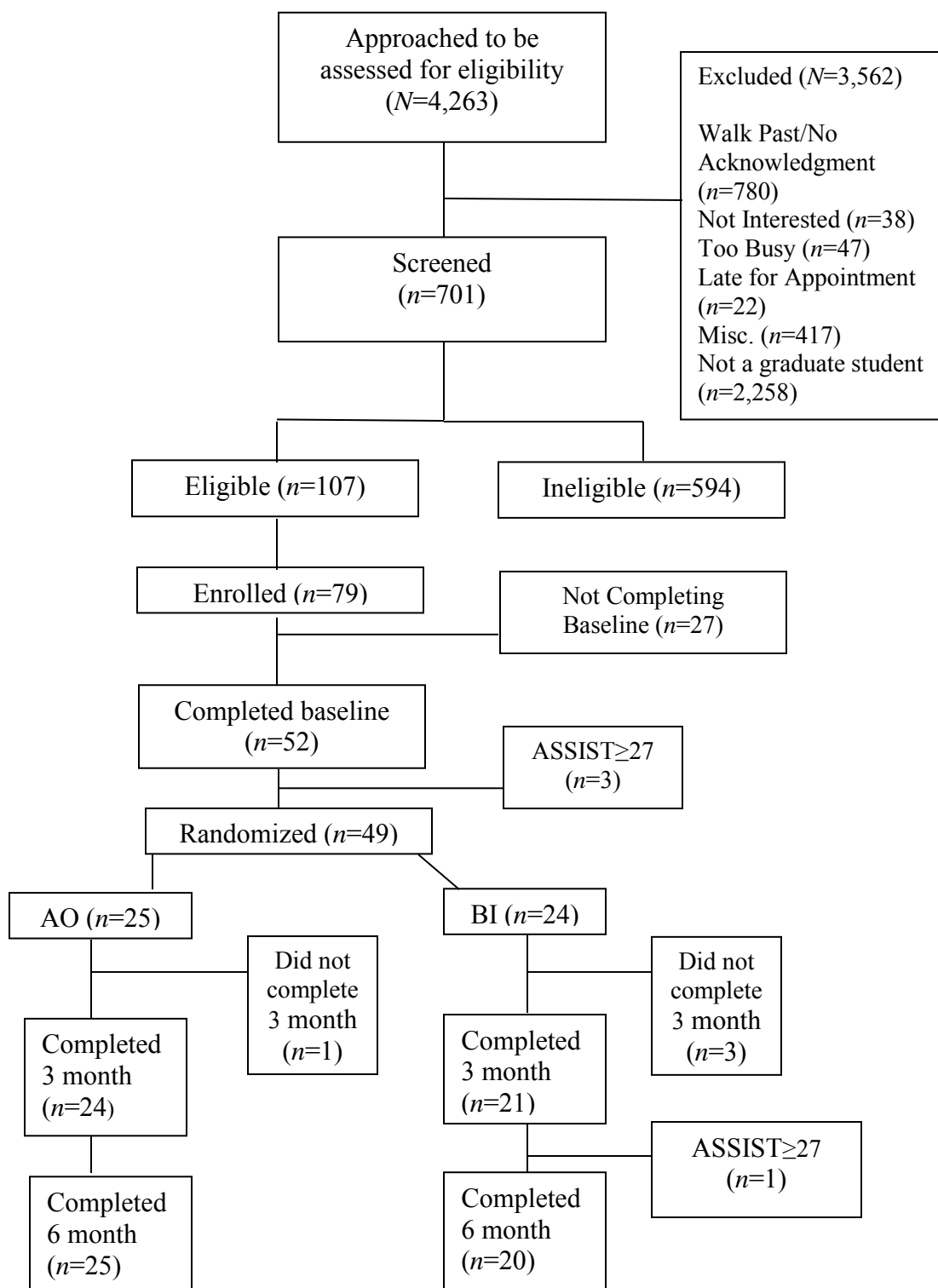


Table 2 Baseline Description of Sample: Overall and by Experimental Condition

	Total N=49	BI N=24	AO N=25
Age M (SD)	26.21 (2.62)	26.27 (2.20)	26.15 (3.02)
Gender, male (n) (%)	24 (49.0%)	11 (45.8%)	13 (52.0%)
Age (SD)	25.53 (2.42)	25.63 (2.28)	25.44 (2.58)
Race/Ethnicity Composition			
Hispanic/Latino	8 (16.3%)	4 (16.7%)	4 (16.0%)
American Indian/Alaskan Native	2 (4.1%)	1 (4.2%)	1 (4.0%)
White	38 (77.6%)	19 (79.2%)	19 (76.0%)
Black	2 (4.1%)	0 (0.0%)	2 (8.0%)
Asian	5 (10.2%)	2 (8.3%)	3 (12.0%)
“Other”	2 (4.1%)	1 (4.2%)	1 (4.0%)
MarjDay^a (SD)	35.61 (33.03)	39.21 (32.93)	32.16 (33.42)
MJ-CNSQ^b (SD)	2.63 (2.75)	3.17 (3.21)	2.12 (2.17)
MARJASSIST^c (SD)	10.35 (5.91)	11.25 (7.14)	9.48 (4.42)
Pre- contemplation^e (SD)	15.04 (2.96)	14.71 (3.20)	15.36 (2.75)
Contemplation^f (SD)	8.55 (3.54)	9.08 (4.02)	8.04 (3.01)
Action^g (SD)	10.27 (3.92)	10.80 (3.64)	9.76 (4.19)
BUMarjMore^h (SD)	24.71 (18.55)	23.58 (20.08)	25.80 (17.28)
BUMarjMonthⁱ (SD)	45.90 (23.80)	46.04 (24.62)	45.76 (23.49)
BUNoMarj^j (SD)	42.53 (19.89)	45.21 (21.14)	39.96 (18.69)
ZNorm^k (SD)	-0.0001 (0.86)	-0.06 (0.89)	0.06 (0.84)

