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Depressive Symptoms and Marijuana Outcomes in College Students: The Mediating Role of Protective Behavioral Strategies for Marijuana

Nicholas Militello

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DEPRESSIVE SYMPTOMS AND MARIJUANA OUTCOMES IN COLLEGE
STUDENTS: THE MEDIATING ROLE OF PROTECTIVE BEHAVIORAL
STRATEGIES FOR MARIJUANA

by

Nicholas Anthony Militello

A Thesis
Submitted to the Graduate School,
the College of Education and Human Sciences
and the School of Psychology
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Master of Arts

Approved by:

Dr. Michael B. Madson, Committee Chair
Dr. Richard S. Mohn
Dr. Bonnie C. Nicholson

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ABSTRACT

The present study evaluated the sequentially mediating role of protective behavioral strategies for marijuana (PBSM) and marijuana use frequency on the relationships depressive symptoms had with hazardous marijuana use and marijuana-related negative consequences in college students. Participants were 338 (50.3% male) undergraduate college students age 18 to 25 ($M = 22.10$; $SD = 1.97$) who reported marijuana use in the past 30 days. Participants reported their gender and completed measures of depressive symptoms, PBSM use, marijuana use frequency, marijuana-related negative consequences, and hazardous marijuana use through an online survey from a 2018 project. Depressive symptoms were positively associated with marijuana-related negative consequences, but this relationship was not sequentially mediated PBSM use and marijuana use frequency. Further, depressive symptoms were positively associated with hazardous marijuana use, but this relationship was not sequentially mediated PBSM use and marijuana use frequency. These relationships were also found to be invariant by gender. Thus, while this study found positive associations between depressive symptoms and marijuana outcomes, PBSM use and marijuana use frequency alone did not explain the relationship between depressive symptoms and marijuana-related outcomes and that gender did not moderate these relationships.

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DEDICATION

I would like to dedicate this thesis to my parents, Anthony and Beverly Militello.

This work would not have been possible without their unwavering love, support, and encouragement.

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CHAPTER I - INTRODUCTION

Marijuana is the most widely used illicit drug in the United States including among college students (Substance Abuse and Mental Health Services Administration [SAMHSA], 2015). In fact, in 2018, annual prevalence of marijuana use reached 43% among college students, which is the highest level it has been in over three decades (Johnston et al., 2019). Marijuana use continues to increase substantially and may be due to several factors such as the increasing approval of use among young adults and the view that marijuana use is relatively low risk (Pearson et al., 2017). Marijuana use rates may also be influenced by the major legal shifts in policies in the United States. At the time of this paper, eleven states (Alaska, California, Colorado, Illinois, Maine, Massachusetts, Michigan, Nevada, Oregon, Vermont, and Washington) and the District of Columbia have legalized the recreational use of marijuana for adults, while 26 states have decriminalized possession of small amounts of marijuana (National Conference of State Legislatures, 2019). As more states begin to legalize recreational marijuana in the coming years, it is likely the number of college students reporting marijuana use will continue to increase substantially.

Harmful Marijuana Use in College Students

The continued increase in college student annual marijuana use rates are the highest since 1983, with daily marijuana use (5.8%) and 30-day prevalence (25%) spiking to nearly all-time high levels in 2018 (Johnston et al., 2019). Similar to trends with alcohol use, it appears that male college students report more marijuana use than females, however, the gap continues to close each year. In 2018, the annual prevalence of marijuana use among college males and females was similar (43% vs. 42%). While

females reported more marijuana use in the past 30 days (25% vs. 24%), males still reported more daily marijuana use (8.4% vs 4.3%). However, over the last five years, female annual and daily marijuana use rates have risen dramatically (Johnston et al., 2019). As these rates continue to increase annually and females appear to be narrowing the gap in marijuana use (and in some instances surpassing males), it is becoming evident that marijuana use is a major component of the college atmosphere. As such, more researchers will likely investigate college student marijuana use, particularly hazardous use, to understand its impact and inform interventions from a harm-reduction standpoint.

Although young adults increasingly consider marijuana to be a low-risk substance, more frequent marijuana use has been associated with more negative consequences and risky behaviors. Specifically, increased marijuana use is associated with increased mental health problems, cognitive impairments, risky sexual behavior, encounters with the police, driving under the influence, cigarette smoking, and heavy drinking (Arria et al., 2015; Bell et al., 1997; Buckner et al., 2018; Keith, et al., 2015). College students that use marijuana more frequently have also been associated with more negative academic outcomes, such as skipping classes, lower GPA, and delaying graduation (Suerken et al., 2016). In fact, about 1 in 10 past month marijuana users experience 19 or more marijuana related negative consequences (Pearson et al., 2017). Another concern with the substantial rise in marijuana use is that increased use is also associated with greater risk for developing a cannabis use disorder (CUD), which refers to the continued use of marijuana despite clinically significant impairment (APA, 2013). While little work has explored the prevalence of CUD in college students, Calderia et al. (2008) found that approximately 15% of first-year college students met at least once

criterion for CUD, while 10% met clinical standards for a CUD diagnosis. CUD has also been associated with lower levels of happiness, motivation, and satisfaction with life (Looby & Earlywine, 2007).

College Student Mental Health

While college is a time of greater educational, intellectual, and personal growth, it can also result in experiencing increased stressful events, including academic pressures, moving away from family for the first time, relationships with new people, and financial difficulties (Blanco et al., 2008; Lee et al., 2019; Pedrelli et al., 2015). Within this context, the traditional college student's age (i.e. 18 to 25 years) is the age of peak onset for many psychological disorders, including anxiety, depression, and schizophrenia (American Psychological Association, 2013; Pedrelli et al., 2015). In fact, according to Blanco et al. (2008), approximately half of a college undergraduate sample met *Diagnostic and Statistical Manual for Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association [APA], 1994) criteria for at least one psychiatric disorder, indicating that psychological distress is common on college campuses.

