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A Mixed-Methods Study to Examine Protective Behavioral Strategies for Simultaneous Alcohol and Cannabis Use in College Students

Jennifer Lynn Shipley
Old Dominion University, jship002@odu.edu

A MIXED-METHODS STUDY TO EXAMINE PROTECTIVE BEHAVIORAL STRATEGIES FOR SIMULTANEOUS ALCOHOL AND CANNABIS USE IN COLLEGE STUDENTS

by

Jennifer Lynn Shipley
B.S. May 2014, California Lutheran University
M.P.H. May 2016, The University of Arizona
M.S. May 2022, Old Dominion University

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Approved by:

Abby L. Braitman (Director)

Cathy Lau-Barraco (Member)

Krystall E. Dunaway (Member)

Natalie M. Yarish (Member)

ABSTRACT

A MIXED-METHODS STUDY TO EXAMINE PROTECTIVE BEHAVIORAL STRATEGIES FOR SIMULTANEOUS ALCOHOL AND CANNABIS USE IN COLLEGE STUDENTS

Jennifer Lynn Shipley
Old Dominion University, 2024
Director: Dr. Abby L. Braitman

State-level cannabis legalization is becoming more common in the United States. With the rise of cannabis legalization, cannabis use among college students has increased and young adults' perceptions of the harms associated with cannabis use have decreased. Moreover, simultaneous use of alcohol and cannabis (so that their effects overlap; SAM) is prominent in the college student population. Negative consequences related to SAM use are greater than those for alcohol or cannabis single-substance use. Protective behavioral strategies (PBS) are robust predictors of reduced harm, and critical components for efficacious interventions for reducing alcohol and cannabis use and their related harms. PBS scales have been developed for single-substance use of alcohol and cannabis. Researchers have called for examinations of PBS use when both alcohol and cannabis are used simultaneously, as no published studies to date have included a measure of PBS for SAM use. The current project developed a PBS measure for SAM use (PBS4SAMM) using a fully mixed exploratory sequential dominant status design mixed-methods approach. Focus groups were conducted to inform the development of the of the PBS4SAMM (qualitative). After receiving feedback on the items from experts, the PBS4SAMM was part of a cross-sectional study (quantitative) to psychometrically validate the content and internal structure of the new measure using exploratory factor analysis. Three factors were extracted with a total of 18 items. Criterion, discriminant, and incremental validity were not fully established for all subscales or the total score. T-test analyses were conducted to examine

differences in SAM-specific PBS use among gender and race. The PBS4SAMM Planning subscale strategies were used more often by cisgender women then cisgender men. There were no other differences across gender and race for the PBS4SAMM, and gender and race did not moderate the association of PBS4SAMM and SAM use and consequences. Results should be interpreted with caution as the analyses may not have been powered sufficiently due to a low sample size. A confirmatory factor analysis and measurement invariance analyses were not able to be conducted because of low sample size. Future research should replicate the study in a larger and more diverse sample.

This dissertation is dedicated to my parents and sister for their unconditional love and support.

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CHAPTER 1

INTRODUCTION

In 2019, 35.4% of emerging adults between the ages of 18-25 years old reported using cannabis in the past year and 5.8% of young adults reported having a cannabis use disorder (Substance Abuse and Mental Health Services Administration, 2020). Currently, 21 states and the District of Columbia have legalized recreational cannabis use (National Conference of State Legislatures, 2023). Research has found associations between legalized recreational cannabis use and cannabis use in college students. For example, using data from the National College Health Assessment, Miller et al. (2017) found that cannabis use significantly increased for college students in Washington State after legalization of recreational cannabis use (between 12-22% increase in use). Additionally, Parnes et al. (2018) found that after recreational cannabis use was legalized in Colorado, more college students used cannabis for the first time. These findings suggest cannabis use will continue to increase in both prevalence and frequency as more states legalize recreational use.

The perception of harm related to using cannabis has declined from 2015 to 2019 among young adults, suggesting cannabis users underestimate their risk of encountering harm related to their use, as many users do experience undesired consequences (Substance Abuse and Mental Health Services Administration, 2020). Researchers have identified the most frequently endorsed consequences related to cannabis use among college students to be driving under the influence and engaging in embarrassing behaviors; however, more severe consequences of cannabis use reported include harming someone else, damaging property, and having unprotected sex (Pearson et al., 2017). Cannabis use can also impact academic performance for college students (Arria et al., 2015). As more states legalized recreational cannabis use, cannabis use has increased among young adults, perception of harm has decreased, and negative consequences of

cannabis use impact college students in all parts of their life. It is critical to understand how emerging adult college students can protect themselves from cannabis use related harms.

Simultaneous Alcohol and Cannabis Use

In addition to single substance use (i.e., using only cannabis), college students are also using cannabis in conjunction with alcohol. Jones et al. (2018) reported that college students in Colorado who engaged in binge drinking were more likely to smoke cannabis. Similarly, Kerr et al. (2017) reported that after legalization of recreational cannabis use, use increased among college students in Oregon who reported heavy alcohol use. College students can use alcohol and cannabis simultaneously, such that their effects overlap, also known as being "cross-faded" (Patrick & Lee, 2018). Simultaneous alcohol and cannabis (also known as simultaneous alcohol and marijuana; SAM) use is prevalent among college students, with one study reporting that among college students who reported using alcohol and cannabis in the past year, 73% reported SAM use (White et al., 2019). Using these substances together could lead to riskier use of both substances. Among a sample of undergraduate students, those who reported using both alcohol and cannabis reported greater motives for alcohol use than those who only reported using alcohol, with enhancement motives associated with consuming more alcohol (Skalisky et al., 2019). Stevens et al. (2022) found via a daily diary study that college students consumed more alcohol on days when they planned to participate in simultaneous alcohol and cannabis use than on days when they only planned to use one substance.

Furthermore, SAM use among college students is associated with greater consequences compared to single substance use alone (Jackson et al., 2020). For example, college student SAM users reported more academic consequences (e.g., "missed a class due to drinking/being stoned") and cannabis-related consequences than concurrent users (use both alcohol and cannabis, but

their effects do not overlap; Cummings et al., 2019; Looby et al., 2021). More recently, Waddell et al. (2023) found that among college students who reported SAM use in the previous month, on days when SAM use consumption was higher, more negative alcohol consequences were reported than on high alcohol use only days. SAM users are experiencing greater harms than concurrent alcohol and cannabis users or single substance users. Protective behavioral strategies (PBS), or strategies individuals use to reduce substance use and related risks, are naturally associated with lower negative consequences related to use of alcohol or cannabis (e.g., Martens et al., 2005; Peterson et al., 2021), and are an important component in successful interventions through helping with the reduction of negative consequences (Peterson et al., 2021; see "PBS Interventions" below for more details); however, there is a major gap in the literature where no research to date has examined PBS to reduce harms of SAM use, an area of critical need given elevated risk for this pattern of use.

Protective Behavioral Strategies and their Assessment

Although PBS for SAM use have not been assessed, there has been extensive research in the area of alcohol-specific PBS use and a growing body of literature for cannabis-specific PBS use. Understanding the history of the development of PBS measures for single-substance use is necessary to develop a PBS measure specific for SAM use.

Alcohol-specific PBS

Multiple PBS measures have been developed for single-substance use of alcohol (for reviews, see Pearson, 2013; Peterson et al., 2021; Prince et al., 2013). Peterson et al. (2021) identified eight measures of alcohol PBS as standards in the literature. These measures have all been found to have adequate internal consistency (α = .76-.94) and construct validity (Peterson et al., 2021), but I review the most popular and updated measures here. One popular alcohol-

specific PBS measure is The Protective Behavioral Strategies Survey (PBSS; Martens et al., 2005), a 15-item measure that has three subscales: limiting/stopping drinking (i.e., “alternate alcoholic and nonalcoholic drinks”); manner of drinking (i.e., “avoid drinking games”); and serious harm reduction (e.g., “use a designated driver”; Martens et al., 2005). The PBSS was originally developed using data from a sample of college students who had consumed alcohol in the previous 30 days (Martens et al., 2005). Items were developed by reviewing the existing literature, with a focus on strategies that could be implemented before or during alcohol consumption. After consulting with graduate student researchers, the list was narrowed to 25 items. One item was removed because it was highly skewed (indicating infrequent endorsement) and an exploratory factor analysis (EFA) identified the three-factor model after removing nine additional items. This factor structure was further validated and confirmed by Martens et al. (2007). However, the PBSS (Martens et al., 2005) may not measure alcohol PBS similarly across race (White and Black college students) as some invariance testing indicated that the measure was not invariant across these identities (Martin, Zamboanga, et al., 2020). As noted by the authors, caution must be taken when examining PBS use assessed by this measure. Additionally, item development did not involve consulting with college students outside of the graduate student researchers. Without the use of focus groups or interviews with the population of interest, important potential items/strategies not included in other measures may have been missed.

A modified 20-item scale was developed to improve the content validity of the PBSS (Martens et al., 2005), particularly the serious harm reduction subscale (PBSS-20; Treloar et al., 2015). According to Peterson et al. (2021), the PBSS-20 is the most cited PBS measure and improved upon the PBSS. The PBSS-20 added more items to the serious harm reduction subscale, including one item related to co-use of alcohol and cannabis (i.e., “avoid combining

alcohol with marijuana"; Treloar et al., 2015). Researchers reviewed the literature and conducted a pilot study to develop the new items. As part of the pilot study, participants were asked to provide three strategies they "used to avoid harm when using alcohol or 'partying'" (Treloar et al., 2015, pg. 3). After narrowing the items, two focus groups provided feedback on the potential new items, which led to a total of 14 possible new items. To assess the new scale with the new items, a sample of college students who consumed alcohol in the past year were recruited to participant in an online survey. Data from the sample were used to conduct item analysis, EFA, confirmatory factor analysis (CFA), and validation analyses. These analyses concluded with a total of five items in the serious harm reduction subscale and one new item for the manner of drinking subscale (with one original item removed; Treloar et al., 2015). However, Treloar et al. (2015) also conducted measurement invariance testing for gender and found that two items for the serious harm reduction scale were not invariant across men and women, suggesting these items may have a different conceptual meaning or relevance across gender.

A newer measure of PBS is the Protective Drinking Practices Scale (PDPS; Martin, Colvin, et al., 2020). To develop the items for the PDPS, Martin, Colvin, et al. (2020) combined items from six PBS measures for a total of 68 unique items. This set of items was administered in a survey to a sample of college students, who reported past 30-day alcohol use, two times: first administration, the response anchor points were the same as the PBSS (Martens et al., 2005) – 1 (*never*) to 6 (*always*); second administration, the response anchor points were numeric – *0, 1, 2-3, 6-10, 11* or more (Martin, Colvin, et al., 2020). After examining probability response curves, fit of each item, and external validity with other alcohol use measures, the results of the study led Martin, Colvin, et al. (2020) to decide to use the first set of response anchors. Martin, Colvin, et al. (2020) narrowed the measure to a total of 20 items with one factor (e.g., "Drink for quality

not quantity") after removing items based on differential item functioning across race or gender, and those with similar psychometric properties. Jordan et al. (2021) psychometrically validated the PDPS (Martin, Colvin, et al., 2020) in a larger, national sample of college students, confirming the results of the original psychometric analyses. Similar to the PBSS (Martens et al., 2005), qualitative work with college students, such as focus groups, could have provided more items to consider for this new measure.

Across measures, alcohol-specific PBS has consistently been linked to reduced use and consequences. This is a robust association that has been documented time and time again, such as in a review for alcohol-specific PBS use (Pearson, 2013) and a review that discussed both alcohol- and cannabis-specific PBS use (Peterson et al., 2021). Although this association is robust for overall PBS use, this association varies across subscales for PBS. For example, using a daily survey methodology with a sample of college students who reported at least one consequence associated with alcohol use in the previous 90 days, Pearson, D'Lima, and Kelley (2013a) found that PBS categorized as manner of drinking were associated with drinking less daily (within person) and across all days (between person). The opposite was true for the serious harm reduction subscale (from Martens et al., 2005), such that more alcohol use was reported on days, and across all days, when more PBS related to serious harm reduction were employed (Pearson, D'Lima, & Kelley, 2013a). This finding was supported by a longitudinal study (Napper et al., 2014) and a more recent cross-sectional study (Braitman et al., 2023). Napper et al. (2014) examined data collected at baseline and 3 months later from a sample of undergraduate students who endorsed past-month heavy drinking. Participants who used more manner of drinking PBS at baseline reported less alcohol consumption 3-months later, but this was not true for serious harm reduction PBS (controlling for baseline alcohol use and consequences; Napper

et al., 2014). Using data from a cross-sectional survey of undergraduate students who reported past 30-day alcohol consumption, Braitman et al. (2023) found that college students who endorsed more manner of drinking strategies reported less alcohol consumption, with the opposite true for serious harm reduction strategies. The inconsistency in findings could be due to college students only using serious harm reduction strategies when they are drinking heavily, as suggested by Braitman et al. (2023). For example, one of the strategies from the PBSS-20 (Treloar et al., 2015) is, “Make sure you drink with people who can take care of you if you drink too much”. Specific types of PBS may be more protective of reduced alcohol consumption.

Alcohol-specific PBS is also linked to reduced consequences. Qualitatively, college students have reported that one of the advantages of using PBS is reduced consequences. Bravo et al. (2018) asked college drinkers to provide five cons and five pros for using alcohol-specific PBS. Two themes for the advantages of using PBS emerged from the data: preventing negative consequences associated with alcohol use (e.g., avoiding feeling sick or having a hangover) and safety (their own and others’; Bravo et al., 2018). There were also four themes for the disadvantages of using PBS (e.g., goal conflict), but overall, more advantages of using PBS were reported (Bravo et al., 2018). Martens et al. (2005) examined data from undergraduate students who consumed alcohol in the previous 30 days and found that PBS overall were negatively associated with consequences. Similar to alcohol use, this association varies across types of PBS. For example, manner of drinking and serious harm reduction PBS were found to predict fewer consequences in a longitudinal survey of college students, but this was not true for stopping/limiting drinking (controlling for baseline alcohol use and consequences; Napper et al., 2014). Linden-Carmichael et al. (2018) analyzed data from a measurement burst study with a sample of college students who participated in high intensity drinking (i.e., 8+ drinks for women;

10+ drinks for men [Patrick, 2016]) and heavy episodic drinking (i.e., 4-7 drinks for women; 5-9 drinks for men [Wechsler et al., 1995]). Participants were less likely to report that they experienced relevant consequences (e.g., passing out) on days when they reported using manner of drinking strategies (controlling for high intensity drinking; Linden-Carmichael et al., 2018). This association was true for only one consequence relevant to serious harm reduction PBS ("had a sexual experience they regretted"; Linden-Carmichael et al., 2018). More recently, Carey et al. (2022) a recruited participants who had to complete alcohol education as a sanction for violating a campus policy. When looking at total PBS endorsed as well as just the manner of drinking PBS and just stopping/limiting drinking PBS, participants were less likely to report blacking out in the previous month if they reported using more of these PBS, but this was not true for serious harm reduction (controlling for demographic variables and substance use; Carey et al., 2022). As Carey et al. (2022) noted in regards to blacking out, different types of PBS may be more important to focus on to reduce certain alcohol outcomes (e.g., acute consequences versus alcohol consumption) than others.

In summary, psychometrically validated measures of alcohol-specific PBS have been developed and used extensively in research with college students, and use of PBS is generally associated with consuming less alcohol and reporting fewer consequences. However, there are multiple dimensions of alcohol-specific PBS use, which have differential associations with use and related harms. More research is needed to determine if all or only specific PBS associated with alcohol use exist when using alcohol at the same time as cannabis.

Cannabis-specific PBS

PBS for cannabis is an emerging field of research, with few published measures, in addition to variations of one measure. The PBS for Marijuana scale (PBSM; Pedersen et al.,

2016) was originally developed after reviewing the literature and conversations with researchers in the field of cannabis use among young adults as well as conversations with college students who used cannabis. A total of 50 items were included in an online survey that was administered to a sample of college students who reported using cannabis in the past 6 months (Pedersen et al., 2016). Results suggested a 39-item measure with one factor (Pedersen et al., 2016). Pedersen et al. (2017) further validated the PBSM using data from college students across 11 states who reported using cannabis in the previous month. Exploratory and confirmatory factor analysis confirmed a one factor structure, but suggested only 36 items (three less than the original study; Pedersen et al., 2017). Examples of cannabis PBS include "Limit use to weekends" and "Avoid using marijuana out of boredom".