Note: BI = Brief Intervention; AO = Assessment Only

^aMarjDay – Number of days using marijuana in the past 90 days [Range 1 - 90]

^bMJ-CNSQ - Number of marijuana-related negative consequences in the past 90 days [Range 0 - 38]

^cMARJASSIST – NIDA-modified Alcohol, Smoking, and Substance Involvement Test (Assist) – Marijuana section [Range 0-39; 0-3 Low Risk, 4-26 Moderate Risk; 27+ High Risk]

^ePre-contemplation subscale of RTC - [Total Range: 4 - 20]

^fContemplation subscale of RTC - [Total Range: 4 - 20]

^g*Action subscale of RTC* - [Total Range: 4 - 20]

^h*BUMarjMore* - What % of BU students use marijuana more than you? [Range 0-100]

ⁱ*BUMarjMonth* - What % of BU students use marijuana at least once a month? [Range 0-100]

^j*BUNoMarj* - What % of BU students have not used marijuana at all in the past 3 months? [Range 0-100]

^k*ZNorm* – Composite score of means of 3 norms questions, with last question reverse-scored; items are standardized.

Figure 1 Conditional Latent Growth Model - Effect of Intervention on Frequency of Use at 3- and 6-Month Outcomes

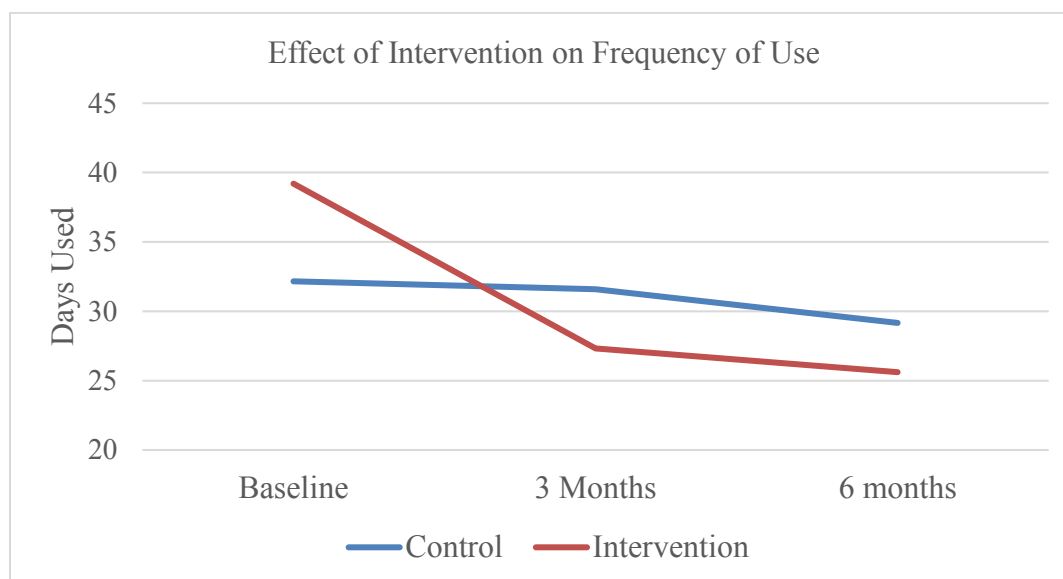
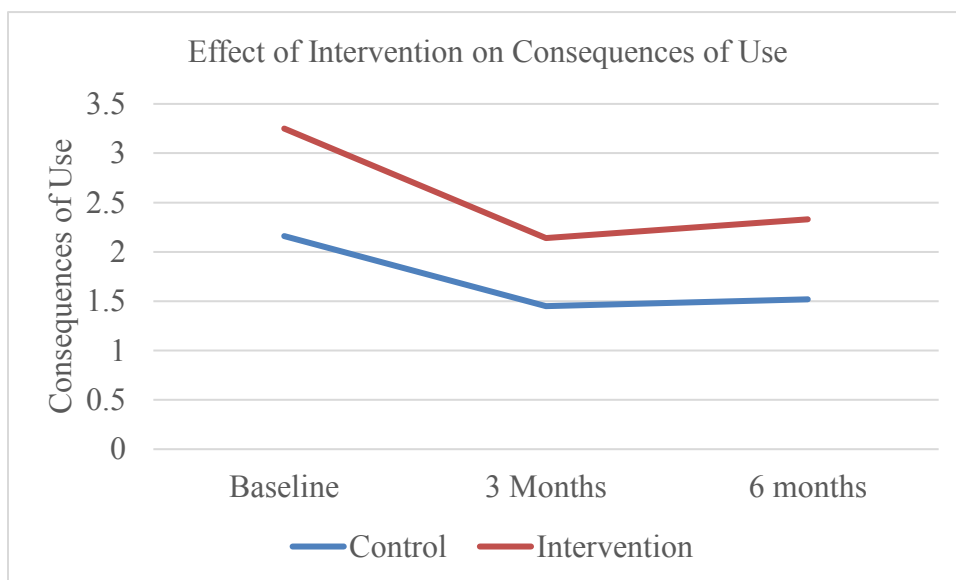


Figure 2 Conditional Latent Growth Model - Effect of Intervention on Consequences of Use at 3- and 6-Month Outcomes