Research has shown that a plethora of mental health problems are prevalent in college students, including panic disorder, generalized anxiety disorder, suicidal ideation, and major depressive disorder (MDD; Eisenberg et al., 2013). According to the American College Health Association (ACHA; 2019), 20% of college students reported being diagnosed with or treated for depression within the last 12 months, and 21.6% reported being so depressed that it negatively affected their academic performance. Depression includes a series of symptoms that involve persistent feelings of sadness, hopelessness, and a lack of interest in once enjoyable activities that significantly negatively affects an

individual's functioning in daily life activities (APA, 2013). However, many college students may also experience depressive symptoms at a subclinical level, meaning they do not meet DSM-V criteria for MDD, but they still experience significant levels of distress. For instance, Cukrowicz et al. (2011) found that college students with mild and moderate depressive symptoms still experienced heightened thoughts of suicidal ideation similarly to those with severe depressive symptoms. Similar to marijuana use, depression in college students is associated with a number of negative consequences, including lower GPA, acute infectious illness, health problems, insomnia, increased smoking/alcohol use, increased self-injurious behaviors, and increased suicidal thoughts and attempts (Buchanan, 2012; Doom & Haeffel, 2013; Gress-Smith et al., 2013). Sex differences also exist in relation to the experience of depressive symptoms. According to the ACHA (2019), females report approximately twice as much depressive symptomatology than males (22.4% vs 11.6%). As such, it is important to examine the full range of depressive symptoms, whether they meet criteria for a diagnosis or not.

Despite experiencing significant mental health issues, approximately 19% of college students report seeking past year mental health treatment for any disorder (Eisenberg et al., 2013). College students are also less likely to seek treatment for substance use behaviors. For instance, Capron and colleagues (2018) found that approximately 73% of a college student sample with co-existing mood disorders and hazardous drinking did not report any interest in treatment for alcohol use problems. Specific to depression, Garlow et al. (2010) found that 85% of an undergraduate sample with moderate to severe depressive symptoms reported not receiving any form of psychiatric treatment. This suggests that many students may be turning to alternative

coping methods such as substance use to deal with their psychological distress and avoid negative internal states (Hyman & Sinha, 2009). In fact, Boys et al. (2001) found that 69% of past year marijuana users reported use to alleviate symptoms of “feeling down and depressed.” Through the lens of the self-medication hypothesis (Wilkinson et al., 2016), college students may be using marijuana to avoid experiencing negative affect. As such, with the increasing prevalence of marijuana use and depressive symptoms among college students, it is important to further examine this relationship.

Depression and Marijuana Use in College Students

While other mental health factors (e.g., posttraumatic stress disorder) are related to marijuana-related negative consequences and CUD symptoms (Jordan et al., 2019), the relationship between depressive symptoms and marijuana outcomes is inconsistent. In adult populations, reductions in marijuana use among those treated for CUD was negatively associated with depressive symptoms (Hser et al., 2017), however, Harder et al. (2006) found no relationship between past year marijuana usage and depressive symptoms. According to the Committee on Health Effects of Marijuana (2017), two systematic reviews suggested that increased marijuana use was associated with an increased risk for developing a depressive disorder among adults. Research strictly examining undergraduate populations has shown the same inconsistencies. Studies showing support for this relationship have found that students experiencing higher levels of depressive symptoms report higher marijuana use among freshmen (Suerken et al., 2014), while others found more frequent marijuana use in the last 30 days was positively associated with MDD (Keith et al., 2015). College students with increased depressive symptomology have also been linked to increased past year marijuana use (Walter et al.,

2018). Thus, there appears to be an association between experiencing increased depressive symptoms and increased marijuana use. On the other hand, studies have also found little support for an association between depression and marijuana use among undergraduate samples. Phillips et al. (2018) did not find an association between depressive symptoms and past year marijuana use, while Cranford et al. (2009) did not find an association between depressive symptoms and past 30-day marijuana use.

Although study results examining marijuana use and depressive symptoms among college students are mixed, noteworthy limitations exist, with the most notable concerning methodological issues. The aforementioned investigations used a wide range of measures to assess marijuana use frequency. These methods involved asking participants to answer “yes” or “no” to items such as lifetime marijuana use, past year use, or past 30-day use. Other studies asked participants to simply recall the number of days within the past year or month that they used marijuana. Furthermore, with new trends like vaping marijuana emerging, it is also unclear if the previous studies instructed participants to consider various modes of marijuana consumption (i.e. smoking, eating, vaping) when assessing frequency of use. These methodological discrepancies highlight the issue of quantifying marijuana use since there is no standardization like with alcohol use (National Institute on Alcohol Abuse and Alcoholism, 2019). Overall, these findings shed light on the importance of further examining this relationship and other factors that may be influencing it.

Protective Behavioral Strategies for Marijuana

One factor that might play a role in the association between depressive symptoms and marijuana outcomes is protective behavioral strategies for marijuana (PBSM). The

majority of research in these strategies has focused on PBS for alcohol (PBSA), which are a set of behaviors framed from a harm-reduction viewpoint to reduce the experience of alcohol-related negative consequences (Pearson, 2013). Research has consistently shown that PBSA are related to decreased alcohol consumption and alcohol-related negative consequences among college students (Pearson, 2013). Recently, research has begun to examine PBS for marijuana (PBSM), which are planned behaviors that people can use prior to, during, and after marijuana use with the intention of reducing use-related harm. While PBSM shares similar strategies to PBSA, such as using a designated driver, PBSM also includes behaviors such as avoiding using marijuana prior to physical activity, buying less marijuana at a time to use less, using marijuana only with trusted peers, and keeping track of costs of purchasing marijuana (Pederson et al., 2016).