Given the length of the original measure, Pedersen et al. (2017) further conducted DIF analyses to develop a short form alternative of the PBSM that included 17 items. The PBSM 17-item short form was further examined by Mian et al. (2021). Two samples of college students who reported lifetime cannabis use completed the short-form version of the PBSM (Pedersen et al., 2017) via an online survey. Mian et al. (2021) conducted a CFA to confirm the previous work of Pedersen et al. (2016); however, the model fit for a one-factor solution was poor. Next, Mian et al. (2021) conducted an EFA, which suggested that the PBSM short form (PBSM-SF; Mian et al., 2021) has two factors: quantity (e.g., "Limit amount to smoke in one sitting") and context (e.g., "Avoid using before work or school"). Four items were removed because they mapped on to both factors, resulting in 13 items total for the updated measure. However, the two-factor model may not measure cannabis PBS similarly across gender (men and women) and race/ethnicity (White and ethnic minorities) as invariance testing indicated that the measure was not invariant across these demographic groups (Mian et al., 2021).

Continuing on the work of Mian et al. (2021), Jordan et al. (2022) conducted CFA and measurement invariance testing with the PBSM-SF (Mian et al., 2021). Using data from a sample of college students across 11 states who reported past-month cannabis use, Jordan et al. (2022) first conducted a CFA for the 17-item factor suggested by Pedersen et al. (2017). Then, the researchers removed the four items indicated by Mian et al. (2021) to examine the two-factor model. Model fit was improved with the two-factor, 13-item CFA (Mian et al., 2021). Measurement invariance testing revealed that the PBSM-SF was metric invariant by race, but did not meet invariance across sex, meaning male versus female college students interpreted or understood some items differently. Interestingly, Jordan et al. (2022) also conducted measurement invariance testing by legalization of cannabis use (living in a state with legalized use of any kind vs. no form of legal use) and found that the measure was invariant across legalization status. As the researchers noted, this is an important finding as legalization still varies across the United States, so these results confirm that the PBSM-SF (Mian et al., 2021) can be used to assess cannabis PBS use regardless of legalization status (Jordan et al., 2022).

One other cannabis PBS measure is the Protective Behavioral Strategies Survey for Cannabis (PBSS-C; Caffrey et al., 2018). Similar to previous research, the authors identified items after conducting a literature review, which resulted in 23 items. Using data from a sample of college students who reported past 30-day cannabis use, Caffrey et al. (2018) conducted an EFA, which suggested a four-factor model with 19 items: Respiratory Health (e.g., “use edibles”), Frequency/Quantity (e.g., “Avoid using more than once a week”), Socializing (e.g., “Stay with the same friends”), and General Health (e.g., “use ‘organic’ cannabis”). Then, an exploratory structural equation model was conducted, which suggested that residuals between two items be correlated and one item removed. This measure has not been widely used; however,

Caffrey et al. (2018) provided recommendations for modifications to the measure which could inform future research of cannabis-specific PBS. This measure may also benefit from qualitative methods to learn if there are other PBS specific to cannabis use among college students that should be considered.

Similar to alcohol-specific PBS, cannabis-specific PBS has also been linked to reduced use and consequences. For example, Bravo, Prince, et al. (2017) examined cross-sectional data from a sample of college students across 11 states who reported past-month cannabis use. There was a negative association between cannabis PBS use and use frequency (Bravo, Prince, et al., 2017). Pearson et al. (2020) conducted a daily diary study with college students across three states that examined the association between cannabis PBS and cannabis use outcomes and found that on days when participants reported using more cannabis PBS, there were fewer use sessions.

A review by Grigsby et al. (2023) of risk and protective factors for consequences of cannabis use noted that several cross-sectional studies have supported the negative association between cannabis PBS and related consequences. Richards et al. (2022) examined data from an online survey of college students across 10 states who endorsed past month cannabis use. The researchers concluded that using cannabis-specific PBS was associated with reporting fewer consequences, even after controlling for sex (Richards et al., 2022). One study did report that cannabis PBS was not associated with lower consequences; however, as noted by the researchers, this could be due to the type and number of consequences measured (Pearson et al., 2020). Pearson et al.'s (2020) daily diary study only used eight items from the Marijuana Consequences Questionnaire (Simons et al., 2012) that spanned seven domains. Thus, there were not as many consequences to endorse, potentially limiting the sensitivity of the measure.

To summarize, a few validated measures of cannabis-specific PBS have been developed and used in research with college students. Like alcohol-specific PBS, these measures have been explored psychometrically with improvements recommended using independent samples, with some exploration into measurement invariance across gender or race for select measures. Also, like alcohol-specific PBS, use of cannabis-specific PBS is generally associated with less cannabis use and reporting fewer consequences. However, there is a critical gap in the literature for understanding PBS specific to SAM use, including no psychometrically validated measures for its assessment.

SAM-specific PBS

Although a specific measure of SAM PBS use has not been developed, prior studies have explored potential harm reduction strategies, such as pattern of use and mode of use. A qualitative study examined SAM use among young adult college students, including patterns of use (Boyle et al., 2021). Participants reported choosing a specific order of using alcohol and cannabis during SAM use to reduce or eliminate negative consequences. However, this ordered varied, with some participants reporting that they use cannabis first, while others reported using alcohol first (Boyle et al., 2021). Participants also reported participating in SAM use to reduce their use of alcohol, however, Boyle et al. (2021) cautioned that this may be because their sample was a heavy drinking sample of college students. Gunn et al. (2021) found that order of use may impact quantity of consumption, specifically using cannabis first was associated with using less alcohol use but greater cannabis use among college students. Interestingly, order of use was not associated with consequences. However, Karoly et al. (2023) found that order of use was associated with consequences among college students – more days using alcohol first was negatively associated with cannabis consequences. And the inverse was also true, that more days

using cannabis first on a SAM use day was negatively associated with alcohol consequences. Thus, order of alcohol and cannabis use may be a potential PBS specific to SAM use.

The type of alcohol or cannabis product may also be linked to experiencing negative consequences. Stevens et al. (2021) found that more negative consequences were reported on SAM use days when more than one type of alcohol product was used as compared to days when only leaf and beer were used. More research is needed to determine if type and number of alcohol and cannabis used is a SAM-specific PBS.

Gender and Race Disparities in Alcohol Use and PBS Use

Gender and race differences are well established for alcohol use among college students. Studies have documented that college student men participate in more high-risk drinking behaviors (Schulenberg et al., 2021), but college student women experience more consequences related to drinking (after controlling for use; Doumas et al., 2013). In regards to race, Madson & Zeigler-Hill (2013) found that African American college students consumed less alcohol than White, non-Hispanic college students. A more recent study by Gardner et al. (2020) expanded upon these results and documented that White college students reported more high-risk drinking behaviors and consequences than Black college students.

Some research has also demonstrated differences in alcohol-specific PBS use across race and gender. Clarke et al. (2016) examined race differences in PBS use among college students using data across multiple studies, focusing on White, Black, and Asian college students who endorsed at least past month alcohol use. Although White college students reported more alcohol consumption and consequences, Asian college students endorsed more PBS (Clarke et al., 2016). Madson and Zeigler-Hill (2013) examined data from a sample of college students who reported past-month alcohol use and identified as either White, non-Hispanic or African Americans and

found that African American college students used more PBS than White, non-Hispanic college students, specifically limiting/stopping drinking and manner of drinking strategies. However, more research is needed with a greater representation of Black/African American college students. For example, less than 35% of the samples for Madson and Zeigler-Hill (2013) and Gardner et al.'s (2020) studies were comprised of students who identified as Black/African American.

Similarly, college student men reported more alcohol consumption and consequences, but college student women endorsed more PBS (Clarke et al., 2016). Further, participants who used more PBS reported fewer alcohol consequences, but this association was stronger for women (Clarke et al., 2016). Blanchard et al. (2021) examined PBS subscales for differences across biological sex in a sample of undergraduate students and found that there were no differences across biological sex for the association between the PBS subscales and consequences, but there were for alcohol use disorder symptoms; for male undergraduates, there was not a significant association between the stopping/limiting drinking and manner of drinking subscales and alcohol use disorder symptoms. In summary, alcohol-specific PBS use may be more protective for some college students than others. Moreover, ensuring that measures are consistently assessing PBS across gender and race strengthens the inference that these are true differences in PBS use or its associations with outcomes, not artifacts of differences in assessment.

Gender and Race Disparities in Cannabis Use and PBS Use

Gender and race differences have also been established for cannabis use among college students. College student men more frequently use cannabis (Cloutier et al., 2021; Schulenberg et al., 2021) and report more cannabis use consequences than college student women (Cloutier et al., 2021). Park et al.'s (2022) results from a sample of undergraduate college students between

21-25 years old supported Schulenberg et al.'s (2021) study, finding that college student men reported greater cannabis use than college student women.

Studies have also found differences in cannabis use across race. For example, using data from the National College Health Assessment, Miller et al. (2017) examined the likelihood of college students using cannabis after recreational cannabis legalization in Washington state. College students who identified as White or Black were the most likely to use cannabis (Miller et al., 2017). Chandler et al. (2021) analyzed data from a minority-serving institution in California that was also collected via the National College Health Assessment and found that more White college students reported using cannabis than Hispanic/Latino/a, Asian/Pacific Islander, Multiracial/Biracial, and those who endorsed "other".

Cannabis-specific PBS use also varies across gender. Bravo, Anthenien, et al. (2017) examined data from college students who reported past-month cannabis use. For college students who reported low to average use of cannabis-specific PBS, cannabis use frequency was higher specifically for male college students. However, for those who reported greater than average use of cannabis-specific PBS use, cannabis use frequency was higher for female college students (Bravo, Anthenien, et al., 2017). Thus, it appears cannabis-specific PBS may be more protective for men (Bravo, Anthenien, et al., 2017). Similar to alcohol-specific PBS, PBS for cannabis use may be more protective for some college students than others. It is also important to examine if there are differences across gender and race, specifically college students who identify as White or Black, as these students have endorsed using cannabis more than other college students (e.g., Miller et al., 2017).

Gender and Race Disparities in SAM Use

Although still a nascent area of research, prior studies have demonstrated gender and racial differences for SAM use among young adults (e.g., Lee et al., 2022; Patrick et al., 2019) and college student SAM users (White et al., 2019). A review of studies examining SAM use among young adults found that 7 studies examined gender or sex differences in SAM use, noting males typically engage in more SAM use than females (Lee et al., 2022). For example, Patrick et al. (2019) examined data from young adults who were 19 or 20 years old and found that participants who identified as women were less likely to report SAM use than men. White et al.'s (2019) study supported this finding in a sample of college students from three universities; college students who identified as female reported fewer SAM use days than those who identified as male.

Three studies have examined young adult SAM use racial or ethnic disparities, and they found that more White participants tend to engage in SAM use than other races/ethnicities and do so more frequently (for a review, see Lee et al., 2022). For example, Patrick et al. (2019) found that White young adults were more likely to report SAM use than those who identified as Black or Hispanic. Similarly, White et al. (2019) found that college students who identified as White reported more SAM use days than those who identified as Hispanic/Latinx, Asian, or more than one race. However, for both studies (Patrick et al., 2019; White et al., 2019), less than 10% of the samples identified as Black. More research is needed in this area to determine if these are robust and consistent findings among college students, specifically with more representation from students who identify as Black. Gender and racial disparities examinations for SAM-specific PBS use have not been possible due to the absence of an established measure to assess SAM-specific PBS use, but researchers have examined single-substance PBS use

among concurrent users of alcohol and cannabis. Among a sample of college student alcohol and marijuana concurrent users, men reported less PBS use (for both substances) than women (Bravo et al., 2019).

Given the demonstrated history of differences in SAM use among young adults across gender and race, and the differential associations between alcohol and cannabis PBS use and drinking, this area remains under-explored yet critically important to examine for SAM-specific PBS use. The creation of a new SAM-specific PBS measure that is free from bias across gender (woman vs. man) or race (Black vs. White) would greatly facilitate work in this area. Moreover, this area of research is necessary to inform appropriately tailored interventions for SAM use.

PBS Interventions

Because of the strong empirical history of PBS as a proximal indicator of alcohol consumption, PBS are an important component of successful interventions focused on college student drinking behaviors (for reviews, see Peterson et al., 2021; Reid & Carey, 2015). PBS are part of multicomponent interventions that are aimed at reducing use and consequences through different components, such as normative feedback, goal setting, and increasing use of PBS (Peterson et al., 2021). PBS are generally presented as a menu, or list, of options where participants are able to make their own choices about which PBS they choose to use. While some facets of the multi-component interventions address social and cognitive aspects of drinking, PBS address behaviors that can be targeted (e.g., skills training), drawing from Social Cognitive Theory (Bandura, 2004). Interventions can provide knowledge about the risk of substance use and the benefits of using PBS. Additionally, by providing information about specific strategies already used in addition to suggestions for new ones to try, PBS feedback may improve self-efficacy about one's ability to cut back. For example, researchers developed a scale to assess

self-efficacy related to alcohol-specific PBS and found that most participants were moderately confident use multiple PBS while consuming alcohol (Rosenberg et al., 2011).

Alcohol-specific PBS has been integrated into different types of interventions, such as brief motivational interviews, personalized normative feedback, and PBS instruction (Peterson et al., 2021), reliably leading to reductions in drinking and related consequences. PBS may also be specifically targeted as a harm reducing behavior to enhance. For example, Braitman et al. (2022a) examined the effectiveness of personalized normative feedback as a booster two weeks after an online intervention for college. They found that those who received PBS feedback in their booster email did not reduce their use of PBS one month after the intervention, whereas those who only received the intervention or received the intervention and a booster email that did not include PBS feedback (included only norms) reduced their use of PBS (Braitman et al., 2022a). Additionally, Sugarman & Carey (2009) conducted an intervention with college students who reported consuming alcohol in the previous two weeks. Participants were randomized to groups who were instructed to reduce their alcohol intake, increase the number of PBS they used, or a control group. Two weeks after the intervention, participants in the strategy increase group did increase the number of PBS they used (Sugarman & Carey, 2009).

Interventions for cannabis use behaviors among college students have also incorporated cannabis-specific PBS, although this still is a novel area of research. For example, Riggs et al. (2018) examined the effects of an intervention that utilized an adapted version of Marijuana eCHECKUP TO GO (now Cannabis eCHECKUP TO GO; San Diego Research Foundation, 2021). The researchers added the assessment of PBSM (Pedersen et al., 2017) and injunctive norms specific to cannabis (i.e., how much friends approve of cannabis use) to the intervention. Participants were college students who reported recreational cannabis use in the previous two

weeks. Six weeks after the intervention, participants reported less cannabis use compared to those in the control group who did not receive the intervention. Interestingly, female participants in the intervention group reported using more PBS than male participants in the intervention group six weeks after the intervention, underscoring the importance of examining gender differences. Prince et al. (2020) developed a brief intervention that also included using Marijuana eCHECKUP TO GO as one of its components and assessed its efficacy in sample of participants from the larger young adult population (18-25 years old) who endorsed using cannabis at least three times a week. Participants were encouraged to use PBS via a smartphone application (Prince et al., 2020). PBS use was assessed each time participants reported a cannabis use episode over a two-week period. When participants reporting using PBS during a cannabis use episode, lower cannabis use was reported. More research is needed to determine the effectiveness of including PBS in interventions regarding cannabis use behaviors in college students, but research in this area is promising.

Despite the high prevalence of SAM use in emerging adult college students (White et al., 2019) and the evidence of PBS as a successful component in reducing use and harm for alcohol and cannabis, there is not yet a harm reduction assessment specific to SAM use. Greater use and harm may continue to escalate as recreational cannabis use is legalized across states, leaving a critical gap. Understanding how emerging adult college students protect themselves from SAM use-related harm is an important first step to develop a tailored intervention to address high-risk SAM use.

Emerging Adulthood and College Students

College students may be engaging in high-risk SAM use to cope with the developmental, or transitional, nature of emerging adulthood. The majority of college students are in the

developmental period of emerging adulthood (U.S. Department of Education, Institute of Education Sciences, 2022). Proposed by Arnett (2000), “emerging adulthood” is a developmental period defined by those between the ages of 18 and 25 years old. Arnett classifies emerging adulthood as a period of change and identity exploration, which can be related to risky behaviors, such as substance use. Arnett further explored the theory of emerging adulthood and substance use by using the five stages to provide a framework to relate this period to substance use (Arnett, 2005). First is the age of identity exploration, in which emerging adults may use substances to cope with changes in their identity. Second is the age of instability. Similar to the age of identity exploration, emerging adults may use substances as a way to cope with the changes in their lives, such as changes in their living environments, jobs, and romantic partners. Third is the self-focused age, in which emerging adults’ lives are less controlled by parental, or authority, figures, and emerging adults may increase substance use as there is less external control. Fourth is the age of feeling in-between. Emerging adults are in between the stage of adolescence and adulthood. They are able to make more decisions on their own, but still have not reached the responsibilities of adulthood. Thus, they may engage in more risky substance use behavior. Fifth is the age of possibilities, in which emerging adults see time in their lives as a time to experience substance use and may not understand the negative consequences associated with use (Arnett, 2005). This non-recognition of negative consequences is especially important when considering that perception of negative consequences of cannabis use is declining (Substance Abuse and Mental Health Services Administration, 2020). In summary, emerging adulthood is a time of change and instability, in which individuals may be using alcohol and cannabis to cope with the change, show their independence, or experiment before they have more adult-like responsibilities.