BIBLIOGRAPHY

- Allen, H. K., Lilly, F., Beck, K. H., Vincent, K. B., & Arria, A. M. (2018). Graduate degree completion: Associations with alcohol and marijuana use before and after enrollment. *Addictive behaviors reports, 9*, 100156-100156. doi:10.1016/j.abrep.2018.100156
- Amaro, H., Reed, E., Rowe, E., Picci, J., Mantella, P., & Prado, G. (2010). Brief screening and intervention for alcohol and drug use in a college student health clinic: Feasibility, implementation, and outcomes. *Journal of American College Health, 58*(4), 357-364. doi:10.1080/07448480903501764
- American College Health Association. American College Health Association-National College Health Assessment II: Graduate and Professional Student Executive Summary Fall 2018. Silver Spring, MD: American College Health Association; 2018.
- Arria, A. M., Caldeira, K. M., Bugbee, B. A., Vincent, K. B., & O'Grady, K. E. (2015). The Academic Consequences of Marijuana Use During College. *Psychology of Addictive Behaviors*. doi:10.1037/adb0000108
10.1037/adb0000108.supp (Supplemental)
- Arria, A. M., Garnier-Dykstra, L. M., Caldeira, K. M., Vincent, K. B., Winick, E. R., & O'Grady, K. E. (2013). Drug use patterns and continuous enrollment in college: Results from a longitudinal study. *Journal of Studies on Alcohol and Drugs, 74*(1), 71-83.
- Arria, A. M., Garnier-Dykstra, L. M., Cook, E. T., Caldeira, K. M., Vincent, K. B., Baron, R. A., & O'Grady, K. E. (2013). Drug use patterns in young adulthood and post-college employment. *Drug and Alcohol Dependence, 127*(1-3), 23-30. doi:10.1016/j.drugalcdep.2012.06.001
- Babor, T., de la Fuente, J., Saunders, J., & Grant, M. (1992). The Alcohol Use Identification Test (AUDIT): Guidelines for use in primary health care. *World Health Organization, Geneva*.
- Babor, T. F., & Higgins-Biddle, J. C. (2000). Alcohol screening and brief intervention: Dissemination strategies for medical practice and public health. *Addiction, 95*(5), 677-686. doi:10.1046/j.1360-0443.2000.9556773.x
- Baer, J. S. (2002). Student factors: understanding individual variation in college drinking. *Journal of Studies on Alcohol, supplement*(14), 40-53.
- Baer, J. S., Stacy, A., & Larimer, M. (1991). Biases in the perception of drinking norms among college students. *Journal of Studies on Alcohol, 52*(6), 580-586.
- Barnett, N. P., Murphy, J. G., Colby, S. M., & Monti, P. M. (2007). Efficacy of counselor vs. computer-delivered intervention with mandated college students. *Addictive Behaviors, 32*(11), 2529-2548.
- Bartholow, B. D., Sher, K. J., & Krull, J. L. (2003). Changes in heavy drinking over the third decade of life as a function of collegiate fraternity and sorority involvement: a prospective, multilevel analysis. *Health Psychology, 22*(6), 616.

- Battistella, G., Fornari, E., Annoni, J. M., Chtioui, H., Dao, K., Fabritius, M., . . . Giroud, C. (2014). Long-term effects of cannabis on brain structure. *Neuropsychopharmacology*, *39*(9), 2041-2048. doi:10.1038/npp.2014.67
- Baumann, S., Gaertner, B., Haberecht, K., Bischof, G., John, U., & Freyer-Adam, J. (2018). How alcohol use problem severity affects the outcome of brief intervention delivered in-person versus through computer-generated feedback letters. *Drug and Alcohol Dependence*, *183*, 82-88. doi:10.1016/j.drugalcdep.2017.10.032
- Beich, A., Gannik, D., & Malterud, K. (2002). Screening and brief intervention for excessive alcohol use: Qualitative interview study of the experiences of general practitioners. *BMJ: British Medical Journal*, *325*(7369), 870-870. doi:10.1136/bmj.325.7369.870
- Bell, R., Wechsler, H., & Johnston, L. D. (1997). Correlates of college student marijuana use: Results of a US national survey. *Addiction*, *92*(5), 571-581. doi:10.1111/j.1360-0443.1997.tb02914.x
- Bentler, P. M. (1995). EQS structural equations program manual. Encino, CA: Multivariate Software.
- Berkowitz, A. D., & Perkins, H. W. (1986). Problem drinking among college students: A review of recent research. *Journal of American College Health*, *35*(1), 21-28. doi:10.1080/07448481.1986.9938960
- Bidwal, M. K., Ip, E. J., Shah, B. M., & Serino, M. J. (2014). Stress, Drugs, and Alcohol Use Among Health Care Professional Students: A Focus on Prescription Stimulants. *J Pharm Pract*. doi:10.1177/0897190014544824
- Borsari, B., & Carey, K. B. (2001). Peer influences on college drinking: A review of the research. *Journal of Substance Abuse*, *13*(4), 391-424. doi:10.1016/S0899-3289(01)00098-0
- Borsari, B., & Carey, K. B. (2003). Descriptive and Injunctive Norms in College Drinking: A Meta-Analytic Integration. *Journal of Studies on Alcohol*, *64*(3), 331-341.
- BU Facts and Stats. (2018). A quick, by-the-numbers overview of Boston University and our community for fiscal year 2018. Retrieved from <http://www.bu.edu/president/boston-university-facts-stats/>
- Buckner, J. D. (2013). College cannabis use: The unique roles of social norms, motives, and expectancies. *Journal of Studies on Alcohol and Drugs*, *74*(5), 720-726.
- Buckner, J. D., Keough, M. E., & Schmidt, N. B. (2007). Problematic alcohol and cannabis use among young adults: The roles of depression and discomfort and distress tolerance. *Addictive Behaviors*, *32*(9), 1957-1963. doi:10.1016/j.addbeh.2006.12.019
- Buckner, J. D., Walukevich, K. A., Lemke, A. W., & Jeffries, E. R. (2018). The impact of university sanctions on cannabis use: Individual difference factors that predict change in cannabis use. *Translational Issues in Psychological Science*, *4*(1), 76-84. doi:10.1037/tps0000147
- Budd, R. J., & Rollnick, S. (1996). The structure of the Readiness to Change Questionnaire: A test of Prochaska & DiClemente's transtheoretical model.