As an emerging area of research, PBSM appears to be negatively associated with marijuana outcomes. Pederson and colleagues (2016) found that PBSM was negatively correlated with frequency of past-month marijuana use, marijuana-related negative consequences, and CUD symptoms. In addition, Pederson et al. (2017) found that a shortened version of the PBSM was also negatively associated with past month marijuana use and consequences. Consistent with these initial findings, Bravo et al. (2017a) also found that PBSM use was negatively associated with marijuana outcomes. Although still in the early stages of research, PBSM appear to be an effective harm-reduction approach for reducing marijuana outcomes. With respect to sex differences, females tend to report more PBSM use compared to males, while males with low PBSM use tend to report higher marijuana use frequency and more negative consequences compared to females (Bravo et al., 2017a).

PBSM has been identified as a mediator between a host of factors, such as sex, impulsivity-like traits, and marijuana use motives. Specifically, Bravo et al. (2017b) found that PBSM significantly mediated the relationship between coping motives and marijuana outcomes, such that individuals with more coping motives used less PBSM, which in turn led to increased marijuana use frequency and marijuana-related consequences. Neugebauer et al. (2019) also found that PBSM significantly mediated the relationship between sensation-seeking and marijuana-related consequences, such that those high in risk seeking used less PBSM, which led to increased marijuana-related consequences. However, little work has been conducted on the mediating role of PBSM between mental health factors and marijuana use outcomes. Jordan et al. (2019) recently found that PBSM mediated the relationship between PTSD and several marijuana outcomes, such that increased PTSD symptoms predicted lower PBSM use, which was associated with increased marijuana use frequency, CUD symptoms, and marijuana-related negative consequences. Since this study was the first to investigate this relationship, it is important to examine PBSM's role on the links between other mental health factors and marijuana outcomes. Given the mixed findings concerning the relationship between depressive symptoms and marijuana use, it is important to examine factors such as PBSM that might play a protective role for individuals with increased depressive symptoms. To date, no studies have examined PBSM's role on the relationship between depressive symptoms and marijuana outcomes.

Present Study

Marijuana use among college students continues to increase in prevalence every year and is becoming a normal part of the college experience (Johnston et al., 2019). This

is a concern given the associations between marijuana use and risky behavior, academic difficulties, and mental health problems, including depression (Arria et al., 2015; Bell et al., 1997; Buckner et al., 2018; Keith, et al., 2015; Suerken et al., 2016). Depressive symptoms are often experienced by college students and are associated with risky behaviors and negative consequences (Buchanan, 2012; Doom & Haeffel, 2013; Gress-Smith et al., 2013), but the findings concerning its relationship with marijuana have been inconsistent. Previous research has also shown that PBSM are effective strategies for reducing marijuana outcomes. Research is emerging demonstrating the protective value of PBSM with individuals experiencing mental health concerns, however, it is in its infancy and, to date, no studies have investigated the degree to which PBSM use explains the association between depressive symptoms and marijuana outcomes. The present study sought to shed light on the associations between depression and marijuana use behaviors and may have important clinical implications for informing interventions and workshops that could help identify college students experiencing depressive symptoms and promote safe marijuana practices. Thus, the purpose of the present study was to examine the mediating role of PBSM use on the relationship between depressive symptoms and marijuana outcomes (i.e. marijuana use frequency, marijuana-related negative consequences, and CUD symptoms). The present study also used a more comprehensive measure of marijuana use frequency that has been increasingly used more recently in the literature. Given the findings regarding gender in relation to marijuana outcomes and depressive symptoms, gender differences were another variable to account for within this relationship. With this in mind, the current study sought to answer the following questions:

Question 1: To what degree is there an association between depressive symptoms and marijuana outcomes?

Hypothesis 1a: Depressive symptoms will be positively associated with marijuana use frequency, marijuana-related negative consequences, and CUD symptoms.

Hypothesis 1b: Depressive symptoms will be negatively associated with PBSM.

Question 2: To what degree is the relationship depressive symptoms have with marijuana outcomes (i.e. marijuana-related negative consequences and CUD symptoms) sequentially mediated by PBSM use and marijuana use frequency?

Hypothesis 2: The positive relationship between depressive symptoms and marijuana outcomes will be sequentially mediated by PBSM use and marijuana use frequency, such that more depressive symptoms will predict lower levels of PBSM use and higher levels of marijuana use frequency, which will in turn predict more marijuana-related negative consequences and greater risk for CUD.

Question 3: To what degree is the sequentially mediated relationship between depressive symptoms, PBSM use and marijuana use frequency, and marijuana outcomes also invariant by gender?

Hypothesis 3: The sequentially mediating effects of PBSM on the relationship between depressive symptoms and marijuana outcomes will vary by gender, such that males with depressive symptoms who employ fewer PBSM and use more marijuana will report more marijuana-related negative consequences and have greater risk for CUD.

CHAPTER II - METHOD

Participants and Procedures

Participants were 338 (50.3% male) undergraduate college students age 18 to 25 ($M = 22.10$; $SD = 1.97$) who reported marijuana use in the past 30 days, enrollment at a college or university in the United States, and physically attending classes on campus. The majority of participants identified as White (41.7%), followed by Asian American (19.2%), Native American (18.9%), African American (10.4%), Multiracial (3.8%), Other (1.8%), Eastern Indian American (1.8%), and Middle Eastern American (1.5%). Most participants were seniors (38.5%), followed by juniors (36.1%), sophomores (16.0%), and freshman (9.5%). Most of the sample reported consuming alcohol in the past 30 days (97.9%).

This project featured a secondary data analysis of a larger study conducted in Spring 2018 exploring a national sample of college student substance use and health behaviors. After reading an Institutional Review Board (IRB) approved consent form and electronically providing informed consent, participants completed a demographic form followed by all study measures presented randomly to minimize order effects. To ensure participants did not complete the survey more than once, an HTML script from <http://uniqueturker.myleott.com/> was used to restrict the number of responses participants could provide. Two validity items were embedded in the survey to ensure valid responding (Meade & Craig, 2012). For example, one item directed participants to “select 0 for this item.” Participation in the larger project from Spring 2018 took approximately 1 hour for participants to complete, and participants were compensated 50 cents for completing at least 75% of the survey. All data were collected using Amazon’s

Mechanical Turk (MTurk), an online international data collection system in which participants can be monetarily compensated for research participation. Research employing MTurk has been found to be a reliable method of data collection (Buhrmester et al., 2011). Furthermore, Shapiro and colleagues (2013) found MTurk to be a reliable and valid resource for accessing and studying clinical and subclinical populations, which also provides support for using MTurk in the present study to obtain participants reporting depressive symptoms.