Current Study

Previous research has shown that SAM use is prevalent in the college student population (Bravo et al., 2021) and that college students experience more consequences when using alcohol and cannabis simultaneously, rather than on their own (Jackson et al., 2020). PBS use is consistently and robustly linked to reduced harm for both alcohol and cannabis use (Peterson et al., 2021), but this has not been examined for SAM use because a measure of PBS specific to SAM use does not exist. Moreover, researchers have called for more research of PBS for SAM use (Boyle et al., 2021; Bravo et al., 2019). This call is appropriate as PBS are critical for effective interventions (Peterson et al., 2021), and with the widespread legalization of cannabis, more young adults are using alcohol and cannabis simultaneously and experiencing greater consequences than single substance use (e.g., Jackson et al., 2020). Rather than combining the single substance use measures for alcohol and cannabis PBS, using qualitative methods, such as focus groups, will be beneficial to understand PBS college students use to reduce consequences and quantity/frequency specifically for SAM use. Using a qualitative approach will allow for the inclusion of potentially new strategies unique to SAM use that may not be as relevant for single substance use, whereas combining single substance use measures limits the new measure to old strategies. It is also critical to understand if there are gender and race differences in PBS for SAM use, particularly in how SAM-specific PBS relates to SAM use, to tailor interventions as needed. This means a SAM-specific PBS measure is needed that is not biased in its assessment across gender or race.

The current project proposes to develop and validate a Protective Behavioral Strategies for SAM Use Measure (PBS4SAMM) using a fully mixed exploratory sequential dominant status design mixed-methods approach. With this approach, the qualitative and quantitative

components occur consecutively and places more emphasis on the qualitative phase of the study, as it is needed to develop the new measure (Leech & Onwuegbuzie, 2009). The aims of the current project are: (1) develop an empirically-driven measure of PBS for SAM use based on focus groups with SAM users and feedback from experts; (2) psychometrically validate the content and internal structure of the new measure using EFA and CFA, including eliminating items biased across gender or race via measurement invariance testing (quantitative) and (3) examine if the measure is associated with alcohol and cannabis use as well as related consequences. Moreover, examine differences in SAM-specific PBS use among gender and race by a) comparing mean differences in PBS use across groups and b) examining if gender/race moderates the relationship between SAM PBS use and SAM use. It is hypothesized that the new SAM-specific PBS measure will associate with use and consequences over and above existing alcohol-specific and cannabis-specific PBS measures. Moreover, it is hypothesized that women will report greater use of SAM-specific PBS than men and that participants who identify as Black will endorse greater use of SAM-specific PBS than participants who identify as White. Lastly, it is hypothesized that gender and race will not moderate the association between SAM PBS use and SAM use.

CHAPTER II

METHOD

Study 1

Participants

To be eligible to participate in the focus groups, participants needed to be able to read, speak, and understand English, be a current college student between the ages of 18-25 years old, and have participated in SAM use at least monthly and at least twice in the past 30 days. Participants had to agree to have the focus group session recorded. Participants were recruited via the psychology research pool and through student announcements and direct emails to random lists of age-eligible students at Old Dominion University; more emails were sent to men than women to get a balanced sample given the overrepresentation of women in the psychology research pool and that many samples tend to be predominantly women (e.g., Braitman et al., 2022b). A description of the study was included in the advertisements (see Appendix A). Participants were recruited for the focus groups until saturation occurred (i.e., no new information arose; Creswell & Poth, 2018). A total of 28 participants (M_{age} = 20.57, *SD* = 2.33, range = 18-25) participated in the focus groups. Nine focus groups were conducted, with the size of the focus groups ranging from 2-6 participants (*M* = 3.11, median = 2), and on average they last approximately 36 minutes (range = 22.50-55.50 minutes). Two focus groups were in person; seven focus groups were virtual. Participants reported engaging in SAM use at least once a month (*n* = 19) and on average 5.46 days (*SD* = 3.23) in the past 30 days (median = 4.50; see Table 1 for demographics). Focus group participants received either a $30 Amazon e-gift card, which is comparable to a qualitative study with college students (Kim et al., 2022), or research credits (1 credit if they participated online and 1.5 credits if they participated in person).

Participants from the psychology research pool were able to choose their form of compensation whereas those who were not were automatically given the gift card. This study was approved by Old Dominion University's Institutional Review Board and a Certificate of Confidentiality from the National Institutes of Health was secured to further protect participant confidentiality.

Table 1

Qualitative Study Demographics

Variables	*M* (*SD*)
Age	20.57 (2.33)
Past 30-day SAM use	5.46 (3.23)
	n (%)
Gender	
Cisgender woman	20 (71.4)
Cisgender man	8 (28.6)
Race	
White	14 (50.0)
African American/Black	9 (32.1)
Multi-race	3 (10.7)
Asian	1 (3.6)
Another race not listed	1 (3.6)
Hispanic/Latinx	5 (17.9)
Student Status	
Full-time	25 (89.3)
Part-time	3 (10.7)
Class Standing	
Freshman	9 (32.1)
Sophomore	6 (21.4)
Junior	4 (14.3)
Senior	4 (14.3)
Other	1 (3.6)
Frequency of SAM use	
At least once a week	8 (28.6)
At least once a month	20 (71.4)

Note. Racial identity percentages add up to more than 100% because participants could select more than one race.

Procedure

Focus groups took place in person or via Zoom. Both options were offered to participants to be as accessible as possible. Potential participants first took an online screener survey in Qualtrics to assess eligibility. If eligible, they were directed to a scheduling system to sign up for a focus group, where they had their choice of in-person versus virtual meetings (via live video sessions). At the beginning of each focus group, participants provided informed consent (see Appendix B) and I provided the guidelines for the session, such as keeping the information shared in the focus group confidential and that the session will be audio recorded. Consistent with best practices, each focus group was led by two members of the project team (myself and undergraduate research assistants) and started with a demographic survey to confirm eligibility and collect demographic information (Appendix C). Then a list of open-ended questions and a semi-structured interview format (Creswell & Poth, 2018; Appendix D) were used to conduct the focus group. The pre-determined list of open-ended questions were developed based on a review of the alcohol and cannabis PBS literature and input and guidance of an expert panel of SAM and alcohol and cannabis PBS researchers (see Appendix E) as well as undergraduate research assistants. The research team (undergraduate research assistants and myself) transcribed the interviews, and all transcriptions were verified by me. Based on these transcriptions, items were developed for the new PBS4SAMM measure. A draft of these items was circulated to the expert panel, who provided feedback and suggestions. Based on this feedback, the items were modified.

Materials

Simultaneous Alcohol and Cannabis Use. To assess eligibility based on SAM use, participants were asked two questions: “How often in the past 30 days did you use alcohol and marijuana at the same time so that their effects overlapped?” and “How frequently do you use

alcohol and marijuana at the same time so that their effects overlap?" (see Appendix G). This style of question has been used in previous research (e.g., White et al., 2019). This definition of SAM use has been recommended based on a recent review of young adult SAM use (Lee et al., 2022).

Demographic Information. Participants were asked basic demographic questions, such as age, gender, race, and student status (Appendix C).

Focus Group Questions. An ice breaker was used at the beginning of the focus groups to ensure that each participant felt comfortable speaking during the session. Then participants were asked about the terminology they have heard or used for cannabis/marijuana and SAM use. To make sure everyone was on the same page, definitions of these words were reviewed. Next, participants were asked about the order of use, type of alcohol and cannabis used during single substance and SAM use, and motives for SAM use. Then participants were asked about the context and consequences of SAM use. The next set of items focused specifically on strategies participants used to reduce or limit use or unwanted consequences of SAM use. These questions were broken up by before, during, and after use. Participants were also asked about alternatives to SAM use and if there were other strategies they have heard about but had not tried. Lastly, we asked participants if there was anything else they wanted to talk about related to SAM use. See Appendix D for the full script.

Study 2

Participants

A total of 266 eligible participants were recruited for this study. To be eligible for the cross-sectional quantitative study, participants needed to be current college students between the ages of 18-25 years old who have participated in SAM use at least monthly and at least twice in

the past 30 days. Participants had to be able to read, speak, and understand English, reside in the United States, and could not have participated in the focus groups. Participants were recruited nationally via MTurk using the CloudResearch Mturk Toolkit (CloudResearch approved and traditional [not approved] participants), Prolific, and Connect by CloudResearch; they were also recruited through the institution's psychology research pool. A description of the study was included in all advertisements (see Appendix F). In MTurk, participants had to have a task approval rating of greater than 95% and have completed more than 50 tasks. CloudResearch approved participants in Mturk had additional vetting by CloudResearch to identify participants who provide high-quality data (Prime Research Solutions LLC, 2024), though traditional Mturk participants without additional vetting were also included. The majority of participants identified as cisgender women (53%), White (71.8%), and enrolled as college students full-time (84.2%; see Table 2 for detailed demographic information). Participants were compensated the minimum allowed for each platform. All participants received compensation for the screening survey ($0.15 for MTurk and Connect; $0.27 for Prolific). To be compensated for the main survey, participants had to retain their eligibility and provide plausible responses ($2 for MTurk and Connect; $2.98 for Prolific). Psychology research pool participants who were eligible were compensated with 0.5 research credits.

Table 2

Quantitative Study Demographics

Variables	*M* (*SD*)
Age	22.57 (2.99)
	n (%)
Gender	
Cisgender woman	141 (53.0)
Cisgender man	103 (38.7)
Transgender man	6 (2.3)
Transgender woman	3 (1.1)
Nonbinary	11 (4.1)
Another gender not listed	2 (0.8)
Race	
White	191 (71.8)
African American/Black	25 (9.4)
Multi-race	21 (7.9)
Asian	19 (7.1)
Middle Eastern/North African	2 (0.8)
Native American	2 (0.8)
Native Hawaiian or other Pacific Islander	1 (0.4)
Another race not listed	5 (1.9)
Hispanic/Latinx	33 (12.4)
Student Status	
Full-time	224 (84.2)
Part-time	41 (15.4)
Class Standing	
Freshman	36 (13.5)
Sophomore	29 (10.9)
Junior	86 (32.3)
Senior	71 (26.7)
Graduate	40 (15.0)
Other	4 (1.5)

Note. Racial identity percentages add up to more than 100% because participants could select more than one race.

Procedure

Participants were first directed to the informed consent form that provided more information about the study, as well as contact information if the participants had any questions or concerns. Once participants provided consent, they completed an online screening survey via Qualtrics. All nationally-recruited participants were provided with a randomized completion code to enter into the crowdsource platform to confirm they completed the screening survey. Eligible participants who were interested in participating in the main study were either given a password and directed to the HIT for the main survey or directly invited to the main survey via a message in the crowdsource platform. After providing informed consent for the main survey, participants completed the survey via Qualtrics. At the end of the survey participants were provided with a randomized completion code to enter in to the crowdsource platform to confirm they completed the main survey.

Materials

Alcohol and Cannabis Use. Participants' alcohol use was assessed using a modified version of the Daily Drinking Questionnaire (Collins et al., 1985), in which they were asked to report their typical weekly drinking behavior in the past three months. Participants were directed to select the number of drinks they typically drink on each day of the week, and the number of hours they typically spend drinking (see Appendix G). Typical quantity (number of standard drinks per week) and frequency (number of drinking days per week) were calculated.

Participants also reported their typical weekly cannabis use behavior in the past 30 days using the Marijuana Use Grid, in which they will be asked to report the number of times they used cannabis during each day in a typical week (broken down into six 4-hour time blocks per

day; Pearson et al., 2017; See Appendix H). Typical quantity (number of grams per week) and frequency (number of use days per week) were calculated.

Simultaneous Alcohol and Cannabis Use. To assess eligibility based on SAM use, participants were asked two questions: "How often in the past 30 days did you use alcohol and marijuana so that their effects overlapped?" and "How frequently do you use alcohol and marijuana so that their effects overlap?" To assess frequency of use for analyses, participants were asked, "How many days in the past 3 months did you use alcohol and marijuana so that their effects overlapped?" (see Appendix I). This style of question has been used in previous research (e.g., White et al., 2019). This definition of SAM use has been recommended based on a recent review of young adult SAM use (Lee et al., 2022) and was modified based on feedback from the expert panel of researchers in the field to remove "at the same time".

Protective Behavioral Strategies. Cannabis PBS use was assessed using the 13-item Protective Behavioral Strategies for Marijuana - Short Form (PBSM-SF; Mian et al., 2021; Pedersen et al., 2017; see Appendix J). Participants were asked to "indicate the degree to which you engage in the following behaviors when using marijuana/cannabis" from 0 = *never* to 5 = *always*. One item ("Buy less marijuana at a time so you smoke less") was dropped from the current study because of an error (incorrect wording in the survey). The two-factor scale had adequate internal consistence (Quantity – $\alpha = 0.82$; Context – $\alpha = 0.73$).

The Protective Behavioral Strategies Scale-20 (PBSS-20; Treloar et al., 2015) was used to assess alcohol use PBS (see Appendix K). On a scale of 0 = *never* to 5 = *always*, participants were asked to "indicate the degree to which you engage in the following behaviors when using alcohol or 'partying'" (Martens et al., 2005; Treloar et al., 2015). The PBSS-20 subscales had adequate internal consistency (Serious Harm Reduction - $\alpha = .78$; Limiting Drinking - $\alpha = .82$;

Manner of Drinking - α = .80). Both single-substance PBS measures have been used to assess PBS in college student samples who reported using both alcohol and cannabis (e.g., Bravo et al., 2019).

The newly-created PBS4SAMM was used to assess SAM use PBS (see Appendix L). There were two sets of instructions. The first set of instructions were for the first 19 items (strategies used during SAM use). On a scale of 0 = *never* to 6 = *always*, participants were first asked:

"The following questions are about using alcohol and cannabis such that their effects overlap, sometimes called being 'cross-faded,' and below called 'simultaneous use'. 'Cannabis' is any product that contains THC used in any way (for example, weed, flower, bud, marijuana, carts, oils, or other products containing THC that are smoked, eaten, vaped, applied to skin, or used in any way). Thinking back over the past 3 months, when you used alcohol and cannabis such that their effects overlap, how often did you use the following strategies to reduce or limit use or unwanted consequences (e.g., a hangover)"

The instructions for the next six items (strategies used as an alternative to SAM use) were as follows:

"The following questions are about when you had the opportunity to use alcohol and cannabis such that their effects overlap, sometimes called being 'cross-faded', and below called 'simultaneous use'. 'Cannabis' is any product that contains THC used in any way (for example, weed, flower, bud, marijuana, carts, oils, or other products containing THC that are smoked, eaten, vaped, applied to skin, or used in any way). Thinking back over the past 3 months, when you had the opportunity to use alcohol and cannabis such that their effects overlap, how often did you use the following strategies instead of simultaneously using these substances:"

Consequences. Consequences of SAM, alcohol-only, and cannabis-only use were assessed for the previous 3 months using a modified measure that allowed respondents to differentiate consequences experienced during simultaneous use of both substances versus use of one substance alone (Jackson et al., 2020; Appendix M). For example, participants were asked to select if a consequence (e.g., "My school work has suffered because of my use") occurred "because of [their] alcohol use alone, [their] marijuana use alone, and/or because of using alcohol and marijuana together so that their effect overlapped" (Jackson et al., 2020, p. 4). The sum of the consequences specific to SAM use, alcohol use only, and cannabis use only were calculated and these items had good internal consistency (α = .86-.89).

Depression. The Center for Epidemiological Studies Depression (CESD-10) scale (Andresen et al., 1994) was used to assess depression to examine discriminant validity (Appendix O). Participants were asked to rate each mood or symptom (e.g., "I felt depressed") on a scale from 0 = *none of the time* to 3 = *most of the time* (Andresen et al., 1994). Items 5 ("I felt hopeful about the future") and 8 ("I was happy") were reversed scored. The CESD-10 had good internal consistency (α = .86).

Social Desirability. The Marlowe-Crowne Social Desirability Scale (SDS; Crowne & Marlowe, 1960) was used to assess social desirability to determine if participants were answering truthfully (Appendix P). Participants were asked to rate each item about personal attitudes and traits as either true or false in regards to how it pertains to them (Crowne & Marlowe, 1960). The SDS had adequate internal consistency (α = .70).

Demographic Information. Participants were asked basic demographic questions, such as age, gender, race, and student status (Appendix Q).

Attention and Plausible Data Checks. Three attention checks were in the survey (Appendix R). Participants were randomized to either receive feedback on the first attention check if they answered it incorrectly, or not. If they were in the group that received feedback, participants needed to answer the attention check correctly before moving on to the next question.

Additional questions were also added to check for plausible answers. Age was asked at the beginning of the demographic question section. At the end of the section, participants were asked to enter the year they were born. Participants were also asked which state they currently live in. If the year they were born and they age they submitted did not align, or they answered the state question with anything other than a state, then they were deemed ineligible for the study.