- British Journal of Health Psychology*, 1(Part 4), 365-376. doi:10.1111/j.2044-8287.1996.tb00517.x
- Cadigan, J. M., Martens, M. P., Arterberry, B. J., Smith, A. E., & Murphy, J. G. (2013). Examining a curvilinear model of readiness to change and alcohol consumption. *Addiction Research & Theory*, 21(6), 507-515. doi:10.3109/16066359.2012.754884
- Caldeira, K. M., Arria, A. M., O'Grady, K. E., Vincent, K. B., & Wish, E. D. (2008). The occurrence of cannabis use disorders and other cannabis-related problems among first-year college students. *Addictive Behaviors*, 33(3), 397-411. doi:10.1016/j.addbeh.2007.10.001
- Caldeira, K. M., Kasperski, S. J., Sharma, E., Vincent, K. B., O'Grady, K. E., Wish, E. D., & Arria, A. M. (2009). College students rarely seek help despite serious substance use problems. *Journal of Substance Abuse Treatment*, 37(4), 368-378. doi:10.1016/j.jsat.2009.04.005
- Carey, K. B., Scott-Sheldon, L. A., Elliott, J. C., Garey, L., & Carey, M. P. (2012). Face-to-face versus computer-delivered alcohol interventions for college drinkers: a meta-analytic review, 1998 to 2010. *Clin Psychol Rev*, 32(8), 690-703. doi:10.1016/j.cpr.2012.08.001
- Carey, K. B., Scott-Sheldon, L. A. J., Elliott, J. C., Bolles, J. R., & Carey, M. P. (2009). Computer-delivered interventions to reduce college student drinking: A meta-analysis. *Addiction*, 104(11), 1807-1819. doi:10.1111/j.1360-0443.2009.02691.x
- Center for Behavioral Health Statistics and Quality. (2018). 2017 National Survey on Drug Use and Health: Detailed Tables. Substance Abuse and Mental Health Services Administration, Rockville, MD
- Churchwell, J. C., Lopez-Larson, M., & Yurgelun-Todd, D. A. (2010). Altered frontal cortical volume and decision making in adolescent cannabis users. *Front Psychol*, 1, 225. doi:10.3389/fpsyg.2010.00225
- Cimini, M. D., Monserrat, J. M., Sokolowski, K. L., Dewitt-Parker, J. Y., Rivero, E. M., & McElroy, L. A. (2015). Reducing high-risk drinking among student-athletes: The effects of a targeted athlete-specific brief intervention. *Journal of American College Health*, 63(6), 343-352. doi:10.1080/07448481.2015.1031236
- Cohen, J. (1988). *Statistical Power for the Behavioural Sciences*. Hillsdale, NY: Lawrence Erlbaum.
- Compton, W. M., Thomas, Y. F., Stinson, F. S., & Grant, B. F. (2007). Prevalence, correlates, disability, and comorbidity of dsm-iv drug abuse and dependence in the united states: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*, 64(5), 566-576. doi:10.1001/archpsyc.64.5.566
- Connors, G. J., DiClemente, C. C., Velasquez, M. M., & Donovan, D. M. (2013). *Substance abuse treatment and the stages of change: Selecting and planning interventions*: Guilford Press.
- Core Institute. (2014). *Executive Summary: Core Alcohol and Drug Survey - Long Form*. Retrieved from https://core.siu.edu/_common/documents/2011-2013.pdf

- Cranford, J. A., Eisenberg, D., & Serras, A. M. (2009). Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students. *Addictive Behaviors, 34*(2), 134-145.
doi:10.1016/j.addbeh.2008.09.004
- DeJong, W., & Linkenbach, J. (1999). Telling it like it is: Using social norms marketing campaigns to reduce student drinking. *Amer. Assoc. Higher Educ. Bull, 32*(4), 11-16.
- Denering, L. L., & Spear, S. E. (2012). Routine use of screening and brief intervention for college students in a university counseling center. *J Psychoactive Drugs, 44*(4), 318-324. doi:10.1080/02791072.2012.718647
- Donoghue, K., Patton, R., Phillips, T., Deluca, P., & Drummond, C. (2014). The effectiveness of electronic screening and brief intervention for reducing levels of alcohol consumption: a systematic review and meta-analysis. *J Med Internet Res, 16*(6), e142. doi:10.2196/jmir.3193
- Ehrenreich, H., Rinn, T., Kunert, H. J., Moeller, M. R., Poser, W., Schilling, L., . . . Hoehe, M. R. (1999). Specific attentional dysfunction in adults following early start of cannabis use. *Psychopharmacology, 142*(3), 295-301.
doi:10.1007/s002130050892
- Ehrlich, P. F., Haque, A., Swisher-McClure, S., & Helmkamp, J. (2006). Screening and Brief Intervention for Alcohol Problems in a University Student Health Clinic. *Journal of American College Health, 54*(5), 279-287.
doi:10.3200/JACH.54.5.279-288
- Elliot, J. C., & Carey, K. B. (2012). Correcting exaggerated marijuana use norms among college abstainers: A preliminary test of a preventive intervention. *Journal of Studies on Alcohol and Drugs, 73*(6), 976-980.
- Fankhaenel, T., Samos, F., Luck-Sikorski, C., Thiel, C., Klement, A., & Frese, T. (2018). Patient satisfaction as a moderator of risky alcohol consumers' attitude towards screening and brief intervention: A cross sectional survey. *Alcohol and Alcoholism, 53*(4), 403-407. doi:10.1093/alcalc/agy001
- Fernandez, A. C., Waller, R., Walton, M. A., Bonar, E. E., Ignacio, R. V., Chermack, S. T., . . . Blow, F. C. (2019). Alcohol use severity and age moderate the effects of brief interventions in an emergency department randomized controlled trial. *Drug and Alcohol Dependence, 194*, 386-394. doi:10.1016/j.drugalcdep.2018.10.021
- Ferriman, K., Lubinski, D., & Benbow, C. P. (2009). Work preferences, life values, and personal views of top math/science graduate students and the profoundly gifted: Developmental changes and gender differences during emerging adulthood and parenthood. *Journal of personality and social psychology, 97*(3), 517-532.
doi:10.1037/a0016030
10.1037/a0016030.supp (Supplemental)
- Fleming, M. F., Balousek, S. L., Grossberg, P. M., Mundt, M. P., Brown, D., Wiegel, J. R., . . . Saewyc, E. M. (2010). Brief physician advice for heavy drinking college students: A randomized controlled trial in college health clinics. *Journal of Studies on Alcohol and Drugs, 71*(1), 23-31.