University IRB approval was obtained prior to conducting data analyses in the present study (Appendix A). Participants for this study were selected from an initial sample of 4691 college students who completed the survey and screened using the present study's inclusion criteria (i.e. age 18 to 25, past 30 day marijuana use, enrolled at a college in the United States, and physically attending classes on campus). Participants that reported an age outside of the traditional undergraduate range (i.e. 18 to 25) were excluded ($N = 1293$), as well as those reporting residencies outside of the United States ($N = 578$). Participants were also excluded if they denied current enrollment as a college student ($N = 213$) and if they did not physically attend most of their courses on campus ($N = 117$). Those not reporting marijuana use in the last 30 days were also excluded ($N = 1240$).

Following exclusion on the basis of the screening criteria, 1,250 participants remained, and of those, data from 320 participants were removed for not completing at least 75% of the overall survey. To ensure data integrity, 168 cases were excluded for failing the validity item which directed participants to "Select 0 for this item." Two participants failed to report their gender and were excluded since gender is an important

component in the present study's analyses. Based on recommendations from Meade and Craig (2012), 37 cases responding faster than 95% of the sample were excluded to protect against potential random responding. Additionally, 96 participants who reported their academic status as graduate students were removed given that the present study is only interested in undergraduate students. Completion of at least 75% of each measure of interest in the analyses was also evaluated with 45 cases being excluded on this basis. Long string indices for the PBSM-17 ($N = 84$) and PHQ-9 ($N = 49$) were also evaluated to exclude cases consecutively responding invariantly to nine or more items (DeSimone & Harms, 2018). Total scores of "0" on the marijuana use frequency measure were excluded ($N = 58$) given the present study's primary interest in those using marijuana in the past month. In addition, due to concerns of a potential ceiling effect for the marijuana use frequency measure, 53 cases that scored a max of "42" were removed. It was determined that the measure was not sensitive enough to capture the high end of the distribution. The final sample was comprised of 338 undergraduate college students.

Measures

Demographics

Participants were asked to report their age, gender, race, academic status (i.e. freshman, sophomore, junior, senior), and college attendance status (i.e. in-person, online).

Patient Health Questionnaire (PHQ-9)

The PHQ-9 is a nine-item measure assessing depressive symptoms using items corresponding with DSM-IV diagnostic criteria for major depressive disorder (Kroenke et al., 2001). Participants were asked to report the degree to which they have experienced

problems within the last two weeks using a Likert-type scale ranging from “0” (not at all) to “3” (nearly every day). Example items include “little interest or pleasure in doing things,” poor appetite or overeating,” and “thoughts that you would be better off dead, or of hurting yourself.” Total scores were the sum of all nine items and range from 0 to 27, with greater scores suggesting the presence of a depressive disorder. Keum and colleagues (2018) found strong internal consistency among a racially diverse sample of college students with Cronbach’s alpha ranging from .86 to .93 across sample groups. The PHQ-9 was also found to have construct validity with significant negative correlations with mental well-being (Keum et al., 2018). The present study replicated the strong evidence of internal consistency for the PHQ-9 ($\alpha = .89$).

Marijuana Use (MUG)

Typical marijuana use frequency was assessed following a procedure outlined by Pearson and colleagues (Bravo et al., 2017b; Bravo et al., 2018; Jordan et al., 2019; Villarosa-Hurlocker et al., 2019). Participants were asked to report the times they used marijuana during a “typical week” in the last 30 days and estimate the amount of marijuana, in grams, consumed during that time period. Each day of the week was broken down into six 4-hour time blocks (i.e. 12a-4a, 4a-8a, 8a-12p, etc.). Typical marijuana use frequency scores range from 0 to 42 and was calculated by summing the total number of time blocks in which participants indicate using marijuana during a typical week (Bravo et al., 2017b; Bravo et al., 2018; Jordan et al., 2019; Villarosa-Hurlocker et al., 2019).

Brief Marijuana Consequences Questionnaire (B-MACQ)

The B-MACQ is a 21-item measure evaluating participants’ experiences of marijuana-related negative consequences in the past 30 days (Simons et al., 2012).

Participants were asked to answer “0” (no) or “1” (yes) to reflect whether they had experienced the absence or presence of the marijuana-related problem. Example items include “I have driven a car when I was high,” “when using marijuana I have done impulsive things that I regretted later,” and “I have lost motivation to do things because of my marijuana use.” Total scores were calculated by summing the total number of items endorsed as “yes” and range from 0 to 21 with greater scores indicating the experience of more marijuana-related negative consequences. Simons and colleagues (2012) found the B-MACQ to have very strong internal consistency ($\alpha = .95$) with college students. Total scores of the B-MACQ appear to be consistent over time with good test-retest reliability and have evidence of convergent validity with the Marijuana Problem Index (MPI) and marijuana use frequency (Simons et al., 2012). The B-MACQ demonstrated good internal consistency in the present study ($\alpha = .90$).

Cannabis Use Disorder Identification Test-Revised (CUDIT-R)

The eight-item CUDIT-R is used to screen for cannabis use disorder (Adamson et al., 2010). The first item (i.e. “how often do you use cannabis?”) was scored on a four-point scale ranging from “0” (never) to “4” (4+ times a week), while the rest of the items were scored on a four-point scale ranging from “0” (never) to “4” (daily). Total scores were the sum of all eight items and range from 0 to 32, with greater scores indicating greater risk for cannabis use disorder symptoms. Schultz and colleagues (2019) found good internal consistency for the CUDIT-R with college students ($\alpha = .83$). In addition, this measure also has evidence of concurrent validity with other marijuana-related outcome measures, such as the Daily Smoking Questionnaire and MPI (Schultz et al.,

2019). Similar evidence of good internal consistency for the CUDIT-R was found in the present study ($\alpha = .82$).