Data Analysis Approach

Study 1 (Aim 1)

Content analysis was conducted to identify items for the new PBS measure from the focus group recordings and transcripts. A directed content analysis approach was used, which allowed for existing theory and prior research to guide the identification of strategies (Hsieh & Shannon, 2005). I reviewed the transcripts, specifically looked for strategies that students used to decrease consequences or quantity/frequency of SAM use. Using the data from the focus groups, as well as previous literature, measures on PBS of alcohol and cannabis single substance use, and the guidance of the expert panel of researchers, I developed the PBS4SAMM. I invited researchers who have experience in developing and validating PBS measures, as well as those who have extensively published studies examining SAM use in college students. After a draft of the new measure was developed, the expert panel of SAM and alcohol and cannabis PBS researchers reviewed this draft. The expert panel was asked for feedback on the items themselves

(if any should be removed or if they believed any strategies were missed), if the wording of the item itself should be modified, and if the instructions for the measure should be modified (Zhou, 2019). I reviewed the feedback provided by the expert panel and modified the measure as appropriate.

Study 2 (Aims 2 and 3)

Exploratory Factor Analysis (Aim 2). To examine the internal structure of the new measure, an EFA was conducted. An EFA was chosen over principal components analysis as the goal of this study was to identify latent constructs distinguishing between common and unique variance among the variables (Fabrigar et al., 1999; Park et al., 2002). First, the number of factors within the new measure were identified and extracted. Based on recommendations/best practices, the type of factor extraction method was determined by the distribution of the data (Costello & Osborne, 2005; Fabrigar et al., 1999). Principal (axis) factor extraction was used because data were not normally distributed (Fabrigar et al., 1999). The number of factors to retain was decided by examining eigenvalues (and associated scree plots), variance explained, parallel analysis, and Velicer's minimum average partial procedure (Costello & Osborne, 2005; Boateng et al., 2018). Next, factor rotation using oblique rotation was conducted because the factors were correlated (Costello & Osborne, 2005). It was anticipated the factors would be correlated, given the performance of substance-specific PBS measures. Then, factor loadings for each item were examined and interpreted to ensure they were theoretically sound. If items had a low factor loading, or crossloaded on more than one factor, then the item was dropped (Costello & Osborne, 2005). Each time an item was dropped, the EFA was re-analyzed. Factors must have had at least three items to be retained (Costello & Osborne, 2005).

Confirmatory Factor Analysis (Aim 2). With the second sub-sample from the cross-sectional survey (approximately $N = 400$, see power analysis below), a CFA was planned to test dimensionality of the new measure based on the results of the EFA. Evaluations of goodness of model fit would be based off of recommendations (Hu & Bentler, 1999). The standardized factor loadings and their associated confidence intervals for each item would also be examined (Kline, 2016), and modifications indices would be explored for suggested adjustments that make theoretical sense. Note, a sufficient sample size was not recruited to include the CFA analyses, so these were dropped.

Measurement Invariance Testing (Aim 2). After a good-fitting model was established, measurement invariance testing using a structural equation modeling framework was planned to be conducted for gender (men vs. women, excluding cases that endorse other identities) and race (Black vs. White, excluding cases that endorse other identities or more than one identity). Three levels of invariance would be tested: configural, metric, and scalar. Given oversensitivity of chi-square comparisons to sample size, alternative fit indices (e.g., ΔRMSEA) would be used to examine model fit at each test of invariance using Chen's (2007) recommendations for sample sizes greater than 300. If items were identified as varying across gender or race, they would be dropped. Similarly, a sufficient sample size was not obtained, so these comparisons were dropped.

Validity (Aim 3). Validity examinations used the full sample. Criterion validity was examined using correlations between the new PBS4SAMM and both SAM use (modified from Jackson et al., 2020; White et al., 2019) and SAM consequences (Jackson et al., 2020). Discriminant validity was examined using sets of correlations between the new PBS4SAMM and the CESD-10 (Andresen et al., 1994). Correlations for alcohol PBS use (Treloar et al., 2015),

cannabis PBS use (Mian et al., 2021), and the new PBS4SAMM with use of alcohol alone (quantity and frequency), cannabis alone (quantity and frequency), and SAM use (frequency) as well as alcohol consequences, cannabis consequences, and SAM consequences were examined. Finally, multiple regressions were conducted with all PBS use as predictors of SAM use (first regression) and SAM consequences (second regression) to assess incremental prediction of the new measure.

Comparison of Means and Moderation Analyses (Aim 3). Individual sample *t*-tests were conducted to compare SAM-specific PBS use across gender (cisgender women and cisgender men) and race (participants who identified as White and participants who identified as Black). Other gender and racial identities were not included due to low endorsement. Moderation analyses within a regression framework were also conducted to examine if gender and/or race moderated the association between SAM-specific PBS use and SAM use and consequences. These analyses were conducted in Mplus using syntax from Stride et al. (2015).

CHAPTER III

RESULTS

Study 1 (Aim 1)

The results of the content analysis found that some strategies discussed in the focus groups were similar to single substance use, but others were specific to SAM use. For example, participants discussed strategies that can be used for single use such as eating a meal or staying hydrated, and strategies specific to SAM use such as limiting their use of one or both substances because of both substances being used and order of use. Order of use was asked before asking about PBS specifically, but some of the reasons why they used a certain substance first was sometimes related to wanting to reduce negative consequences. Order of use varied across participants, with about half of participants endorsing using cannabis first. Five participants discussed that cannabis use was something that they typically used daily, whereas they do not use alcohol daily. Other participants stated that they would start with drinking alcohol, then use cannabis (smoking), with three participants saying using cannabis helped them to “calm down” or “cool down” after drinking. Items were considered for the draft of the new measure based on if they were endorsed multiple times within or across the focus groups, if they were unique strategies to SAM use, or they were strategies that were previously established in single substance use measures. For example, eating or staying hydrated was endorsed across multiple groups, as was spacing and/or limiting use of the second substance they use. Six participants mentioned that they would space out their consumption of alcohol if they had already been using cannabis. Five participants said that they would limit their use of cannabis if they had already been drinking and four mentioned limiting their alcohol consumption if they had already been using cannabis. Additionally, order of use was included as an item as this is a unique strategy for

SAM use, as some participants stated that they used a specific substance first to reduce the consequences of use. Items that were similar to strategies in single substance use measures but were also discussed in at least one focus group included only using alcohol and cannabis from a trusted source (similar to a PBSM [Pedersen et al., 2016] item), and listening to your body/check in with yourself to know when to stop using alcohol and cannabis (similar to a SQ [Sugarman & Carey, 2007] item). Items were not considered even if they were discussed multiple times if they were not theoretically sound based on previous literature or knowledge regarding the effects of substance use, included taking a bath/shower at the end of the night, making themselves throw up if they feel bad, or regretting that they did it and say they won't do it again.

These results, as well as a literature review of PBS for single substance use, informed the development of the PBS4SAMM. The original draft of the measure that was sent to the expert panel of researchers for review had 17 items for strategies used during SAM use occasions and five items for alternatives to SAM use. The response scale proposed was from 1 = *Never* to 6 = *Always*. Feedback was received from six researchers in the field of PBS and/or SAM use. Suggestions from the expert panel included updating the instructions for both sets of items. For example, it was suggested to assess past 3-month use instead of past 30 days as the sample assessed may not engage in SAM use frequently in 30 days, and adding a point on the response scale (*almost always*). Additionally, it was suggested to remove "at the same time" from the instructions to provide more clarity around the definition of SAM use (indicating respondents sometimes misunderstand and think use of both substances must be initiated within a very short window), focusing more on the overlapping effects. It was also suggested to move items about limiting SAM use (e.g., "Limit the number of days you use alcohol and cannabis simultaneously") to the alternatives to SAM use section. Expert panelists also suggested more

items to include and adding items from previous PBS measures, such as, “Drinking non-alcoholic beverages to slow down the use of alcohol and cannabis”). The final measure included 25 items, 19 assessing strategies used during SAM use occasions and six items assessing alternatives to SAM use (see Appendix L).

Study 2 (Aims 2 and 3)

Power and Sample Size Considerations

Based on recommendations for EFA sample sizes by Kahn (2006), I aimed to recruit 300 participants for the EFA. Assuming no more than 30 items were included in the survey, this met or surpassed several other EFA power recommendations (Boateng et al., 2018). Given prior psychometric work with PBS for single-substance use, high communalities, no more than 3 dimensions suggesting several items per dimension, and strong factor loadings were anticipated (e.g., Martens et al., 2005; Sugarman & Carey, 2007; Treloar et al., 2015), suggesting a larger sample than this was not necessary or beneficial. I attempted to recruit an additional 400 participants for the CFA and subsequent measurement invariance examinations across race and gender (Meade & Bauer, 2007). The full sample of 700 participants (combining the EFA and CFA samples) were to be used for the validation analyses. Specifying a power of .80 and alpha of .05, a power examination in G*Power (Faul et al., 2007) indicated 700 participants is more than enough to detect even small associations. Due to limitations in recruiting participants for this study, after expanding recruitment across multiple crowdsource platforms, the number of participants to conduct the CFA and measurement invariance analyses was not reached. A sample of size of 264 participants (two participants were missing an item in the PBS4SAMM) was used to conduct the EFA analyses and the validation analyses. This sample size still met the recommendation of 10 participants per item by Kahn (2006) given the measure used contained

25 items; however, the comparison of means and moderation analyses may not be sufficiently powered.

Data Cleaning

All analyses for Study 2 were conducted in Mplus or SPSS. Before conducting the EFA, the normality of each item for the PBS4SAMM was examined (skewness, kurtosis, and histograms). Although all items exhibited acceptable skewness and kurtosis, items 4, 11, and 17 did not have normal distributions as shown by the shape of the histograms (e.g., they appeared bimodal). Additionally, two participants were removed from the EFA analyses via listwise deletion for not fully completing the measure.

Histograms, skewness, and kurtosis statistics were used to examine the normality of the data for the validation analyses. The distributions for typical alcohol quantity and typical cannabis quantity were mildly positively skewed, so they were transformed using a square root transformation. Typical cannabis frequency was dichotomized to 0 = *less than daily* and 1 = *daily* as over 50% of participants answered that they participated in cannabis use daily. Boxplots were used to assess outliers, using the guideline of three interquartile ranges from the interference. Past 3-month SAM use had eight outliers that were Winsorized, maintaining rank. Linearity was also assessed for the regressions by examining scatterplots of the outcomes (past 3-month SAM use and SAM consequences) and predictor (PBS4SAMM). All scatterplots appeared linear. Table 3 lists the study variables descriptives.

Table 3

Descriptives for Study Variables

Variables	*M* (*SD*)
Past 3-month SAM use Frequency	11.33 (10.83)
Typical Past 3-month Weekly Alcohol Quantity	15.65 (13.30)
Typical Past 3-month Weekly Alcohol Frequency	4.20 (1.98)
Typical Past 3-month Weekly Cannabis Quantity	7.88 (10.48)
Typical Past 3-month Weekly Cannabis Frequency	5.32 (2.12)
PBS4SAMM Limiting	28.87 (10.98)
PBS4SAMM Planning	21.48 (5.69)
PBS4SAMM Alternatives	11.82 (4.57)
PBS4SAMM Total	71.72 (19.05)
PBSS-20 SHR	29.44 (6.51)
PBSS-20 LD	19.55 (7.41)
PBSS-20 MOD	13.56 (5.62)
PBSS-20 Total	39.03 (10.78)
PBSM-SF Q	14.58 (5.75)
PBSM-SF C	24.44 (6.09)
PBSM-SF Total	39.03 (10.78)
CESD	12.24 (6.41)
SDS	15.31 (4.67)

Note. SAM = simultaneous alcohol and marijuana/cannabis, PBS4SAMM is the new measure of protective behavioral strategy use specific to SAM, PBSS-20 = Protective Behavioral Strategy Scale-20 (Treloar et al., 2015), SHR = serious harm reduction, LD = limiting drinking, MOD = manner of drinking, PBSM-SF = Protective Behavioral Strategies for Marijuana Short Form (Mian et al., 2021), Q = quantity, C = context, CESD = Center for Epidemiological Studies Depression scale (Andresen et al., 1994), SDS = Social Desirability Scale (Marlowe-Crowne scale; Crowne & Marlowe, 1960). Frequency for SAM, alcohol, and cannabis use reflects days. Quantity for alcohol use reflects number of standard drinks. Quantity for cannabis use reflects grams.

Statistical Analyses for Aim 2

All EFAs were conducted in SPSS. Because of the non-normality of the data, principal (axis) factor extraction was used (Fabrigar et al., 1999). Based on the eigenvalues (>1), the results suggested that five factors should be retained (Table 4). However, the associated scree plot suggested retaining four factors (Figure 1). The results from the total variance explained suggested that two factors explained the most variance (Table 4), with only small incremental variance explained beyond that. In addition, Velicer's minimum average partial procedure (using SPSS code from O'Connor, 2000) was conducted, which suggested retaining three factors. Lastly, parallel analysis was conducted (using SPSS code from O'Connor, 2000), however, the results were inconclusive, as the eigenvalues from the random data were all below 1.0.

Figure 1

PBS4SAMM – 25 Item Scree Plot

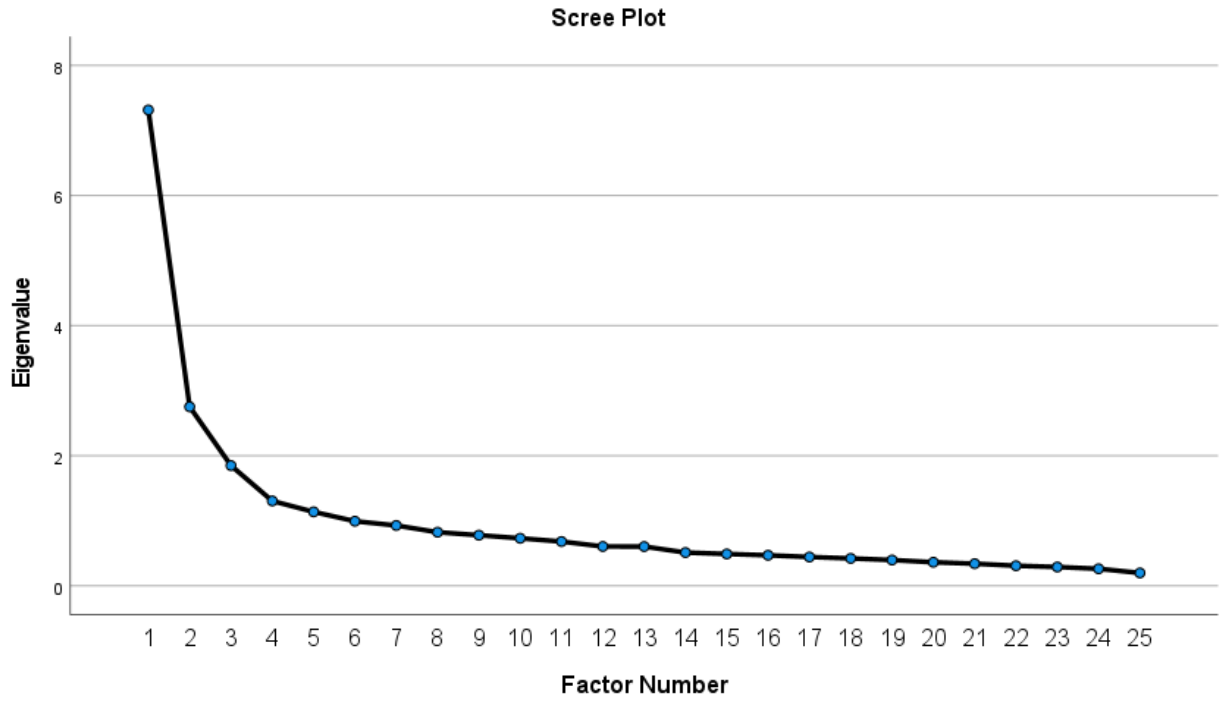

Table 4

Eigenvalues for PBS4SAMM – 25 Items

Factor	Eigenvalue	% of Variance	Cumulative %
1	7.32	29.26	29.26
2	2.75	11.01	40.27
3	1.85	7.40	52.89
4	1.31	5.22	57.44
5	1.14	4.55	61.41

Next, a Promax oblique rotation was used to examine the two, three, four, and five factor solutions. An oblique rotation allows the factors to correlate (Costello & Osborne, 2005), as expected with these factors. The pattern matrix was examined for each factor model for conceptual consistency, including if the "alternatives to SAM use" items were distinct from the items used during SAM use, and if the items used during SAM use were similar to one another within factor. The four- and five-factor solutions had items from the alternatives to SAM use items (e.g., participate in a hobby) loading onto different factors from each other. Additionally, the items that did load onto the same factor did not align with each other conceptually. The three-factor solution kept most of the alternatives to use items together, with item 4 being dropped for not loading onto a factor (factor loading was less than 0.32; Tabachnick & Fidell, 2001, as cited in Costello & Osborne, 2005). The two-factor solution kept the alternatives to SAM use items loading onto the same factor, but other items also loaded onto this factor that did not align conceptually. Based on this information, I decided to move forward with testing the three-factor model further, which displayed the most conceptual consistency.