- Gayman, M. D., Cuddeback, G. S., & Morrissey, J. P. (2011). Help-seeking behaviors in a community sample of young adults with substance use disorders. *The Journal of Behavioral Health Services & Research*, 38(4), 464-477. doi:10.1007/s11414-011-9243-1
- Grossbard, J. R., Mastroleo, N. R., Geisner, I. M., Atkins, D., Ray, A. E., Kilmer, J. R., . . . Turrisi, R. (2016). Drinking norms, readiness to change, and gender as moderators of a combined alcohol intervention for first-year college students. *Addictive Behaviors*, 52, 75-82. doi:10.1016/j.addbeh.2015.07.028
- Gruber, S. A., Sagar, K. A., Dahlgren, M. K., Racine, M., & Lukas, S. E. (2012). 'Age of onset of marijuana use and executive function': Correction to Gruber et al. (2011). *Psychology of Addictive Behaviors*, 26(3), 506-506. doi:10.1037/a0026770
- Hall, W. (2015). What has research over the past two decades revealed about the adverse health effects of recreational cannabis use? *Addiction*, 110(1), 19-35. doi:10.1111/add.12703
- Harris, K. J., Golbeck, A. L., Cronk, N. J., Catley, D., Conway, K., & Williams, K. B. (2009). Timeline follow-back versus global self-reports of tobacco smoking: A comparison of findings with nondaily smokers. *Psychology of Addictive Behaviors*, 23(2), 368-372. doi:10.1037/a0015270
- Hayatbakhsh, M. R., Najman, J. M., Jamrozik, K., Mamun, A. A., Alati, R., & Bor, W. (2007). Cannabis and Anxiety and Depression in Young Adults: A Large Prospective Study. *Journal of the American Academy of Child & Adolescent Psychiatry*, 46(3), 408-417. doi:10.1097/chi.0b013e31802dc54d
- Heather, N., Gold, R., & Rollnick, S. (1991). *Readiness to change questionnaire: User's manual*: National Drug and Alcohol Research Centre, University of New South Wales.
- Heather, N., Rollnick, S., & Bell, A. (1993). Predictive validity of the Readiness to Change Questionnaire. *Addiction*, 88(12), 1667-1677. doi:10.1111/j.1360-0443.1993.tb02042.x
- Horn, B. P., Crandall, C., Forcehimes, A., French, M. T., & Bogenschutz, M. (2017). Benefit-cost analysis of SBIRT interventions for substance using patients in emergency departments. *Journal of Substance Abuse Treatment*, 79, 6-11. doi:10.1016/j.jsat.2017.05.003
- Humenuik, R., Ali, R., Babor, T. F., Farrell, M., Formigoni, M. L., Jittiwutikarn, J., . . . Simon, S. (2008). Validation of the Alcohol, Smoking And Substance Involvement Screening Test (ASSIST). *Addiction*, 103(6), 1039-1047. doi:10.1111/j.1360-0443.2007.02114.x
- Humphreys, K., & Tucker, J. A. (2002). Toward more responsive and effective intervention systems for alcohol-related problems. *Addiction*, 97(2), 126-132.
- Johnson, J. A., & Seale, J. P. (2015). Implementing alcohol screening and brief intervention in primary care: identifying barriers, proposing solutions. *Addiction Science & Clinical Practice*, 10(Suppl 1), A24-A24. doi:10.1186/1940-0640-10-S1-A24

- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. . (2013). *Monitoring the Future national survey results on drug use, 1975-2012*. Ann Arbor, University of Michigan: Institute for Social Research.
- Jöreskog, K. G. (1993). *Testing structural equation models* (K. A. Bollen, & Long, J.S. Ed.). Newbury Park, CA: Sage.
- Keith, D. R., Hart, C. L., McNeil, M. P., Silver, R., & Goodwin, R. D. (2015). Frequent marijuana use, binge drinking and mental health problems among undergraduates. *The American Journal on Addictions, 24*(6), 499-506. doi:10.1111/ajad.12201
- Kenna, G. A., & Wood, M. D. (2004). Substance use by pharmacy and nursing practitioners and students in a northeastern state. *Am J Health Syst Pharm, 61*(9), 921-930.
- Kessler, R. C., Aguilar-Gaxiola, S., Berglund, P. A., Caraveo-Anduaga, J. J., DeWit, D. J., Greenfield, S. F., . . . Vega, W. A. (2001). Patterns and predictors of treatment seeking after onset of a substance use disorder. *Archives of General Psychiatry, 58*(11), 1065-1071. doi:10.1001/archpsyc.58.11.1065
- Kuntsche, E., Kuntsche, S., Thrul, J., & Gmel, G. (2017). Binge drinking: Health impact, prevalence, correlates and interventions. *Psychology & Health, 32*(8), 976-1017. doi:10.1080/08870446.2017.1325889
- Kypri, K., Langley, J. D., Saunders, J. B., Cashell-Smith, M. L., & Herbison, P. (2008). Randomized controlled trial of web-based alcohol screening and brief intervention in primary care. *Arch Intern Med, 168*(5), 530-536. doi:10.1001/archinternmed.2007.109
- Kypri, K., & Lee, N. (2009). New technologies in the prevention and treatment of substance use problems. *Drug and Alcohol Review, 28*(1), 1-2. doi:10.1111/j.1465-3362.2008.00014.x
- Kypri, K., Vater, T., Bowe, S. J., Saunders, J. B., Cunningham, J. A., Horton, N. J., & McCambridge, J. (2014). Web-based alcohol screening and brief intervention for university students: A randomized trial. *JAMA: Journal of the American Medical Association, 311*(12), 1218-1224. doi:10.1001/jama.2014.2138
- Larimer, M. E., Crouce, J. M., Lee, C. M., & Kilmer, J. R. (2004). Brief intervention in college settings. *Alcohol Research and Health, 28*(2), 94.
- Larimer, M. E., Turner, A. P., Anderson, B. K., Fader, J. S., Kilmer, J. R., Palmer, R. S., & Crouce, J. M. (2001). Evaluating a brief alcohol intervention with fraternities. *Journal of Studies on Alcohol, 62*(3), 370-380. doi:10.15288/jsa.2001.62.370
- Larsen, D. L., Attkisson, C. C., Hargreaves, W. A., & Nguyen, T. D. (1979). Assessment of client/patient satisfaction: Development of a general scale. *Evaluation and Program Planning, 2*, 197-207.
- Lee, C. M., Geisner, I. M., Patrick, M. E., & Neighbors, C. (2010). The social norms of alcohol-related negative consequences. *Psychology of Addictive Behaviors, 24*(2), 342-348. doi:10.1037/a0018020
- Lee, C. M., Kilmer, J. R., Neighbors, C., Atkins, D. C., Zheng, C., Walker, D. D., & Larimer, M. E. (2013). Indicated prevention for college student marijuana use: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 81*(4), 702-709. doi:10.1037/a0033285

- Lee, C. M., Neighbors, C., Kilmer, J. R., & Larimer, M. E. (2010). A brief, web-based personalized feedback selective intervention for college student marijuana use: A randomized clinical trial. *Psychology of Addictive Behaviors, 24*(2), 265-273. doi:10.1037/a0018859
- Lewis, M. A., & Neighbors, C. (2004). Gender-Specific Misperceptions of College Student Drinking Norms. *Psychology of Addictive Behaviors, 18*(4), 334-339. doi:10.1037/0893-164X.18.4.334
- Lewis, M. A., Neighbors, C., Geisner, I. M., Lee, C. M., Kilmer, J. R., & Atkins, D. C. (2010). Examining the associations among severity of injunctive drinking norms, alcohol consumption, and alcohol-related negative consequences: The moderating roles of alcohol consumption and identity. *Psychology of Addictive Behaviors, 24*(2), 177-189. doi:10.1037/a0018302
- Lewis, T. F., & Clemens, E. (2008). The influence of social norms on college student alcohol and marijuana use. *Journal of College Counseling, 11*(1), 19-31. doi:10.1002/j.2161-1882.2008.tb00021.x
- Linke, S., Murray, E., Butler, C., & Wallace, P. (2007). Internet-based interactive health intervention for the promotion of sensible drinking: Patterns of use and potential impact on members of the general public. *Journal of Medical Internet Research, 9*(2), 1-12. doi:10.2196/jmir.9.2.e10
- Longabaugh, R., Woolard, R. F., Nirenberg, T. D., Minugh, A. P., Becker, B., Clifford, P. R., . . . Gogineni, A. (2001). Evaluating the effects of a brief motivational intervention for injured drinkers in the emergency department. *Journal of Studies on Alcohol, 62*(6), 806-816. doi:10.15288/jsa.2001.62.806
- Maisto, S. A., Conigliaro, J., McNeil, M., Kraemer, K., Conigliaro, R. L., & Kelley, M. E. (2001). Effects of two types of brief intervention and readiness to change on alcohol use in hazardous drinkers. *Journal of Studies on Alcohol, 62*(5), 605-614.
- Marsch, L. A., & Borodovsky, J. T. (2016). Technology-based interventions for preventing and treating substance use among youth. *Child and Adolescent Psychiatric Clinics of North America, 25*(4), 755-768. doi:10.1016/j.chc.2016.06.005
- Martens, M. P., Cimini, M. D., Barr, A. R., Rivero, E. M., Vellis, P. A., Desemone, G. A., & Horner, K. J. (2007). Implementing a screening and brief intervention for high-risk drinking in university-based health and mental health care settings: Reductions in alcohol use and correlates of success. *Addictive Behaviors, 32*(11), 2563-2572. doi:10.1016/j.addbeh.2007.05.005
- McCarthy, D. M., Lynch, A. M., & Pederson, S. L. (2007). Driving after use of alcohol and marijuana in college students. *Psychology of Addictive Behaviors, 21*(3), 425-430. doi:10.1037/0893-164X.21.3.425
- McClatchey, K., Boyce, M., & Dombrowski, S. U. (2017). Alcohol brief intervention in a university setting: A small-scale experimental study. *Journal of Health Psychology, 22*(7), 886-895. doi:10.1177/1359105315617331
- McClellan, M. L., Schneider, M. F., & Perney, J. (1998). Rating (life task action) change in journal excerpts and narratives using Prochaska, DiClemente, and Norcross's Five Stages of Change. *The Journal of Individual Psychology, 54*(4), 546-559.