Protective Behavioral Strategies for Marijuana Scale (PBSM)

The 17-item PBSM scale measures participants' use of protective strategies in the past 30 days (Pederson et al., 2016). Participants reported the degree to which they engaged in specific behaviors while using marijuana in the past 30 days using a Likert-type scale ranging from "1" (never) to "6" (always). Example items include "use marijuana only among trusted peers," "avoid mixing marijuana with other drugs," and "avoid methods of using marijuana that can make you more intoxicated than you would like." Total scores were calculated by adding each item and range from 17 to 102, with greater scores indicating more use of PBSM. Pederson and colleagues (2016) found evidence of strong internal consistency ($\alpha = .95$) with college students. Additionally, the PBSM-17 was found to have evidence of criterion validity, such that it was negatively correlated with marijuana use frequency, marijuana-related negative consequences, and CUD symptoms. The PBSM-17 demonstrated strong evidence of internal consistency in the present study, with $\alpha = .88$.

CHAPTER III - RESULTS

Participants that met the present study's inclusion criteria and data screening procedures were included in the analyses. All missing values for each measure were coded as such before calculating total scores. Diagnostics were conducted to evaluate any potentially influential data points and outliers using mahalanobis distance and standardized residuals (i.e. z -scores within plus or minus three), respectively. No influential data points or multivariate outliers were found. Data were also screened for violations of skewness and kurtosis with cutoffs of plus or minus three standard deviations. No transformations were necessary.

Descriptive Statistics

Means, standard deviations, and intercorrelations were calculated for all measures are presented in Table 1 for the entire sample and Table 2 for males and females independently. Participants reported, on average, using marijuana 9.98 ($SD = 10.11$) times during a "typical week." PHQ-9 scores for the entire sample averaged 11.26 ($SD = 6.38$), and CUDIT-R scores averaged 11.67 ($SD = 6.67$). Thus, based on the mean scores, the sample consisted of participants experiencing moderate depressive symptoms (i.e. total scores ranging from 10 to 15) as specified by Kroneke and colleagues (2001) and engaging in hazardous marijuana use using CUDIT-R cutoff scores of 8 indicating hazardous use (Adamson et al., 2010). Independent samples t -tests were conducted to determine any significant differences between the means of males and females on depressive symptoms, PBSM use, and marijuana outcomes. There was not a significant difference in depressive symptoms for males and females, $t(336) = -.90, p = .369$. Males and females also did not differ significantly in PBSM use, $t(336) = -.76, p = .450$.

Although females reported higher typical weekly marijuana use compared to males, there was not a significant difference in marijuana use, $t(326.30) = -.55, p = .584$. There was not a significant difference in the experience of marijuana-related negative consequences for males and females, $t(336) = 1.73, p = .084$. Additionally, males and females also did not differ significantly in CUD symptoms, $t(326.11) = .49, p = .627$.

Depressive symptoms had a significant positive association with marijuana use frequency, marijuana-related negative consequences, and hazardous marijuana use. However, depressive symptoms did not have an association with PBSM use. In addition, PBSM use did not have any associations with negative consequences and hazardous marijuana use, which was not expected. However, the PBSM use was significantly negatively correlated with marijuana use frequency, which was in the expected direction. All paths in the sequential mediation model were accounted for, so the global model fit statistics are not reported (Muthen & Muthen, 2017).

Table 1

Overall Sample Means, Standard Deviations, and Intercorrelations

Scale	1	2	3	4	5
1. MUG	-				
2. PHQ-9	.18**	-			
3. CUDIT-R	.40**	.44**	-		
4. PBSM-17	-.15**	.08	.06	-	
5. B-MACQ	.22**	.42**	.56**	-.02	-
<i>M</i>	9.98	11.26	11.67	65.77	7.86
<i>SD</i>	10.11	6.38	6.67	15.57	5.71

Note. MUG = Marijuana Use Grid, PHQ-9 = Patient Health Questionnaire, CUDIT-R = Cannabis Use Disorder Identification Test,

PBSM = Protective Behavioral Strategies for Marijuana, B-MACQ- Brief Marijuana Consequences Questionnaire.

* $p < .05$; ** $p < .01$.

Table 2

Males and Females Means, Standard Deviations, and Intercorrelations

Scale	1	2	3	4	5
1. MUG	-	.15*	.38**	-.16*	.12
2. PHQ-9	.21**	-	.39**	.03	.44**
3. CUDIT-R	.45**	.48**	-	.03	.44**
4. PBSM-17	-.14	.13	.08	-	-.05
5. B-MACQ	.31**	.42**	.67**	.02	-
<i>M</i> Male	9.68	10.95	11.85	65.14	8.39
<i>SD</i> Male	9.28	6.15	6.11	15.36	5.68
<i>M</i> Fem.	10.23	11.57	11.49	66.42	7.32
<i>SD</i> Fem.	10.91	6.61	7.20	15.80	5.70

Note. Correlations for males appear above the diagonal line, and correlations for females appear below the diagonal line.

MUG = Marijuana Use Grid, PHQ-9 = Patient Health Questionnaire, CUDIT-R = Cannabis Use Disorder Identification Test, PBSM = Protective Behavioral Strategies for Marijuana, B-MACQ- Brief Marijuana Consequences Questionnaire, *M* Male = mean scores for male participants, *SD* Male = standard deviation for male participants, *M* Fem. = mean scores for female participants, *SD* Fem. = standard deviation for female participants.

* $p < .05$; ** $p < .01$.

Hazardous Marijuana Use

Structural equation modeling (SEM) in Mplus Version 8.4 was used to run a sequential mediation to test hypotheses 1a, 1b, and 2 (Muthen & Muthen, 2017).