Item 4 was removed because it had all low factor loadings, and items 1, 5, 6, and 24 were removed for cross loading onto multiple factors (i.e., factor loadings were greater than .32 on more than one factor; Tabachnick & Fidell, 2001, as cited in Costello & Osborne, 2005). An EFA without rotation was conducted again with the remaining 20 items. The eigenvalues (>1) suggested a four-factor solution (Table 5), with the scree plot suggesting a three-factor solution (Figure 2). Velicer's minimum average partial procedure suggested a three-factor solution based on the original (1976) test and a two-factor solution based on the revised (2000) test. Because of the previous reasons, a three-factor solution was examined with Promax oblique rotation. All items for the three-factor solution had adequate factor loadings and did not cross load (Table 6).

However, two items did not fit conceptually with their own factors: item 2 and item 3. The factors suggested could be classified as Limiting/restricting (items 8, 11, 14, 15, 16, 17, 18, 19, 25), Planning (items 2, 7, 9, 10, 12, 13), and Alternatives to SAM use (items 3, 20, 21, 22, 23). Item 2 (“Drink water after simultaneous use”) did not fit conceptually with other items in the Planning factor (e.g., “Plan ahead to stay where you are or how to get home at the end of the night safely”). Similarly, item 3 (“Drink non-alcoholic beverages to slow down the use of alcohol or cannabis”) did not fit conceptually with other items in the Alternatives to SAM use factor (e.g., “Go for a walk, run, or other form of exercise”). These two items were removed and the EFA was tested again.

Table 5

Eigenvalues for PBS4SAMM – 20 Items

Factor	Total	% of Variance	Cumulative %
1	6.23	31.16	31.16
2	2.50	12.52	43.68
3	1.50	7.48	51.16
4	1.11	5.54	56.70

Figure 2

PBS4SAMM – 20 Item Scree Plot

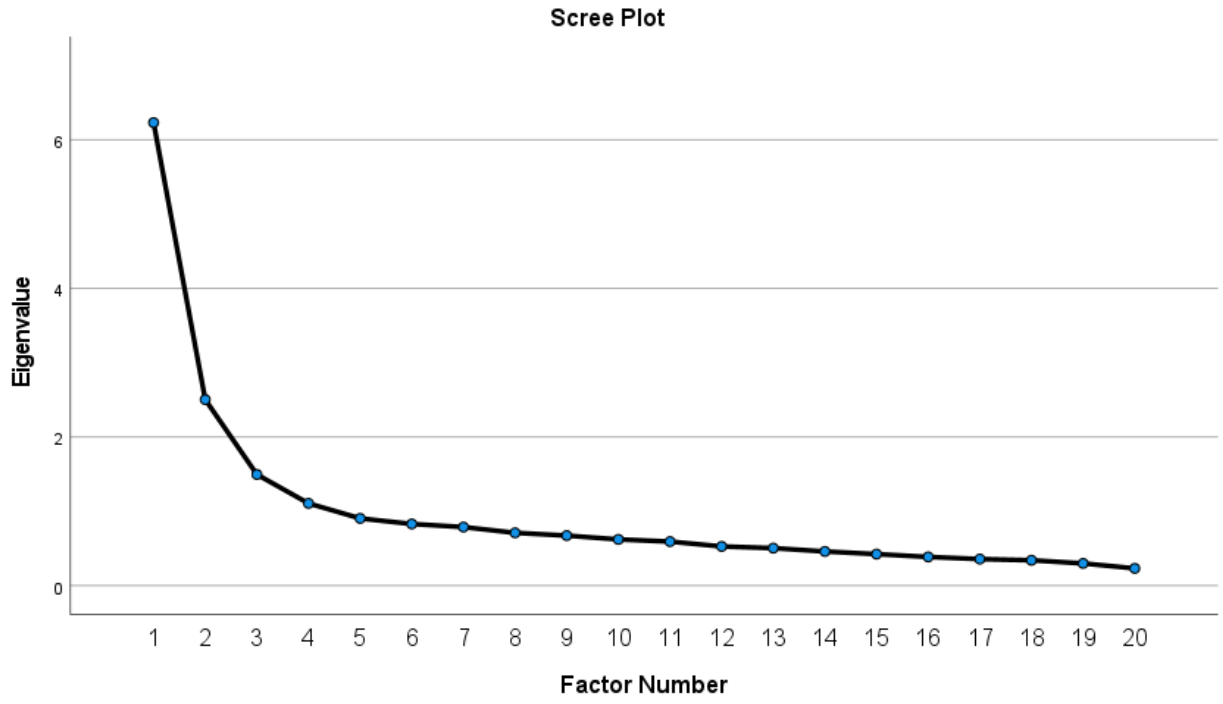

Table 6

PBS4SAMM Factor Loadings – 20 Items

Items	Limit/Restrict	Planning	Alternatives to SAM Use
2. Drink water after simultaneous use	-.180	**.579**	.133
3. Drink non-alcoholic beverages to slow down the use of alcohol or cannabis	.125	.191	**.342**
7. Plan ahead to stay where you are or how to get home at the end of the night safely	-.062	**.683**	.074
8. Set a specific time to stop using alcohol and cannabis	**.749**	-.136	.019
9. Plan ahead to make sure you are in a safe place during use	.165	**.520**	.015
10. Be with people who will watch out for you	.155	**.634**	-.077
11. Tell someone your limit of alcohol and/or cannabis use	**.619**	-.054	.154
12. Listen to your body/check in with yourself to know when to stop using alcohol and cannabis	.095	**.688**	.008
13. Only use cannabis and alcohol that are from a trusted source	-.001	**.673**	-.052
14. Have at least one friend with you who is not drunk or high	**.619**	-.007	.070
15. Set a limit for how much alcohol you plan to drink and/or how much cannabis you plan to use	**.935**	-.106	-.106
16. Avoid trying to keep up with or out do others	**.554**	.202	-.132
17. Avoid using certain types of alcohol and cannabis (e.g., not edibles, not liquor)	**.582**	.032	.068
18. Use only when in a good headspace (e.g., not feeling emotional)	**.560**	.092	.042
19. Keep track of how much alcohol and cannabis you use	**.560**	.222	-.082
20. Participate in a hobby	.091	-.096	**.754**
21. Watch TV, movies, or videos on social media	-.220	.196	**.698**
22. Go for a walk, run, or other form of exercise	.227	-.212	**.564**
23. Choose to only use one substance (alcohol or cannabis)	.160	.121	**.380**
25. Limit the number of days you use alcohol and cannabis simultaneously	**.372**	.130	.130

The final EFA model was tested with the remaining 18 items. The eigenvalues (>1) suggested a four-factor solution (Table 7). The scree plot suggested retaining a three-factor solution (Figure 4). Velicer's minimum average partial procedure suggested a three-factor solution based on the original (1976) test and a two factor solution based on the revised (2000) test. The three-factor solution was tested again using Promax oblique rotation. All items had adequate factor loadings, there were no cross-loadings, and items were conceptually consistent with their factors (Table 8). Although items 4 ("Purposefully choose the order of what you use first [in other words, choosing specifically to use alcohol then cannabis, or cannabis then alcohol])", 5 ("Limit the amount of alcohol and/or cannabis you use"), and 6 ("Pace yourself by spacing out the use of alcohol and cannabis") did not load onto a factor, they were kept for the total score examinations as they were conceptually important items for PBS for SAM use.

Table 7

Eigenvalues for PBS4SAMM – 18 Items

Factor	Total	% of Variance	Cumulative %
1	5.95	33.04	33.04
2	2.37	13.17	46.21
3	1.37	7.63	53.85
4	1.09	6.40	59.89

Figure 3

PBS4SAMM – 18 Item Scree Plot

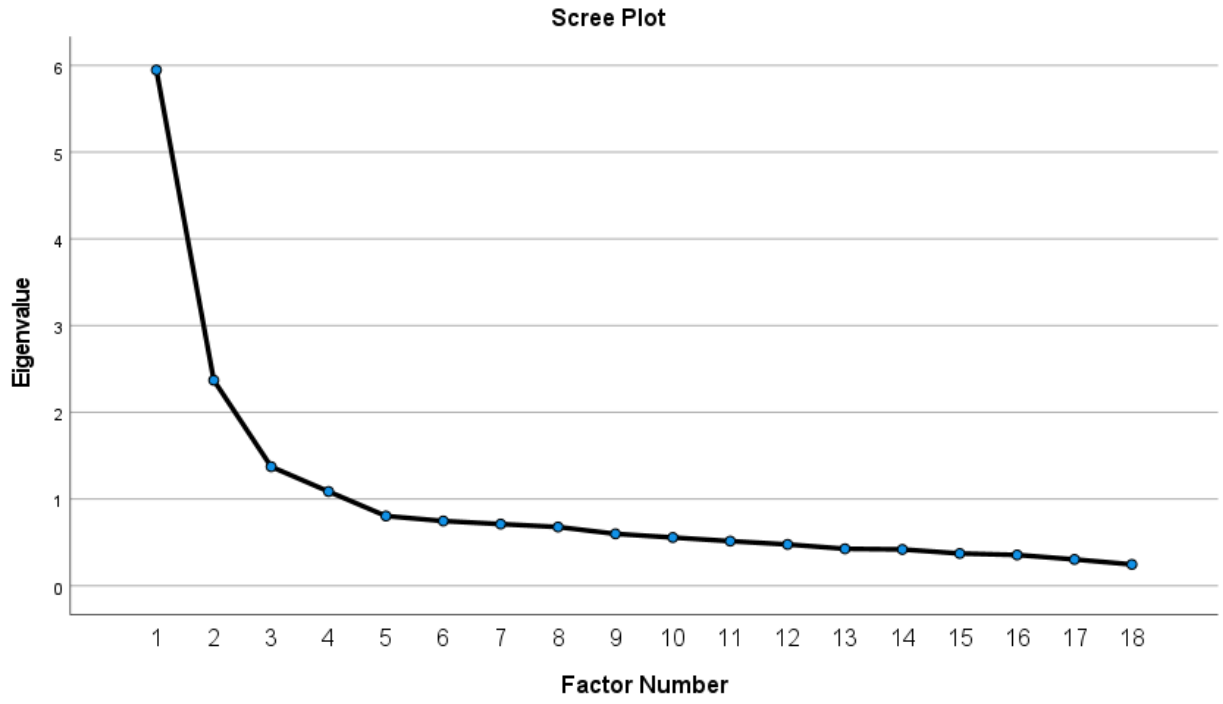

Table 8

PBS4SAMM Factor Loadings – 18 Items

Items	Limit/ Restrict	Planning	Alternatives to SAM Use
4. Purposefully choose the order of what you use first (in other words, choosing specifically to use alcohol then cannabis, or cannabis then alcohol)	-	-	-
5. Limit the amount of alcohol and/or cannabis you use	-	-	-
6. Pace yourself by spacing out the use of alcohol and cannabis	-	-	-
7. Plan ahead to stay where you are or how to get home at the end of the night safely	-.105	**.719**	.103
8. Set a specific time to stop using alcohol and cannabis	**.723**	-.099	.030
9. Plan ahead to make sure you are in a safe place during use	.099	**.582**	.067
10. Be with people who will watch out for you	.128	**.648**	-.055
11. Tell someone your limit of alcohol and/or cannabis use	**.625**	-.035	.120
12. Listen to your body/check in with yourself to know when to stop using alcohol and cannabis	.092	**.674**	.020
13. Only use cannabis and alcohol that are from a trusted source	-.030	**.688**	-.022
14. Have at least one friend with you who is not drunk or high	**.629**	-.002	.042
15. Set a limit for how much alcohol you plan to drink and/or how much cannabis you plan to use	**.886**	-.052	-.082
16. Avoid trying to keep up with or out do others	**.571**	.179	-.146
17. Avoid using certain types of alcohol and cannabis (e.g., not edibles, not liquor)	**.623**	.008	.020
18. Use only when in a good headspace (e.g., not feeling emotional)	**.561**	.109	.028
19. Keep track of how much alcohol and cannabis you use	**.541**	.241	-.079
20. Participate in a hobby	.100	-.066	**.790**
21. Watch TV, movies, or videos on social media	-.220	.219	**.735**
22. Go for a walk, run, or other form of exercise	.284	-.213	**.500**
23. Choose to only use one substance (alcohol or cannabis)	.216	.096	**.330**
25. Limit the number of days you use alcohol and cannabis simultaneously	**.409**	.111	.082

Note. Items 4, 5, and 6 were not included in this factor analysis, but were included in the total score.

Statistical Analyses for Aim 3

On average, participants reported engaging in SAM use 11 days in the previous 3 months. Participants reported drinking alcohol on 4 days in a typical week in the previous 3 months and consumed on average 15.65 standard drinks in a typical week in the previous 3 months, and used cannabis on 5 days of a typical week and on average used 8 grams in a typical week over the previous 3 months. Correlations among all study variables can be found in Table 9. Criterion validity was not established for all subscales of the PBS4SAMM and SAM use outcomes. Although the PBS4SAMM Planning subscale was not significantly correlated with SAM use, it was significantly negatively correlated with SAM consequences. Alternatively, the PBS4SAMM Limiting subscale was significantly correlated with SAM use, but not SAM consequences. The PBS4SAMM Alternatives subscale was significantly negatively correlated with both SAM use, and SAM consequences. The total score for the PBS4SAMM was negatively significantly correlated with SAM use, but not SAM consequences.

Discriminant validity was established for the Limiting and Planning subscales, as well as the total score of the PBS4SAMM, as all did not have a significant correlation with depression. However, the correlation between the Alternatives subscale and depression was significant.

Similarly, findings were mixed regarding if the associations between the PBS measures and their own substances were stronger than across other substances. The PBS4SAMM Limiting subscale had a stronger association with SAM use than with alcohol use or cannabis use; however, the association with alcohol consequences was stronger than the association with SAM consequences. The PBS4SAMM Planning subscale had a stronger association with alcohol use and cannabis use than SAM use (not significantly correlated), but the association with SAM consequences was stronger than with alcohol or cannabis consequences. The PBS4SAMM

Alternatives subscale had a weaker association with SAM use than with alcohol or cannabis use, and the association with SAM consequences was weaker than with cannabis consequences. The PBS4SAMM total score was not significantly correlated with alcohol use or cannabis use. However, it was significantly correlated with alcohol consequences and not SAM consequences.

The PBSS-20 Serious Harm reduction Subscale had a stronger association with SAM use than alcohol or cannabis use. The strength of the association was the same for the PBSS-20 Limiting Drinking subscale with SAM use and alcohol use. It was not significantly correlated with cannabis use. The PBSS-20 Manner of Drinking subscale was only significantly associated with alcohol use, and the association with alcohol consequences was stronger than with cannabis consequences (SAM consequences was not significantly associated). The PBSS-20 total score was only significantly correlated with SAM use and alcohol consequences, not alcohol use, cannabis use, SAM consequences, or cannabis consequences.

The PBSM-SF Quantity subscale was only significantly correlated with SAM use and alcohol consequences (not cannabis use, alcohol use, SAM consequences, or cannabis consequences). There was a stronger association between the PBSM-SF Context subscale and cannabis use and consequences compared to SAM use, alcohol use, SAM consequences, and alcohol consequences. Similarly, the PBSM-SF total score had a stronger association with all cannabis use outcomes than with the SAM or alcohol outcomes (only SAM use and alcohol consequences were significantly correlated).

Incremental validity was not established. The PBS4SAMM total score did not predict SAM use or SAM consequences over and above the PBSS-20 total score and PBSM-SF total score. There was not a significant change in R^2 for use ($\Delta R^2 = .004$, $p = .296$) or consequences

($\Delta R^2 = .012$, $p = .078$) when the PBS4SAMM was added to the model with the PBSS-20 and PBSM-SF (Tables 10 and 11).