- Mdege, N. D., & Lang, J. (2011). Screening instruments for detecting illicit drug use/abuse that could be useful in general hospital wards: A systematic review. *Addictive Behaviors*, *36*(12), 1111-1119. doi:10.1016/j.addbeh.2011.07.007
- Meier, M. H., Caspi, A., Ambler, A., Harrington, H., Houts, R., Keefe, R. S. E., . . . Moffitt, T. E. (2012). Persistent cannabis users show neuropsychological decline from childhood to midlife. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, *109*(40), E2657-E2664. doi:10.1073/pnas.1206820109
- Merrill, J. E., Wardell, J. D., & Read, J. P. (2015). Is readiness to change drinking related to reductions in alcohol use and consequences? A week-to-week analysis. *Journal of Studies on Alcohol and Drugs*, *76*(5), 790-798. doi:10.15288/jsad.2015.76.790
- Miller, W. R., & Rollnick, S. (1991). *Motivational interviewing: Preparing people to change addictive behavior*. New York, NY, US: The Guilford Press.
- Miller, W. R., & Rollnick, S. (2002). *Motivational interviewing: Preparing people for change (2nd ed.)*. New York, NY, US: Guilford Press.
- Miller, W. R., & Rollnick, S. (2013). *Motivational interviewing: Helping people change, 3rd edition*. New York, NY, US: Guilford Press.
- Muthén, B. O., & Curran, P. J. (1997). General longitudinal modeling of individual differences in experimental designs: A latent variable framework for analysis and power estimation. *Psychological methods*, *2*(4), 371.
- Muthén, L. K., & Muthén, B. O. (2012). MPlus: statistical analysis with latent variables--User's guide.
- Neighbors, C., Geisner, I. M., & Lee, C. M. (2008). Perceived marijuana norms and social expectancies among entering college student marijuana users. *Psychology of Addictive Behaviors*, *22*(3), 433-438. doi:10.1037/0893-164x.22.3.433
- Neighbors, C., LaBrie, J. W., Hummer, J. F., Lewis, M. A., Lee, C. M., Desai, S., . . . Larimer, M. E. (2010). Group identification as a moderator of the relationship between perceived social norms and alcohol consumption. *Psychology of Addictive Behaviors*, *24*(3), 522-528. doi:10.1037/a0019944
- Neighbors, C., Lewis, M. A., Atkins, D. C., Jensen, M. M., Walter, T., Fossos, N., . . . Larimer, M. E. (2010). Efficacy of web-based personalized normative feedback: A two-year randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *78*(6), 898-911. doi:10.1037/a0020766
- Neighbors, C., Lewis, M. A., Bergstrom, R. L., & Larimer, M. E. (2006). Being controlled by normative influences: Self-determination as a moderator of a normative feedback alcohol intervention. *Health Psychology*, *25*(5), 571-579. doi:10.1037/0278-6133.25.5.571
- Nicholi, A. M. (1983). The college student and marijuana: Research findings concerning adverse biological and psychological effects. *Journal of American College Health*, *32*(2), 73-77. doi:10.1080/07448481.1983.9936145
- NIDA. (2002). WHO ASSIST Working Group. The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): development, reliability and feasibility. *Addiction* *97*, 1183-1194.

- Ondersma, S. J., Chase, S. K., Svikis, D. S., & Schuster, C. R. (2005). Computer-based brief motivational intervention for perinatal drug use. *Journal of Substance Abuse Treatment, 28*(4), 305-312. doi:10.1016/j.jsat.2005.02.004
- Palfai, Saitz, R., Winter, M., Brown, T. A., Kypri, K., Goodness, T. M., . . . Lu, J. (2014). Web-based screening and brief intervention for student marijuana use in a university health center: pilot study to examine the implementation of eCHECKUP TO GO in different contexts. *Addict Behav, 39*(9), 1346-1352. doi:10.1016/j.addbeh.2014.04.025
- Palfai, T., Tahaney, K., Winter, M., & Saitz, R. (2016). Readiness-to-change as a moderator of a web-based brief intervention for marijuana among students identified by health center screening. *Drug and Alcohol Dependence, 161*, 368-371.
- Pearson, M. R., Liese, B. S., & Dvorak, R. D. (2017). College student marijuana involvement: Perceptions, use, and consequences across 11 college campuses. *Addictive Behaviors, 66*, 83-89. doi:10.1016/j.addbeh.2016.10.019
- Perkins, H. W. (2002). Social norms and the prevention of alcohol misuse in collegiate contexts. *Journal of Studies on Alcohol, Suppl14*, 164-172.
- Phillips, K. T., Phillips, M. M., & Duck, K. D. (2018). Factors associated with marijuana use and problems among college students in Colorado. *Substance Use & Misuse, 53*(3), 477-483. doi:10.1080/10826084.2017.1341923
- Phillips, K. T., Phillips, M. M., Lalonde, T. L., & Tormohlen, K. N. (2015). Marijuana use, craving, and academic motivation and performance among college students: An in-the-moment study. *Addictive Behaviors, 47*, 42-47. doi:10.1016/j.addbeh.2015.03.020
- Polen, M. R., Sidney, S., Tekawa, I. S., Sadler, M., & Friedman, G. D. (1993). Health care use by frequent marijuana smokers who do not smoke tobacco. *Western Journal of Medicine, 158*(6), 596-601.
- Pope, H. G., Jr., Gruber, A. J., Hudson, J. I., Cohane, G., Heustis, M. A., & Yurgelun-Todd, D. (2003). Early-onset cannabis use and cognitive deficits: What is the nature of the association? *Drug and Alcohol Dependence, 69*(3), 303-310. doi:10.1016/S0376-8716(02)00334-4
- Presley, C. A., Meilman, P. W., & Leichliter, J. S. (2002). College factors that influence drinking. *Journal of Studies on Alcohol, supplement*(14), 82-90.
- Riggs, N. R., Conner, B. T., Parnes, J. E., Prince, M. A., Shillington, A. M., & George, M. W. (2018). Marijuana eCHECKUPTO GO: Effects of a personalized feedback plus protective behavioral strategies intervention for heavy marijuana-using college students. *Drug and Alcohol Dependence, 190*, 13-19. doi:10.1016/j.drugalcdep.2018.05.020
- Riggs Romaine, C. L., & Kavanaugh, A. (2018). Risks, benefits, and complexities: Reporting race & ethnicity in forensic mental health reports. *The International Journal of Forensic Mental Health*. doi:10.1080/14999013.2018.1531094
- Saitz, R. (2015). 'SBIRT' is the answer? Probably not. *Addiction, 110*(9), 1416-1417. doi:10.1111/add.12986