Bootstrapping confidence intervals (CI) from 5,000 resamples were used to determine significant mediations and was represented by a 95% CI of effects that did not include zero (Preacher & Hayes, 2008). Consistent with hypothesis 1a, depressive symptoms positively predicted typical weekly marijuana use ($\beta = .20, p < .001$; see Figure 1), and hazardous marijuana use ($\beta = .37, p < .001$). Depressive symptoms did not have an association with PBSM use ($\beta = .08, p = .175$), which is inconsistent with hypothesis 1b. Contrary to hypothesis 2, there was not a significant sequential mediation path between PBSM use and marijuana use frequency ($\beta = .07$; 95% CI [-.014, .001]) in the overall

relationship between depressive symptoms and hazardous marijuana use. PBSM use negatively predicted typical weekly marijuana frequency ($\beta = -.16, p = .004$).

Although the hypothesized sequential mediation was not significant in relation to hypothesis 2, one simple mediation that was not hypothesized emerged as significant. Specifically, typical weekly marijuana use mediated ($\beta = .07; 95\% \text{ CI } [.031, .104]$) the relationship between depressive symptoms and hazardous marijuana use, such that depressive symptoms positively predicted typical weekly marijuana use ($\beta = .20, p < .001$), which, in turn, positively predicted hazardous marijuana use ($\beta = .34, p < .001$).

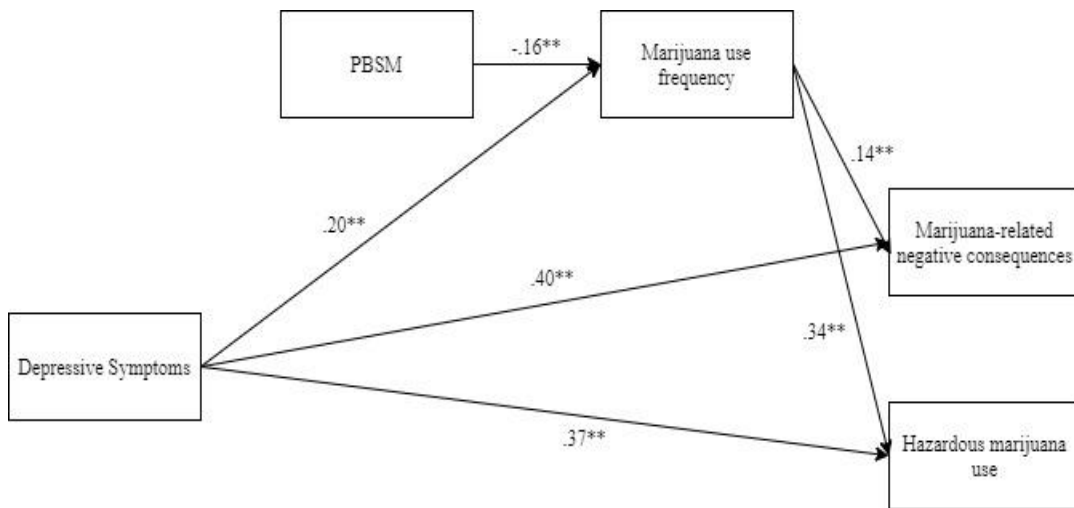


Figure 1. Significant Paths Within Sequential Mediation Model

Note. * $p < .05$; ** $p < .01$.

Marijuana-Related Negative Consequences

Consistent with hypothesis 1a, depressive symptoms positively predicted marijuana-related negative consequences ($\beta = .40, p < .001$; see Figure 1). Contrary to hypothesis 2, there was not a significant sequential mediation path between PBSM use

and marijuana use frequency ($\beta = .02$; 95% CI [-.008, .000]) in the overall relationship between depressive symptoms and marijuana-related negative consequences.

Although the hypothesized sequential mediation was not significant in relation to hypothesis 2, one simple mediation that was not hypothesized emerged as significant. Specifically, marijuana use frequency mediated ($\beta = .02$; 95% CI [.008, .053]) the relationship between depressive symptoms and marijuana-related negative consequences, such that depressive symptoms positively predicted marijuana use frequency ($\beta = .20$, $p < .001$), which, in turn, positively predicted marijuana-related negative consequences ($\beta = .14$, $p = .005$).

Invariance Testing

Invariance testing by gender was conducted in MPlus to determine whether relationships were moderated by gender (hypothesis 3). A fully constrained model by gender and freely estimated model were compared to conduct these analyses. Criteria for a meaningful change in CFI was defined as a change of .01 or more from the freely estimated model to the constrained model (Chen, 2007). When the model was freely estimated for males and females, neither of the sequential mediation paths emerged as significant for one gender and not the other (i.e. depressive symptoms \rightarrow marijuana use frequency \rightarrow PBSM use \rightarrow marijuana-related negative consequences, or depressive symptoms \rightarrow marijuana use frequency \rightarrow PBSM use \rightarrow hazardous marijuana use). Thus, the model was determined to be invariant by gender.

Although the hypothesized sequential mediations were found to be invariant by gender, two simple mediations that were hypothesized warranted further exploration. When the model was freely estimated for males and females, one simple mediation path

emerged as significant for females and for males (i.e. depressive symptoms → marijuana use frequency → CUD symptoms). After constraining the simple mediation paths to be equal, the criteria of a .01 change in CFI was not found, thus meaning the paths were significant and invariant by gender. Another simple mediation path emerged as significant for females only (i.e. depressive symptoms → marijuana use frequency → marijuana-related negative consequences). However, after constraining the simple mediation paths to be equal, the criteria of a .01 change in CFI was not found, thus meaning the paths were significant and invariant by gender.

CHAPTER IV – DISCUSSION

Given the increasing rates of marijuana use and mental health concerns among college students, this study sought to shed light on the inconsistent relationship between college student marijuana use and depressive symptoms found in previous studies. In particular, the purpose of the present study was to examine the sequentially mediating role of PBSM use and marijuana use frequency on the relationship between depressive symptoms and marijuana outcomes (i.e. marijuana-related negative consequences, and CUD symptoms). Given the known gender differences concerning PBSM use, marijuana outcomes, and experience of depressive symptoms, this study also sought to examine the moderating role of gender on these relationships.