Table 9

Correlations of the PBS Measures with Substance Use and Depression Outcomes

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1. PBS4SAMM Limiting	-																			
2. PBS4SAMM Planning	**.50**	-																		
3. PBS4SAMM Alternatives	**.44**	.12	-																	
4. PBS4SAMM Total	**.92**	**.68**	**.59**	-																
5. PBSS-20 SHR	**.45**	**.64**	**.21**	**.55**	-															
6. PBSS-20 Limiting	**.72**	**.31**	**.46**	**.68**	**.50**	-														
7. PBSS-20 MOD	**.63**	**.30**	**.28**	**.58**	**.40**	**.69**	-													
8. PBSS-20 Total	**.73**	**.50**	**.39**	**.73**	**.77**	**.89**	**.82**	-												
9. PBSM-SF Quantity	**.65**	**.37**	**.29**	**.63**	**.45**	**.55**	**.51**	**.61**	-											
10. PBSM-SF Context	**.48**	**.50**	**.12**	**.51**	**.54**	**.35**	**.39**	**.51**	**.66**	-										
11. PBSM-SF Total	**.62**	**.48**	**.23**	**.63**	**.55**	**.49**	**.50**	**.62**	**.90**	**.92**	-									
12. CESD	-.09	-.11	**.21**	-.03	-.11	.06	-.05	-.03	**-.13**	**-.28**	**-.23**	-								
13. SAM use	**-.19**	-.03	**-.14**	**-.17**	**-.24**	**-.22**	-.12	**-.23**	**-.26**	**-.23**	**-.28**	.03	-							
14. SAM Consequences	.09	**-.20**	**-.20**	.05	**-.16**	**.13**	.02	.00	.03	**-.17**	-.08	**.26**	.08	-						
15. Alcohol Quantity	.05	**-.17**	**.21**	.04	**-.17**	.00	-.01	-.07	.01	-.12	-.06	**.21**	**.27**	**.34**	-					
16. Alcohol Frequency	**.13**	**-.22**	**.26**	.09	**-.20**	**.14**	**.18**	.05	.08	**-.15**	-.05	**.30**	**.27**	**.41**	**.72**	-				
17. Alcohol Consequences	**-.23**	-.03	-.06	**-.17**	**-.14**	**-.21**	**-.28**	**-.25**	**-.15**	**-.20**	**-.19**	**.14**	**.21**	.01	.11	.03	-			
18. Cannabis Quantity	-.01	**-.22**	**.29**	.007	**-.14**	.07	.07	.00	**-.22**	**-.33**	**-.31**	**.21**	**.17**	**.21**	**.41**	**.33**	.08	-		
19. Cannabis Frequency	-.03	**-.15**	**.30**	.02	**-.17**	.07	.00	-.04	**-.24**	**-.32**	**-.31**	**.31**	**.24**	**.28**	**.32**	**.37**	.03	**.55**	-	
20. Cannabis Consequences	-.02	**-.18**	**.30**	.01	**-.18**	.04	**-.13**	-.10	**-.14**	**-.29**	**-.24**	**.37**	.01	**.48**	**.15**	**.25**	**.13**	**.25**	**.44**	-

Note. PBS4SAMM is the new measure of protective behavioral strategy use specific to SAM use, PBSS-20 = Protective Behavioral Strategy Scale (Treloar et al., 2015), SHR = Serious Harm Reduction, MOD = Manner of Drinking, PBSM-SF = Protective Behavioral Strategies for Marijuana (Mian et al., 2021), CESD = Center for Epidemiological Studies Depression scale (Andresen et al., 1994), SAM = simultaneous alcohol and marijuana/cannabis; bold values indicate significance at $p < .05$.

Table 10

Multiple Regressions for PBS Measures Predicting SAM Use

Model	Predictors	*B*	*SE*	β	*t*	*p*
1	PBSS-20	-0.07	0.05	-0.11	-1.48	.141
	PBSM-SF	-0.20	0.08	-0.20	-2.65	.009*
2	PBSS-20	-0.11	0.06	-0.16	-1.81	.071
	PBSM-SF	-0.23	0.08	-0.23	-2.85	.005*
	PBS4SAMM	0.06	0.05	0.10	1.05	.296

Note. PBS4SAMM is the new measure of protective behavioral strategy use specific to simultaneous use of alcohol and marijuana/cannabis, PBSS-20 = Protective Behavioral Strategy Scale-20 (Treloar et al., 2015), PBSM-SF = Protective Behavioral Strategies for Marijuana – Short Form (Mian et al., 2021); *$p < .05$

Table 11

Results Multiple Regressions for PBS Measures Predicting SAM Consequences

Model	Predictors	*B*	*SE*	β	*t*	*p*
1	PBSS-20	.03	.03	.09	1.10	.272
	PBSM-SF	-.07	.04	-.14	-1.75	.081
2	PBSS-20	-.002	.03	-.01	-.08	.934
	PBSM-SF	-.09	.04	-.19	-2.25	.026*
	PBS4SAMM	.05	.03	.17	1.77	.078

Note. PBS4SAMM is the new measure of protective behavioral strategy use specific to simultaneous use of alcohol and marijuana/cannabis, PBSS-20 = Protective Behavioral Strategy Scale-20 (Treloar et al., 2015), PBSM-SF = Protective Behavioral Strategies for Marijuana – Short Form (Mian et al., 2021); *$p < .05$

There was not a significant difference between cisgender men and women for the PBS4SAMM Limiting, $t(242) = 0.58$, $p = .563$, Alternatives, $t(242) = -0.92$, $p = .357$, or total score, $t(242) = 1.53$, $p = .127$. However, there was a significant difference between cisgender women and cisgender men for the PBS4SAMM Planning subscale, $t(242) = 4.71$, $p < .001$, such that cisgender women reported using these strategies more often than cisgender men. There was not a significant difference between participants who identified as White and those who identified as Black for the PBS4SAMM Limiting, $t(227) = -0.14$, $p = .888$, Planning, $t(227) = 0.27$, $p = .789$, Alternatives, $t(227) = 0.17$, $p = .862$, or total score, $t(227) = 0.05$, $p = .964$ (see Table 12 for means of PBS4SAMM across gender and race). Gender did not moderate the association between PBS4SAMM and SAM use ($B = 0.001$, $SE = 0.08$, $p = .968$) and SAM consequences ($B = 0.03$, $SE = 0.04$, $p = .359$). Race also did not significantly moderate the association between the PBS4SAMM and SAM use ($B = 0.18$, $SE = 0.11$, $p = .110$) and SAM consequences ($B = -0.06$, $SE = 0.06$, $p = .307$).

Table 12

Means and Standard Deviations for the PBS4SAMM by Gender and Race

Variables		*N*	Mean (*SD*)
	Gender		
PBS4SAMM Limiting	Cisgender Women	141	29.79 (11.48)
	Cisgender Men	103	28.98 (9.64)
PBS4SAMM Planning	Cisgender Women	141	22.90 (5.43)
	Cisgender Men	103	19.57 (5.46)
PBS4SAMM Alternatives	Cisgender Women	141	11.71 (4.59)
	Cisgender Men	103	12.26 (4.66)
PBS4SAMM Total Score	Cisgender Women	141	74.02 (19.79)
	Cisgender Men	103	70.29 (17.34)
	Race		
PBS4SAMM Limiting	White	201	29.44 (10.95)
	Black	28	29.75 (9.88)
PBS4SAMM Planning	White	201	21.61 (5.70)
	Black	28	21.30 (5.65)
PBS4SAMM Alternatives	White	201	12.02 (4.65)
	Black	28	11.86 (4.66)
PBS4SAMM Total Score	White	201	72.80 (19.06)
	Black	28	72.63 (19.19)

Note. PBS4SAMM is the new measure of protective behavioral strategy use specific to simultaneous use of alcohol and marijuana/cannabis

CHAPTER IV

DISCUSSION

The purpose of the current study was to develop a measure of SAM-specific PBS for emerging adult college students. First, focus groups were conducted with emerging adult college students to develop items for the measure. After receiving feedback from an expert panel of researchers in the field, the PBS4SAMM was included in a cross-sectional survey to assess the factor structure and validity of the new measure among a sample of emerging adult college students. Lastly, analyses were conducted to determine if there were differences in SAM-specific PBS use across gender and race, and if gender or race moderated the association between SAM-specific PBS use and SAM outcomes. The sample size (n = 266) was not large enough to conduct the CFA or measurement invariance tests and may not have been large enough to be sufficiently powered across groups for the comparison of means and moderation analyses. Results for the comparison of means and moderation analyses should be interpreted with caution (see Limitations for more details).

Aim 1 – Development of the PBS4SAMM

The PBS4SAMM was developed based on items generated from content analysis of focus groups, review of the literature, and feedback from an expert panel. Although many strategies discussed in the focus groups were similar to single-substance use, such as eating and staying hydrated, there were some that were unique to SAM use, such as order of use. Roughly half of the participants reported that they used cannabis first and half reported they used alcohol first during a SAM use occasion, and one of the reasons that was discussed for using a specific substance first was to limit harms of use. This aligns with previous qualitative research on order of use, in which order of use varied but the order was chosen to reduce negative consequences

(Boyle et al., 2021). The order of use item was dropped from the factor structure after the first EFA analysis for not fitting well onto a factor, but was retained for the total score due to its conceptual importance to SAM use. This may be a strategy that is more person-dependent, such that it could depend on if an individual uses alcohol more frequently or cannabis more frequently. It also may be more related to consequences for a single substance rather than a result of SAM use, as found by Karoly et al. (2023). Future research should examine if order of use is person-dependent in terms of its actual protection from use-related harms.

The other two strategies that did not load onto a factor but were included in the total score for their conceptual relevance to SAM use were "Limit the amount of alcohol and/or cannabis you use" and "Pace yourself by spacing out the use of alcohol and cannabis". Five participants mentioned that they would not use as much cannabis if they had already been drinking and four said they would limit their alcohol consumption if they had already been using cannabis. Six participants discussed spacing out their consumption of alcohol if they had already been using cannabis. These items were specific to SAM use. Although many strategies from the focus groups were similar to single-substance use PBS, these items are important to consider when discussing use of multiple substances, as these would not be captured in a single-substance use measure. More research is needed to determine if these items should continue to be included in the PBS4SAMM given that they did not load on a specific factor, or if there are any other SAM-specific strategies that should be included.

Aim 2 – Psychometric validation of the PBS4SAMM

The EFA analyses resulted in an 18 item, three factor measure. These three factors are slightly different than what has been found in single-substance use PBS measures. The content of the Limiting subscale of the PBS4SAMM aligns with the Limiting Drinking subscale of the

PBSS-20 (Treloar et al., 2015) and the Quantity factor of the PBSM-SF (Mian et al., 2021). The Alternatives subscale of the PBS4SAMM is somewhat similar to the Alternatives subscale of the Strategies Questionnaire (Sugarman & Carey, 2007), however, the PBS4SAMM lists specific activities to consider (e.g., "Go for a walk, run, or other form of exercise") whereas the Strategies Questionnaire subscale only has one question focused on other activities ("Choose to participate in enjoyable activities that do not include alcohol consumption") and the other items in the subscale for the Strategies Questionnaire discuss coping strategies. Although the items within the PBS4SAMM Planning subscale are not specifically unique to SAM use, other PBS scales have not found a factor specifically for Planning PBS. This aligns with discussions from the focus groups, in which some participants stated that if they are going to be engaging in SAM use, they need to plan ahead of time; they consider it an "event" in of itself. The CFA and measurement invariance testing could not be conducted due to a low sample size. Further research is needed to confirm this factor structure in a separate sample and to determine if it is invariant across gender and race.

The resulting factor structure may be more relevant for emerging adult college students, especially the Planning subscale. Simultaneous use has been found to occur frequently at parties more so than cannabis-only use among college students (Looby et al., 2021). When emerging adult college students want to engage in SAM use at parties, they may use more planning strategies to reduce the use of negative consequences or experiences. Stevens et al. (2022) found that there were higher odds of planned SAM use when college students reported engaging in SAM use at a party. Emerging adult college students may be attending more parties than older adults, thus, they need to use more strategies to make sure they are in a safe environment outside

of their own home, be around supportive friends, etc. Older adults may engage in SAM use more often in their own homes and may not need to use as many planning strategies.

Aim 3 – Validity and Comparison of Means and Moderation

Criterion validity was established for the PBS4SAMM Limiting, Alternatives, and Total score with SAM use; however, all correlation coefficients were relatively low [*r*s ranged -.19-(-.14)]. These associations were weaker than other studies have found for other PBS measures and related substance use, such as past-month cannabis use and the PBSM (*r* = -.50; Pedersen et al., 2016) and the subscales of the PBSM-SF [*r*s = -.40-(-.29); Mian et al., 2021]. Additionally, only the Planning and Alternatives subscales for the PBS4SAMM were significantly associated with SAM consequences, although these were also low. However, previous research for PBS use has found that not all subscales of PBS are associated with both use and consequences. In a review, Peterson et al. (2021) outlined how Martens et al. (2005) and Pearson, Kite et al. (2013b) found that the PBSS serious harm reduction subscale had a greater association with alcohol-related consequences than alcohol consumption whereas the manner of drinking subscale is more consistently associated with alcohol consumption than alcohol-related consequences. These differences in associations could be due to the items in the subscales themselves. In regards to the current study, the PBS4SAMM Planning subscale may not have been associated with SAM use because the majority of the items are not related to frequency of use, rather, planning to make sure they are in a safe environment to reduce consequences. Similarly, the PSB4SAMM Limiting subscale may not have been associated with SAM consequences as many of these items are related to frequency or quantity of SAM use.

Discriminant validity was established for all but the Alternatives subscale of the PBS4SAMM. This subscale had a significant, positive correlation with depression, but the

association was low (r = .21). Additionally, the association with the PBS4SAMM measure and SAM use was not always stronger than its association with alcohol and cannabis use on its own. The cannabis-specific PBSM-SF Quantity (Mian et al., 2021) subscale had the strongest association with SAM use than any of the other PBS measures. However, the PBS4SAMM Planning and Alternatives subscales had the strongest association with SAM consequences compared to the other PBS measures. Incremental validity of the PBS4SAMM was not established. The PBS4SAMM did not significantly predict SAM use or SAM consequences more so than the alcohol-specific PBSS-20 (Treloar et al., 2015) or cannabis-specific PBSM-SF (Mian et al., 2021). The PBSM-SF was the only measure that significantly predicted SAM use and SAM consequences.

These low associations could be partly due to having a lower sample size, but may also be due to SAM use not being as frequent of a behavior as single substance use, or may be due to how SAM use was assessed. The current examinations assessed how many days participants engaged in SAM use in the past 3 months, whereas alcohol and cannabis use were assessed using typical weekly quantity and frequency in the past 3 months. Assessing SAM use in the past 3 months was suggested by one of the expert panel members as SAM use tends to not be endorsed as much as single substance use among college students.

Additionally, participants may only be using one strategy that works well for them rather than multiple strategies. Their score for each factor and subscale would be lower than those who use multiple strategies, even though they may not be experiencing negative consequences of use, which may account for the low associations between the PBS4SAMM and SAM use and consequences. Participants also may not be purposefully using SAM-specific PBS because they want to experience the positive consequences of SAM use. Previous research has found that

young adults reported more positive consequences than negative consequences of SAM use on SAM use days (Boyle et al., 2023). More research with a larger sample is needed to support criterion, discriminant, and incremental validity of the PBS4SAMM, possibly with a more nuanced assessment of SAM use, or a heavier-using sample.

Interestingly, cisgender women reported using Planning strategies more often than cisgender men. There was not a significant difference across gender for the other subscales and total score. Three of the planning items focused on being in a safe environment and around people you trust. Prior research has found that women are at an increased risk for consequences on SAM use days compared to cannabis use days (Linden-Carmichael et al., 2020) and women have reported using more alcohol-specific PBS (e.g., Ayala Guzman et al., 2024; Clarke et al., 2016) and cannabis-specific PBS (Bravo, Anthenien et al., 2017) than men. Women may want to prioritize being in a safe environment around people they trust to reduce the risk of experiencing consequences. There were no significant differences found across race for the PBS4SAMM subscales and total scores. These results do not align with prior research that found that African American college students endorsed greater alcohol-specific PBS use than White, Non-Hispanic college students (Madson & Zeigler, 2013). Additionally, gender and race did not moderate the association between the PBS4SAMM and SAM use and consequences. However, the results for race should be interpreted with caution, as these analyses may not have been powered. The majority of the sample identified as White, with the next highest race endorsed as Black (n = 201 vs. n = 28). A more equally representative sample is needed to confirm these findings. Moreover, better representation of other racial and ethnic groups is needed to do a more comprehensive examination across identities.

Implications

The results of this study may help inform prevention and intervention efforts to reduce SAM use and related consequences. First, because the PBS4SAMM was negatively associated with SAM use, harm reduction campaigns could incorporate PBS that are not already present in single-substance use measures, such as including more alternatives to use. Second, harm reduction campaigns focused on SAM use should promote PBS from the Planning subscale, especially among cisgender men, as cisgender women reported higher use of these strategies, and this subscale was negatively associated with SAM consequences. Additionally, as the total score included three additional items that did not load onto a factor, the total score and subscales could be used differently. Researchers could use the total score to better understand how often those who are engaging in SAM use are using PBS. The subscales may be better suited to inform harm reduction interventions to give college students a smaller list of strategies to focus on that demonstrate the most harm reduction (as previously discussed). Lastly, because validity was not fully established for the PBS4SAMM, specifically incremental validity of prediction of harm beyond what is accounted for by other PBS measures, PBS for single substance use may be sufficient to inform harm reduction campaigns for emerging adult college students.