- San Diego State University Research Foundation, 2009. Marijuana eCHECKUP TO GO (eCTG) for Universities and Colleges. Retrieved from. http://www.echeckuptogo.com/usa/programs/coll_mj.php.
- Schaus, J. F., Sole, M. L., McCoy, T. P., Mullett, N., Bolden, J., Sivasithamparam, J., & O'Brien, M. C. (2009). Screening for high-risk drinking in a college student health center: characterizing students based on quantity, frequency, and harms. *J Stud Alcohol Drugs Suppl*(16), 34-44.
- Schulenberg, J. E., Johnston, L. D., O'Malley, P. M., Bachman, J. G., Miech, R. A., & Patrick, M. E. (2017). Monitoring the Future national survey results on drug use, 1975-2016: Volume II, college students and adults ages 19-55.
- Serras, A., Saules, K. K., Cranford, J. A., & Eisenberg, D. (2010). Self-injury, substance use, and associated risk factors in a multi-campus probability sample of college students. *Psychol Addict Behav*, 24(1), 119-128. doi:10.1037/a0017210
- Simons, J. S., Maisto, S. A., & Wray, T. B. (2010). Sexual risk taking among young adult dual alcohol and marijuana users. *Addictive Behaviors*, 35(5), 533-536. doi:10.1016/j.addbeh.2009.12.026
- Solberg, L. I., Maciosek, M. V., & Edwards, N. M. (2008). Primary care intervention to reduce alcohol misuse: Ranking its health impact and cost effectiveness. *American Journal of Preventive Medicine*, 34(2), 143-152. doi:10.1016/j.amepre.2007.09.035
- Solowij, N., Jones, K. A., Rozman, M. E., Davis, S. M., Ciarrochi, J., Heaven, P. C. L., . . . Yücel, M. (2011). Verbal learning and memory in adolescent cannabis users, alcohol users and non-users. *Psychopharmacology*, 216(1), 131-144. doi:10.1007/s00213-011-2203-x
- Stein, L. A. R., Minugh, P. A., Longabaugh, R., Wirtz, P., Baird, J., Nirenberg, T. D., . . . Gogineni, A. (2009). Readiness to change as a mediator of the effect of a brief motivational intervention on posttreatment alcohol-related consequences of injured emergency department hazardous drinkers. *Psychology of Addictive Behaviors*, 23(2), 185-195. doi:10.1037/a0015648
- Stephens, R. S., Roffman, R. A., & Curtin, L. (2000). Comparison of extended versus brief treatments for marijuana use. *Journal of Consulting and Clinical Psychology*, 68(5), 898-908. doi:10.1037/0022-006X.68.5.898
- Stephens, R. S., Roffman, R. A., Fearer, S. A., Williams, C., & Burke, R. S. (2007). The Marijuana Check-up: Promoting change in ambivalent marijuana users. *Addiction*, 102(6), 947-957. doi:10.1111/j.1360-0443.2007.01821.x
- Stephens, R. S., Roffman, R. A., Fearer, S. A., Williams, C., Picciano, J. F., & Burke, R. S. (2004). The Marijuana Check-up: Reaching users who are ambivalent about change. *Addiction*, 99(10), 1323-1332. doi:10.1111/j.1360-0443.2004.00832.x
- Stephens, R. S., Roffman, R. A., & Simpson, E. E. (1994). Treating adult marijuana dependence: A test of the relapse prevention model. *Journal of Consulting and Clinical Psychology*, 62(1), 92-99. doi:10.1037/0022-006X.62.1.92
- Turner, J. C., & Keller, A. (2015). College Health Surveillance Network: Epidemiology and health care utilization of college students at US 4-year universities. *Journal of American College Health*, 63(8), 530-538. doi:10.1080/07448481.2015.1055567

- Volkow, N. D., Compton, W. M., & Weiss, S. R. B. (2014). 'Adverse health effects of marijuana use': The authors reply. *The New England Journal of Medicine*, 371(9), 879-879. doi:10.1056/NEJMc1407928
- Walters, S. T., Vader, A. M., & Harris, T. R. (2007). A controlled trial of Web-based feedback for heavy drinking college students. *Prevention Science*, 8(1), 83-88. doi:10.1007/s11121-006-0059-9
- Wang, P. S., Berglund, P., Olfson, M., Pincus, H. A., Wells, K. B., & Kessler, R. C. (2005). Failure and Delay in Initial Treatment Contact After First Onset of Mental Disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 62(6), 603-613. doi:10.1001/archpsyc.62.6.603
- WHO. (1980). *Problems Related to Alcohol Consumption, report of a WHO Expert Committee, tech. report series 650*. Retrieved from Geneva:
- Wright, M. J., Jr. (2015). Legalizing marijuana for medical purposes will increase risk of long-term, deleterious consequences for adolescents. *Drug and Alcohol Dependence*, 149, 298-303. doi:10.1016/j.drugalcdep.2015.01.005
- Yücel, M., Solowij, N., Respondek, C., Whittle, S., Fornito, A., Pantelis, C., & Lubman, D. I. (2008). Regional brain abnormalities associated with long-term heavy cannabis use. *Archives of General Psychiatry*, 65(6), 694-701. doi:10.1001/archpsyc.65.6.694

CURRICULUM VITAE