The hypothesis that PBSM use and marijuana use frequency would sequentially mediate the relationship between depressive symptoms and marijuana outcomes was not supported (hypothesis 2). Specifically, the relationship between depressive symptoms and marijuana-related negative consequences was not sequentially mediated by PBSM use and marijuana use frequency. The hypothesis that PBSM use and marijuana use frequency would sequentially mediate the relationship between depressive symptoms and hazardous marijuana use was also not supported. The present study did not find a significant direct association for depressive symptoms and PBSM use (hypothesis 1b), which may explain the non-significant findings. Although Jordan and colleagues (2019) found PTSD symptoms to be negatively associated with PBSM use, the current findings suggest there might not be a relationship between depressive symptoms and PBSM use, which could be due to the differences among PTSD and depression.

When considering PTSD, depression, and their associations with PBSM, the differences could lie in symptomatology and motivations to use the strategies outlined in the PBSM. For example, it may be that those suffering from PTSD symptoms use more marijuana to stifle their intense physiological symptoms (i.e. hyperarousal and reactivity), and, thus, are not motivated or have the cognitive resources to use the strategies outlined in the PBSM. While those suffering from increased depressive symptoms may also be using more marijuana to cope with negative affect, it is possible that the strategies outlined in the PBSM do not relate to the behavioral and cognitive components of depression, which could explain the lack of association. For example, when looking at specific items on the PBSM-17 in the present sample, approximately 57% of the participants indicated that they avoided using marijuana to cope with emotions such as sadness or depression at least some of the time, which is the only strategy directly related to negative affect. When considering other strategies such as avoiding marijuana use before physical activity (e.g., hiking, exercise), these may not relate to individuals suffering from depression since they are likely experiencing a loss of interest in everyday activities, fatigue, and psychomotor retardation (APA, 2013). Thus, they may not be engaging in physical activities such as exercise to begin with, rendering this and similar strategies ineffective for this subgroup. Furthermore, given that those with increased depressive symptoms tend to isolate, some strategies on the PBSM (e.g., using marijuana only with trusted peers, avoiding use in public places, and avoiding use prior to family gatherings) may not be useful or applicable if these individuals socially withdraw from family and friends. Taken together, it could be that the PBSM, as currently

conceptualized and assessed, does not effectively capture the behavioral and cognitive symptoms typically experienced by depressed individuals using marijuana.

Another explanation for the nonsignificant findings could lie in the lack of association between PBSM use and marijuana-related negative consequences and hazardous marijuana use, which is contrary to previous findings that PBSM weakens consequences associated with risk factors (Bravo et al., 2017a; Pederson et al., 2017). While these findings were unexpected and surprising, one potential reason that may explain these relationships could also lie in the PBSM measure itself. It could be that individuals are using the strategies outlined in the PBSM, but these strategies may not be related to the experience of negative consequences or hazardous marijuana use. For example, one strategy is “only use one time during day/night.” Individuals experiencing increased depressive symptoms could be implementing this strategy effectively throughout the day but may use greater quantities of marijuana during the “one time” period in the evening.

Furthermore, the sample used in the present study could provide another explanation for the unexpected findings. Although MTurk samples have been found to be a reliable data collection tool to access clinical and subclinical populations (Buhrmester et al., 2011; Shapiro et al., 2013), there may be differences in this population compared to typical psychology student sample pools. In fact, research has shown crowdsourcing platforms such as MTurk have the ability to obtain large, diverse samples at a low cost, but these samples may be more representative of “consumer samples” rather than college students (Ford, 2017). For example, in the present study, the average age of participants in this sample was 22 years of age, mostly male, majority seniors, and featured a large

Asian American and Native American representation. The demographic characteristics in the presented sample can be compared to the sample in Jordan et al. (2019), which featured college students with an average age of 20, mostly white, and mostly female. Given that Jordan et al. (2019) found PBSM to mediate the relationship between one mental health factor and marijuana outcomes in college students, it is possible that the characteristics in the present sample did not adequately capture “typical” college students. Further, while generally understudied, recent research has indicated that Asian American college students report fewer depressive symptoms and less illicit substance compared to the national average for American college students (SAMHSA, 2018). However, it should be noted that subgroups within this population have begun showing increasing rates of marijuana use similar to other racial/ethnic minorities (SAMHSA, 2018). Native American college students have shown significant increases in monthly and daily marijuana use as well as significant increases in major depressive episodes, but these rates are still lower than the national average for all American college students (SAMHSA, 2018). Taking these factors into account, it could be that the typically lower rates of mental health concerns and marijuana use among these groups impacted the present study’s findings. Furthermore, within the present study’s sample, approximately 97% of the participants endorsed alcohol use in the past 30 days. It is possible that these students were using marijuana and alcohol simultaneously, which may have affected the experience of negative consequences. Future studies should account for this co-use and/or simultaneous use since these students may be engaging in self-medicating behaviors using multiple substances. Finally, although the present study attempted to exclude participants on the basis of fast response time, invariant responding, and random

responding, it is possible that the MTurk sample still engaged in some form of response bias that could not be accounted for and potentially impacted the study's findings.

With respect to the moderating role of gender on these relationships (hypothesis 3), the sequentially mediating effects of PBSM and marijuana use frequency were found to be invariant by gender. Further, tests of mean differences indicated that males and females did not differ significantly on depressive symptoms, PBSM use, or marijuana outcomes. These findings are contrary to several studies that have found gender differences in the variables of interest in the present study (ACHA, 2019; Bravo et al., 2017a). However, the gender gap seen in marijuana use has been rapidly narrowing recently (Johnston et al, 2019), indicating females are reportedly using similar amounts of marijuana compared males, which could, in turn, contribute to increases in experiences of negative consequences and CUD risk. In addition, many studies that found gender-based differences featured a disproportionate number of females compared to males in the sample (Bravo et al., 2017a; Jordan et al., 2019). It is possible this could have occurred in past research due to an overrepresentation of females achieved through convenience sampling often used in psychological science research, which may have resulted in the emerging gender differences. The current study featured an almost even distribution of males and females and may have accurately captured a lack of differences in terms of the relationship between depressive symptoms and marijuana outcomes.