Limitations

Limitations of the current study should be addressed. Firstly, focus group recruitment was more challenging than anticipated. Individuals who were not college students were able to access the sign-up link from the student announcements for the qualitative study because the announcements were available to nonstudents via the university's website, which filled spots for the focus groups. Further screening was needed to confirm that participants were college students; it is possible some students were lost to participation who did not complete the

additional screening. Additionally, the rate of conducting the focus groups was slower than I anticipated; there were many potential participants who did not show up for their session or sessions where no participants signed up. The quantitative study also had recruitment challenges. Although recruitment took place across three crowdsource platforms and the psychology participant pool, the target sample size was not reached. The eligibility criteria of the study were stringent as I wanted to recruit emerging adult college students who engaged in SAM use at least monthly so that they participated in SAM use enough to use PBS. However, this may have hindered timely recruitment of eligible participants. These platforms also did not have the number of college students I expected, making it even more challenging to find sufficient numbers of college students who met these criteria. In addition to not meeting the target sample size, this also precluded the options to use a quota approach to get a diverse sample. Results for the moderation analyses and comparison of means may not be generalizable outside of the current study and should be interpreted with caution because of the increased risk of Type II error given the smaller sample size. Moving forward, collaborating with researchers at multiple college campuses for studies focused on college students should be considered to reach a larger sample size and recruit a diverse sample. Directly contacting college students or using a psychology research pool at multiple college campuses may help to recruit a larger number of student participants, especially for studies that have stringent eligibility criteria.

The eligibility criteria of the study also indicated that participants had to provide plausible answers, as data quality has been a concern across crowdsource platforms, specifically MTurk (e.g., Douglas et al., 2023). There were some participants who screened eligible based on their SAM use, but did not provide plausible responses, such as inputting an age that did not align with their year of birth, or saying they participated in the focus groups despite not residing

in Virginia. Bot detections in Qualtrics were also used to assess if a response was generated by a bot; however, the two checks that were in place did not always agree with each other, and it only gave a likelihood score (Qualtrics, 2024). Thus, we retained participants in the current sample even if the ReCAPTCHA or fraudulent score indicated they might be a bot.

Similarly, the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960) was added as an additional way to assess truthfulness of respondents. Forty-five participants score 20 or higher on this measure, indicating that their responses might not always be truthful (or that they might lie on occasion if they perceive some responses to be more or less socially desirable). However, researchers have cautioned against removing participants based on these scores as it may bias results (Barger, 2002; Crowne, 1991). Thus, all participants were retained in the current analyses. However, it is possible some of the unexpected findings could be related to retaining participants who could potentially be bots, or may not have been fully honest in their responses.

Future Research

Future research should replicate the study with a larger and more diverse sample to be sufficiently powered to run all of the analyses, with additional data quality checks in place to screen out potential bots. Additionally, order of use of alcohol and cannabis and SAM consequences should be assessed at the daily level, either with daily diary studies or ecological momentary assessment studies. This would provide more detail about the order of use and its association with consequences (and protection from harm) and if the association is person dependent. These examinations could inform if order of use should be considered as a truly protective PBS for SAM use. Future research for the development of SAM use-specific measures should continue to use qualitative and mixed-method approaches to ensure that SAM-specific

items are included, rather than combining single substance use measures (Shipley & Braitman, 2024). Lastly, future research should explore if a broader, polysubstance use PBS measure is warranted. When assessing SAM use, participant burden can be increased with the want to assess single substance use as well as SAM use (using potentially up to three measures per construct). Having more universal measures for polysubstance use may be beneficial, although this would not allow for unique substance-specific protections (e.g., drinking water for alcohol PBS; order of use for SAM PBS).

Future research should also consider the length of the instructions for the PBS4SAMM. The instructions were long to ensure that participants understood what was meant by simultaneous use and cannabis. These definitions were considered necessary for the survey as simultaneous use definitions vary across studies (Lee et al., 2022), and college students use varying terms for cannabis. There was also another set of instructions for the alternatives to use section. These instructions may be too onerous for participants to read, and they may skip over them (especially given some of the repeating text from the earlier instructions). Focus groups should be conducted with emerging adult college students to ask their thoughts on the instructions and if there is any way to shorten them without losing helpful information so that participants are more likely to read them fully, thus further ensuring the validity of the measure.

Lastly, future research should continue to examine if a SAM-specific measure of PBS is needed, or if using only single-substance use PBS measures are sufficient to assess strategies used on SAM use occasions. Although a new subscale was found (Planning) and some unique items were retained in the full measure, the majority of the strategies were similar to single-substance use and having a specific SAM use PBS measure may not be needed over the single-substance PBS measures. It may be beneficial to develop a measure similar to the measure

assessing SAM consequences (Jackson et al., 2020), where participants would be asked if they used a strategy for alcohol use only, cannabis use only, both substances, or neither. This could help to determine if strategies are used only for SAM use occasions or single-substance use as well. Additionally, future research should examine if a larger polysubstance measure is needed. Participants may be using other substances in addition to alcohol and cannabis, such as opioids. Having a more versatile PBS measure that can include more than one substance and that would replace multiple single- or double-substance use measures would help to reduce participant burden, rather than having a measure for each substance or each type of use occasion.

Conclusion

The purpose of the current study was to develop a measure of PBS specific for SAM use using qualitive and quantitative methods to address a gap in the literature. The PBS4SAMM was developed using data from focus groups, reviewing the literature, and feedback from an expert panel. The new measure was found to have three factors with a total of 18 items. Validity was not fully established for the measure. Cisgender women did report greater use of PBS4SAMM Planning strategies than cisgender men. This study was a good first step in assessing SAM-specific PBS use, but further research is needed to confirm and expand upon the findings, as the sample size may not have been large enough for the comparison of means and moderation analyses. Thus, these results should be interpreted with caution.

REFERENCES

Andresen, E. M., Malmgren, J. A., Carter, W. B., Patrick, D. L. (1994). Screening for depression in well older adults: Evaluation of a short form of the CES-D. *American Journal of Preventative Medicine, 10*(2), 77-84. https://doi.org/10.1016/S0749-3797(18)30622-6

Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist, 55*(5), 469-480. https://doi.org/10.1037/0003-066X.55.5.469

Arnett, J. J. (2005). The developmental context of substance use in emerging adulthood. *Journal of Drug Issues, 35*(2), 235-254. https://doi.org/10.1177/002204260503500202

Arria, A. M., Calderia, 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, 29*(3), 564-575. https://doi.org/10.1037%2Fadb0000108

Ayala Guzman, R., Bolts, O. L., Shipley, J. L., Strowger, M., Prince, M. A., & Braitman, A. L. (2024). A cross-sectional examination of race, gender, and intersectionality on protective behavioral strategies and alcohol outcomes among Black and White college students. *Experimental and Clinical Psychopharmacology*. Advance online publication. https://doi.org/10.1037/pha0000712

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behaviors, 31*(2), 143-164. https://doi.org/10.1177/1090198104263660

Barger, S. D. (2002). The Marlowe-Crowne affair: Short forms, psychometric structure and social desirability. *Journal of Personality Assessment, 79*(2), 286-305. https://doi.org/10.1207/S15327752JPA7902_11

Blanchard, B. E., Stevens, A. K., & Littlefield, A. K. (2021). Differences in alcohol-related protective behavioral strategies among female and male college students. *Addictive Behaviors, 120,* 106969. https://doi.org/10.1016/j.addbeh.2021.106969

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research. A primer. *Frontiers in Public Health, 6,* 1-18. https://doi.org/10.3389/fpubh.2018.00149

Boyle, H. K., Carey, K. B., Jackson, K. M., & Merrill, J. E. (2023). Applying the Prototype Willingness Model to day-level simultaneous alcohol and cannabis use. *Psychology of Addictive Behaviors*. Advance online publication. https://dx.doi.org/10.1037/adb0000920

Boyle, H. K., Gunn, R. L., López, G., Fox, O. S., & Merrill, J. E. (2021). Qualitative examination of simultaneous alcohol and cannabis use reasons, evaluations, and patterns among heavy drinking young adults. *Psychology of Addictive Behaviors, 35*(6), 638-649. https://doi.org/10.1037/adb0000746

Braitman, A. L., Stamates, A., Colangelo, M., Ehlke, S. J., Ortman, J., Heron, K. E., & Carey, K. B. (2023). Criterion validity of protective behavioral strategies for alcohol consumption among college students: Comparison across two measures. *Substance Use & Misuse, 58*91), 11-21. https://doi.org/10.1080/10826084.2022.2125275

Braitman, A. L., Strowger, M., Lau-Barraco, C., Shipley, J. L., Kelley, M. L., & Carey, K. B. (2022a). Examining the added value of harm reduction strategies to emailed boosters to extend the effects of online interventions for college drinkers. *Psychology of Addictive Behaviors, 36*(6), 635–647. https://doi.org/10.1037/adb0000755

Braitman, A. L., Strowger, M., Shipley, J. L., Ortman, J., MacIntyre, R. I., & Bauer, E. A. (2022b). Data quality and study compliance among college students across 2 recruitment sources: Two study investigation. *JMIR Formative Research, 6*(12), e39488. http://dx.doi.org/10.2196/39488

Bravo, A. J., Anthenien, A. M., Prince, M. A., Pearson, M. R., & Marijuana Outcomes Study Team. (2017). Marijuana protective behavioral strategies as a moderator of the effects of risk/protective factors on marijuana-related outcomes. *Addictive Behaviors, 69*, 14-21. https://doi.org/10.1016/j.addbeh.2017.01.007

Bravo, A. J., Pearson, M. R., Stevens, L. E., & Henson, J. M. (2018). Weighing the pros and cons of using protective behavioral strategies: A qualitative examination among college students. *Substance Use & Misuse, 53*(13), 2190-2198. https://doi.org/10.1080/10826084.2018.1464026

Bravo, A. J., Prince, M. A., Pearson, M. R., & The Marijuana Outcomes Study Team. (2017). Can I use marijuana safely? An examination of distal antecedents, marijuana protective behavioral strategies, and marijuana outcomes. *Journal of Studies on Alcohol and Drugs, 78*, 203-212. https://doi.org/10.15288/jsad.2017.78.203

Bravo, A. J., Prince, M. A., Pilatti, A., Mezquita, L., Keough, M. T., Hogarth, L., & Cross-Cultural Addictions Study Team. (2021). Young adult concurrent use and simultaneous use of alcohol and marijuana: A cross-national examination among college students in seven countries. *Addictive Behaviors Reports, 14*, 100373. https://doi.org/10.1016/j.abrep.2021.100373

Bravo, A. J., Weinstein, A. P., Pearson, M. R., & Protective Strategies Study Team. (2019). The relationship between risk factors and alcohol and marijuana use outcomes among

concurrent users: A comprehensive examination of protective behavioral strategies. *Journal of Studies on Alcohol and Drugs, 80,* 102-108. https://doi.org/10.15288/jsad.2019.80.102

Caffrey, K. S., Wright, B. R., & Maarhuis, P. L. (2018). Harm reduction for cannabis: Factor analysis of a protective behavioral strategies survey. *Journal of American College health, 66*(3), 194-201. https://doi.org/10.1080/07448481.2018.1431894

Carey, K. B., Tempchin, J., DiBello, A. M., & Mastroleo, N. R. (2022). Use of protective behavioral strategies and blackout experience among mandated college students. *Addictive Behaviors, 132,* 107340. https://doi.org/10.1016/j.addbeh.2022.107340

Chandler, L., Abdujawad, A. W., Mitra, S., & McEligot, A. J. (2021). Marijuana use and high-risk health behaviors among diverse college students post-legalization of recreational marijuana use. *Public Health in Practices, 2,* 100195. https://doi.org/10.1016/j.puhip.2021.100195

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal, 14*(3), 464-504. https://doi.org/10.1080/10705510701301834

Clarke, N., Kim, S., Ray, A. E., White, H. R., Jia, Y., & Mun, E. (2016). The association between protective behavioral strategies and alcohol-related problems: An examination of race and gender difference among college drinkers. *Journal of Ethnicity in Substance Abuse, 15* (1), 25-45. https://doi.org/10.1080/15332640.2014.1002877

Cloutier, R. M., Natesan Bately, P., Kearns, N. T., & Knapp, A. A. (2021). A psychometric evaluation of the Marijuana Problems Index among college students: Confirmatory factor

analysis and measurement invariance by gender. *Experimental and Clinical Psychopharmacology, 30*(6), 907-017. https://doi.org/10.1037/pha0000531

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology, 53*(2), 189–200. https://doi.org/10.1037/0022-006X.53.2.189

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*(7), 1-9. https://doi.org/10.7275/jyj1-4868

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications, Inc.

Crowne, D. P. (1991). From response style to motive. *Current Contents: This Week's Citation Classic, 30.* 18.

Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology, 24*(4), 349-354. https://dx.doi.org/10.1037/h0047358

Cummings, C., Beard, C., Habarth, J. M., Weaver, C., & Haas, A. (2019). Is the sum greater than its parts? Variations in substance-related consequences by conjoint alcohol-marijuana use patterns. *Journal of Psychoactive Drugs, 51*(4), 351-359. https://doi.org/10.1080/02791072.2019.1599473

Douglas, B. D., Ewell, P. J., & Brauer, M. (2023). Data quality in online human-subjects research: Comparisons between MTurk, Prolific, CloudResearch, Qualtrics, and SONA. *PLoS ONE, 18*(3), e0279720. https://doi.org/10.1371/journal.pone.0279720

Doumas, T. M., Wells, S., Tremblay, P. F., & Graham, K. (2013). Teasing apart the roles of gender and alcohol in drinking consequences using an event-level analysis. *Contemporary Drug Problems, 40*(3), 321-349. https://doi.org/10.1177/009145091304000303

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*(3), 272-299. https://doi.org/10.1037/1082-989X.4.3.272

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavioral Research Methods, 39,* 175-191. https://doi.org/10.3758/BF03193146

Gardner, S. K., Robertson, A. A., Tatch, A., & Walker, C. S. (2020). Racial differences in college-student drinking. *Journal of Ethnicity in Substance Abuse, 19*(1), 28-43. https://doi.org/10.1080/15332640.2018.1446376

Grigsby, T. J., Lopez, A., Albers, L., Rogers, C. J., & Forster, M. (2023). A scoping review of risk and protective factors for negative cannabis use consequences. *Substance Abuse: Research and Treatment, 17,* 1-16. https://doi.org/10.1177/11782218231166622

Gunn, R. L., Sokolovsky, A., Stevens, A. K., Metrik, J., White, H., & Jackson, K. (2021). Ordering in alcohol and cannabis co-use: Impact on daily consumption and consequences. *Drug and Alcohol Dependence, 218,* 108339. https://doi.org/10.1016/j.drugalcdep.2020.108339

Hsieh, H-F. & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277-1288. https://doi.org/10.1177/1049732305276687

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Jackson, K. M., Sokolovsky, A. W., Gunn, R. L., & White, H. R. (2020). Consequences of alcohol and marijuana use among college students: Prevalence rates and attributions to substance-specific versus simultaneous use. *Psychology of Addictive Behaviors, 34*(2), 370–381. https://doi.org/10.1037/adb0000545

Jones, J., Jones, K. N., & Peil, J. (2018). The impact of the legalization of recreational marijuana on college students. *Addictive Behaviors, 77,* 255-259. https://doi.org/10.1016/j.addbeh.2017.08.015

Jordan, H. R., Colvin, K. F., Kim, K. Y. E., Martin, J. L., & Madson, M. B. (2021). Psychometric validation of the Protective Drinking Practices Scale in college students across the United States. *Experimental and Clinical Psychopharmacology, 29*(3), 251-260. https://doi.org/10.1037/pha0000471

Jordan, H. R., Hoover, S. M., Prince, M. A., Madson, M. B., & the Harm Reduction Research Team. (2022). Evaluating the Protective Behavioral Strategies for Marijuana Scale (PBSM) short-form: Support for a two-factor structure and measurement invariance. *Drug and Alcohol Dependence, 236,* 109489. https://doi.org/10.1016/j.drugalcdep.2022.109489

Kahn, J. H. (2006). Factor analysis in counseling psychology research, training, and practice: Principles, advances, and applications. *The Counseling Psychologist, 34*(5), 684-718. https://doi.org/10.1177/0011000006286347

Karoly, H. C., Prince, M. A., & Conner, B. T. (2023). Alcohol first, cannabis last: Identification of an especially risky use pattern among individuals who co-use alcohol and cannabis. *Substance Use & Misuse, 59*(3), 343-352. https://doi.org/10.1080/10826084.2023.2270674

Kerr, D. C. R., Bae, H., Phibbs, S., & Kern, A. C. (2017). Changes in undergraduates' marijuana, heavy alcohol and cigarette use following legalization of recreational marijuana use in Oregon. *Addiction, 112*(11), 1992-2001. https://doi.org/10.1111/add.13906

Kim, Y., Murphy, J., Craft, K., Waters, L., & Gooden, B. I. (2022). "It's just a constant concern in the back of my mind": Lived experiences of college food insecurity. *Journal of American College Health, 72*(3), 980–987. https://doi.org/10.1080/07448481.2022.2064714

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). The Guildford Press.