To our knowledge, this was the first study to examine PBSM as a mediator between depressive symptoms and marijuana outcomes, and given the unexpected lack of association between PBSM and both depressive symptoms and marijuana outcomes, it is clear that more research is needed in this area when studying individuals experiencing

greater depressive symptoms. In addition, to help resolve the discrepancies in the literature regarding the association between marijuana use and depressive symptoms (Cranford et al., 2009; Keith et al., 2015; Philips et al., 2018; Suerken et al., 2014), the present study did find significant positive associations for depressive symptoms with marijuana outcomes. Specifically, experiencing greater depressive symptoms predicted greater marijuana use frequency, marijuana-related negative consequences, and CUD risk, which was in the expected direction (hypothesis 1a) and is consistent with some of the previous research in this area (Keith et al., 2015; Suerken et al., 2018; Walters et al., 2018). Further, the present study also found that marijuana use frequency mediated the positive association between depressive symptoms and marijuana outcomes (i.e. marijuana-related negative consequences, hazardous marijuana use), such that depressive symptoms positively predicted marijuana use frequency, which, in turn, positively predicted marijuana outcomes. These findings can be viewed through the lens of the self-medication hypothesis, which posits that college students experiencing a greater number of depressive symptoms may be using more marijuana to cope with their negative affect, which, in turn, puts them at increased risk for experiencing marijuana-related negative consequences (Wilkinson et al., 2016). Given these positive associations, it is imperative to assess and intervene with regards to marijuana use for college students experiencing depressive symptoms and further identify effective harm-reduction strategies.

While the results of this study are inconclusive in relation to the effectiveness of PBSM for individuals with certain mental health concerns such as depression, clinicians should continue to look for methods of harm-reduction that could be protective for these individuals. When considering the PBSM specifically, certain types of PBSM simply

may not be effective in preventing negative consequences and/or hazardous use among college students experiencing depressive symptoms. Clinicians may look for ways to modify these strategies to increase applicability to the behavioral and cognitive components of depressive symptoms, including eliciting more helpful strategies from college students suffering from increased depressive symptoms. Another specific intervention could be to emphasize specific strategies that relate to coping with negative affect and depressed mood to avoid hazardous marijuana use and marijuana-related negative consequences. Given the rise of mental health issues and marijuana use on college campuses in the past decade, more widespread interventions (i.e. workshops and speakers) could be employed to encourage healthier ways of coping with psychological distress.

Despite the strengths of the present study such as a diverse, national sample, there are noteworthy limitations. Since the present study was cross-sectional in nature, causal inferences cannot be made. To build on this, future research could employ a diary design that could assess frequency and quantity of marijuana use, motivations for marijuana use, and subsequent marijuana-related negative consequences. Next, as mentioned previously, the MTurk sample could be unique as compared to the general college student population. Given the older average age, majority male, and large number of Asian and Native Americans present in the sample, it may not be generalizable to the general college student population. As such, future studies should employ more targeted recruitment efforts to obtain a more representative sample of college students in the United States. Future research could also target subgroups of college students (e.g., freshmen, sophomores, etc.) to evaluate potential differences across various age groups.

In addition, studies should evaluate the validity of “MTurkers” as compared to the general college student population to determine if differences exist. Another limitation of the present study is that it featured a secondary data analysis in which the parent study screened exclusively for alcohol use, which should be accounted for in future research to determine if these students are using substances simultaneously (or co-using) which may impact the experience of negative consequences.

In addition, given the historical difficulties in assessing marijuana use quantity and frequency, the present study attempted to use an improved measured used assess marijuana use frequency and quantity in the past 30 days. However, the present study only evaluated marijuana use frequency, which leaves out detailed information on how much marijuana was consumed at a time and should be an area of focus for future research. In addition, the present study experienced issues in terms of the distribution for the marijuana use frequency measure, so future research should look to develop and valid more accurate measures of marijuana use among college students. Although the present study conceptualized its hypotheses from the self-medication hypothesis, it did not explore the role of coping motives. Future studies should explore how coping motives impact the relationship between depressive symptoms, PBSM use, and marijuana outcomes.

To the best of the researcher’s knowledge, this is the first study to investigate the relationships among depressive symptoms, PBSM use, marijuana use frequency, and marijuana outcomes in a diverse college student sample. As mental health symptoms and marijuana use prevalence rates continue to increase on college campuses, it is important to further our understanding of various risk factors that contribute to the experience of

negative consequences to better inform interventions targeted at harm-reduction. Although this helped resolve the dispute regarding depression's association with marijuana outcomes, there still appears to be a need to account for other factors that may be playing an impactful role in these relationships. Overall, this study showcases that PBSM and marijuana use frequency alone do not explain the relationship between depressive symptoms and marijuana-related outcomes and that gender does not moderate these relationships.

APPENDIX A –IRB Approval Letter

Office of
Research Integrity



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NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident template on Cayuse IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.
- **FACE-TO-FACE DATA COLLECTION WILL NOT COMMENCE UNTIL USM'S IRB MODIFIES THE DIRECTIVE TO HALT NON-ESSENTIAL (NO DIRECT BENEFIT TO PARTICIPANTS) RESEARCH.**

PROTOCOL NUMBER: IRB-20-157

PROJECT TITLE: Depression, Marijuana Outcomes, and Protective Strategies Use among College Students

SCHOOL/PROGRAM: Psychology

RESEARCHER(S): Nicholas Militello, Michael Madson

IRB COMMITTEE ACTION: Exempt

CATEGORY: Exempt

APPROVED STARTING: May 18, 2020

Donald Sacco, Ph.D.
Institutional Review Board Chairperson

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