Lee, C. M., Calhoun, B. H., Abdallah, D. A., Blayney, J. A., Schultz, N. R., Brunner, M., & Patrick, M. E. (2022). Simultaneous alcohol and marijuana use among young adults: A scoping review of prevalence, patterns, psychosocial correlates, and consequences. *Alcohol Research: Current Reviews, 42*(1), 1-27. https://doi.org/10.35946/arcr.v42.1.08

Leech, N. L., & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. *Quality & Quantity: International Journal of Methodology, 43*(2), 265–275. https://doi.org/10.1007/s11135-007-9105-3

Linden-Carmichael, A. N., Calhoun, B. H., Patrick, M. E., & Maggs, J. L. (2018). Are protective behavioral strategies associated with fewer negative consequences on high-intensity

drinking days? Results from a measurement-burst design. *Psychology of Addictive Behaviors, 32*(8), 904-913. https://doi.org/10.1037/adb0000421

Linden-Carmichael, A. N., Van Doren, N., Masters, L. D., & Lanza, S. T. (2020). Simultaneous alcohol and marijuana use in daily life: Implications for level of use, subjective intoxication, and positive and negative consequences. *Psychology of Addictive Behaviors, 34*(3), 447–453. https://doi.org/10.1037/adb0000556

Looby, A., Prince, M. A., Villarosa-Hurlocker, M. C., Conner, B. T., Schepis, T. S., Bravo, A. J., & Stimulant Norms and Prevalence (SNAP) Study Team. (2021). Young adult use, dual use, and simultaneous use of alcohol and marijuana: An examination of differences across use status on marijuana use context, rates, and consequences. *Psychology of Addictive Behaviors, 35*(6), 682–690. https://doi.org/10.1037/adb0000742

Madson, M. B., & Zeigler-Hill, V. (2013). Protective behavioral strategies, alcohol consumption, and negative alcohol-related consequences: Do race and gender moderate these associations? *Journal of Ethnicity in Substance Abuse*, *12*(3), 242-258. https://doi.org/10.1080/15332640.2013.798848

Martens, M. P., Ferrier, A. G., Sheehy, M. J., Corbett, K., Anderson, D., & Simmons, A. (2005). Development of the Protective Behavioral Strategies Survey. *Journal of Studies on Alcohol, 66,* 698-705. https://doi.org/10.15288/jsa.2005.66.698

Martens, M. P., Pedersen, E. R., LaBrie, J. W., Ferrier, A. G., & Cimini, M. D. (2007). Measuring alcohol-related protective behavioral strategies among college students: Further examination of the Protective Behavioral Strategies Scale. *Psychology of Addictive Behaviors, 21*(3), 307-315. https://doi.org/10.1037/0893-164x.21.3.307

Martin, J. L., Colvin, K. F., Madson, M. B., Zamboanga, B. L., & Pazienza, R. (2020). Optimal assessment of protective behavioral strategies among college drinkers: An item response theory analysis. *Psychological Assessment, 32*(4), 394-406. https://doi.org/10.1037/pas0000799

Martin, J. L., Zamboanga, B. L., Haase, R. F., & Buckner, L. C. (2020). Measurement invariance of the Protective Behavioral Strategies Scale across racial groups. *Measurement and Evaluation in Counseling and Development, 53*(1), 17-33. https://doi.org/10.1080/07481756.2019.1640615

Meade, A. W., & Bauer, D. J. (2007). Power and precision in confirmatory factor analytic tests of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal, 14*(4), 611-635. https://doi.org/10.1080/10705510701575461

Mian, M. N., Altman, B. R., Luba, R., Ueno, L. F., Dalal, D., & Earleywine, M. (2021). Factor analysis of a short form of the Protective Behavioral Strategies for Marijuana scale. *Addictive Behaviors, 117,* 106852. https://doi.org/10.1016/j.addbeh.2021.106852

Miller, A. M., Rosenman, R., & Cowan, B. W. (2017). Recreational marijuana legalization and college student use: Early evidence. *SSM – Population Health, 3,* 649-657. https://doi.org/10.1016/j.ssmph.2017.08.001

Napper, L. E., Kenney, S. R., Lac, A., Lewis, L. J., & LaBrie, J. W. (2014). A cross-lagged panel model examining protective behavioral strategies: Are types of strategies differentially related to alcohol use and consequences? *Addictive Behaviors, 39,* 480-486. https://doi.org/10.1037/pha0000471

National Conference of State Legislatures. (2023). *State medical cannabis laws.* https://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instrumentation, and Computers, 32,* 396-402. https://doi.org/10.3758/BF03200807

Park, H. S., Dailey, R., & Lemus, D. (2002). The use of exploratory factor analysis and principal components analysis in communication research. *Human Communication Research, 28*(4), 562-577. https://doi.org/10.1111/j.1468-2958.2002.tb00824.x

Park, S.Y., Yun, G. W., Constantino, N., Ryu, S. Y. (2022). Gender differences in the risk and protective factors of marijuana use among U.S. college students. *Journal of Health Psychology, 27*(7), 1710-1722. https://doi.org/10.1177/13591053211002248

Parnes, J. E., Smith, J. K., & Conner, B. T. (2018). Reefer madness or much ado about nothing? Cannabis legalization outcomes among young adults in the United States. *International Journal of Drug Policy, 56,* 116-120. https://doi.org/10.1016/j.drugpo.2018.03.011

Patrick, M. E. (2016). A call for research on high-intensity alcohol use. *Alcoholism: Clinical and Experimental Research, 40*(2), 256-259. https://doi.org/10.1111/acer.12945

Patrick, M. E., & Lee, C. M. (2018). Cross-faded: Young adults' language of being simultaneously drunk and high. *Cannabis, 1*(2), 60-65. https://doi.org/10.26828%2Fcannabis.2018.02.006

Patrick, M. E., Terry-McElrath, Y. M., Lee, C. M., & Schulenberg, J. E. (2019). Simultaneous alcohol and marijuana use among underage young adults in the United States. *Addictive Behaviors, 88,* 77-81. https://doi.org/10.1016/j.addbeh.2018.08.015

Pearson, M. R. (2013). Use of alcohol protective behavioral strategies among college students: A critical review. *Clinical Psychology Review, 33,* 1025-1040. https://doi.org/10.1016%2Fj.cpr.2013.08.006

Pearson, M. R., Bravo, A. J., Conner, B. T., & Parnes, J. E. (2020). A day in the life: A daily diary examination of marijuana motives and protective behavioral strategies among college student marijuana users. *Journal of Drug Issues, 50*(2), 142-156. https://doi.org/10.1177/0022042619890837

Pearson, M. R., D'Lima, G. M., & Kelley, M. L. (2013a). Daily use of protective behavioral strategies and alcohol-related outcomes among college students. *Psychology of Addictive Behaviors, 27*(3), 826–831. https://doi.org/10.1037/a0032516

Pearson, M. R., Kite, B. A., & Henson, J. M. (2013b). Predictive effects of good self-control and poor regulation on alcohol-related outcomes: Do protective behavioral strategies mediate? *Psychology of Addictive Behaviors, 27*(1), 81–89. https://doi.org/10.1037/a0028818

Pearson, M. R., Liese, B. S., Dvorak, R. D., & the Marijuana Outcomes Study Team. (2017). College student marijuana involvement: Perceptions, use, and consequences across 11 college campuses. *Addictive Behaviors, 66,* 83-89. https://doi.org/10.1016/j.addbeh.2016.10.019

Pedersen, E. R., Huang, W., Dvorak, R. D., Prince, M. A., Hummer, J. F., & the Marijuana Outcomes Study Team (2017). The Protective Behavioral Strategies for Marijuana Scale: Further examination using item response theory. *Psychology of Addictive Behaviors, 31*(5), 548-559. https://doi.org/10.1037/adb0000271

Pedersen, E. R., Hummer, J. F., Venkataraman Rinker, D., Traylor, Z. K., & Neighbors, C. (2016). Measuring protective behavioral strategies for marijuana use among young adults. *Journal of Studies on Alcohol and Drugs, 77,* 441-450. https://doi.org/10.15288/jsad.2016.77.441

Peterson, R., Kramer, M. P., Pinto, D., De Leon, A. N., Leary, A. V., Marin, A. A., Cora, J. L., & Dvorak, R. D. (2021). A comprehensive review of measures of protective behavioral strategies across various risk factors and associated PBS-related interventions. *Experimental and Clinical Psychopharmacology, 29*(3), 236-250. https://doi.org/10.1037/pha0000498

Prime Research LLC. (2024). Find and manage high quality survey respondents through Amazon's MTurk. *CloudResearch.* https://www.cloudresearch.com/products/turkprime-mturk-toolkit/?ga_ref=turkprime-mturk-toolkit

Prince, M. A., Carey, K. B., & Maisto, S. A. (2013). Protective behavioral strategies for reducing alcohol involvement: A review of the methodological issues. *Addictive Behaviors, 38,* 2343-2351. https://doi.org/10.1016/j.addbeh.2013.03.010

Prince, M. A., Collins, R. L., Wilson, S. D., & Vincent, P. C. (2020). A preliminary test of a brief intervention to lessen young adults' cannabis use: Episodic-level smartphone data highlights the role of protective behavioral strategies and exercise. *Experimental and Clinical Psychopharmacology, 28*(2), 150-156. https://doi.org/10.1037/pha0000301

Qualtrics. (2004). *Fraud Detection.* Qualtrics. https://www.qualtrics.com/support/survey-platform/survey-module/survey-checker/fraud-detection/

Reid, A. E., & Carey, K. B. (2015). Interventions to reduce college student drinking: State of the evidence for mechanisms of behavior change. *Clinical Psychology Review, 40,* 213-224. https://doi.org/10.1016/j.cpr.2015.06.006

Richards, D. K., Schwebel, F. J., Pearson, M. R., & the Protective Strategies Study Team. (2022). A test of interaction effects between cannabis protective behavioral strategies and

antecedents of cannabis-related consequences. *Journal of Psychoactive Drugs*, *54*(1), 61-69. https://doi.org/10.1080/02791072.2021.1909188

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. https://doi.org/10.1016/j.drugalcdep.2018.05.020

Rosenberg, H., Bonar, E. E., Hoffmann, E., Kryszak, E., Young, K. M., Kraus, S. W., Ashrafioun, L., Bannon, E. E., & Pavlick, M. (2011). Assessing university students' self-efficacy to employ alcohol-related harm reduction strategies. *Journal of American College Health, 59*(8), 736-742. https://doi.org/10.1080/07448481.2010.537418

San Diego Research Foundation. (2021). *Cannabis*. eCHECKUP TO GO. https://www.echeckuptogo.com/programs/cannabis

Schulenberg, J. E., Patrick, M. E., Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Miech, R. A. (2021). *Monitoring the Future national survey results on drug use, 1975–2020: Volume II, College students and adults ages 19–60*. Ann Arbor: Institute for Social Research, The University of Michigan. http://monitoringthefuture.org/pubs.html#monographs

Shipley, J. L., & Braitman, A. L. (2024). Assessment of simultaneous alcohol and cannabis use and its related consequences and cognitions in college students: A narrative review. *Alcohol: Clinical and Experimental Research, 48*(2), 230-240. https://doi.org/10.1111/acer.15258

Simons, J. S., Dvorak, R. D., Merrill, J. E., & Read, J. P. (2012). Dimensions and severity of marijuana consequences: Development and validation of the Marijuana Consequences Questionnaire (MACQ). *Addictive Behaviors, 37*(5), 613-621. https://doi.org/10.1016/j.addbeh.2012.01.008

Skalisky, J., Wielgus, M. D., Aldrich, J. T., & Mezulis, A. H. (2019). Motives for and impairment associated with alcohol and marijuana use among college students. *Addictive Behaviors, 88,* 137-143. https://doi.org/10.1016/j.addbeh.2018.08.028

Stevens, A. K., Aston, E. R., Gunn, R. L., Sokolovsky, A. W., Treloar Padovano, H., White, H. R., & Jakson, K. M. (2021). Does the combination matter? Examining the influence of alcohol and cannabis product combinations on simultaneous use and consequences in daily life. *Alcoholism: Clinical and Experimental Research, 45*(1), 181-193. https://doi.org/10.1111/acer.14494

Stevens, A. K., Gunn, R. L., Boyle, H. K., White, H. R., & Jackson, K. M. (2022). Unplanned versus planned simultaneous alcohol and cannabis use in the daily lives of a predominantly white college student sample: What are the motives, contexts, and outcomes? *Psychology of Addictive Behaviors, 36*(3), 243-253. https://doi.org/10.1037%2Fadb0000813

Stride, C.B., Gardner, S., Catley, N. & Thomas, F. (2015) Mplus code for the mediation, moderation, and moderated mediation model templates from Andrew Hayes' PROCESS analysis examples. *Figure it out: Statistial consultancy and training.* http://www.offbeat.group.shef.ac.uk/FIO/mplusmedmod.htm

Substance Abuse and Mental Health Services Administration. (2020). *Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on*

Drug Use and Health (HHS Publication No. PEP20-07-01-001, NSDUH Series H-55). Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/sites/default/files/reports/rpt29393/2019NSDUHFFRPDFWHTML/2019NSDUHFFR1PDFW090120.pdf

Sugarman, D. E., & Carey, K. B. (2007). The relationship between drinking control strategies and college student alcohol use. *Psychology of Addictive Behaviors, 21*(3), 338–345. https://doi.org/10.1037/0893-164X.21.3.338

Sugarman, D. E., & Carey, K. B. (2009). Drink less or drink slower: The effects of instruction on alcohol consumption and drinking control strategy use. *Psychology of Addictive Behaviors, 23*(4), 577–585. https://doi.org/10.1037/a0016580

Treloar, H., Martens, M. P., & McCarthy, D. M. (2015). The Protective Behavioral Strategies Scale-20: Improved content validity of the serious harm reduction subscale. *Psychological Assessment, 27*(1), 340-346. https://doi.org/10.1037%2Fpas0000071

U.S. Department of Education, Institute of Education Sciences. (2022). *Characteristics of Postsecondary Students.* National Center for Education Statistics. https://nces.ed.gov/programs/coe/indicator/csb.

Waddell, J. T., McDonald, A. E., Shah, R., & Corbin, W. R. (2023). Daily relations among alcohol and cannabis co-use, simultaneous use, and negative consequences: A day-level latent profile analysis. *Cannabis, 6*(3), 9–17. https://doi.org/10.26828%2Fcannabis%2F2023%2F000171

Wechsler, H., Dowdall, G. W., Davenport, A., & Rimm, E. B. (1995). A gender-specific measure of binge drinking among college students. *American Journal of Public Health, 85*(7), 982-985. https://doi.org/10.2105/AJPH.85.7.982

White, H. R., Kilmer, J. R., Fossos-Wong, N., Hayes, K., Sokolovsky, A. W., & Jackson, K. M. (2019). Simultaneous alcohol and marijuana use among college students: Patterns, correlates, norms, and consequences. *Alcoholism: Clinical and Experimental Research, 43*(7), 1545-1555. https://doi.org/10.1111/acer.14072

Zhou, Y. (2019). A mixed methods model of scale development and validation analysis. *Measurement: Interdisciplinary Research and Perspectives, 17*(1), 38-47. https://doi.org/10.1080/15366367.2018.1479088

APPENDIX A

RECRUITMENT MATERIALS – FOCUS GROUPS

Student Announcements/Emails

Title: Participate in a Focus Group for $

Body: Participants are needed for a study that examines strategies college students use to protect themselves from negative consequences from using alcohol and cannabis simultaneously (at the same time). If you decide to participate, you will need to complete a screener survey to determine eligibility. Then, eligible individuals will be invited to participate in a focus group (your choice of either in person on campus or via Zoom). Participants joining via Zoom are expected to have their cameras on. The focus groups will last approximately an hour. Participants will have the opportunity to receive Sona credit (if applicable) or a $30 Amazon e-gift card.

To be eligible for the focus groups, you must be able to read, speak, and understand English, be a current college student, be at least 18 years old and no older than 25 years old, agree to have the session recorded, and have participated in simultaneous alcohol and cannabis use (that is, at the same time) at least monthly and at least twice in the past 30 days. To take the screener survey to see if you are eligible, please click here:
https://odu.co1.qualtrics.com/jfe/form/SV_879KVZZtA6MOIyG

If you have any questions, contact us at jship002@odu.edu.

Sona Announcement

ON or OFF - Protective behavioral strategies for simultaneous alcohol and cannabis use in college students

Credits: 1 (online) or 1.5 (in-person)

Duration: 1 hour

Brief Abstract: The current study examines simultaneous alcohol and cannabis use among college students to determine strategies students use to limit or reduce use and consequences via focus groups.

Description: Research is emerging regarding the co-use of alcohol and cannabis in college students. The current study examines simultaneous alcohol and cannabis use among college students to determine strategies students use to limit or reduce use and consequences.

If you decide to participate, you will join a focus group, lasting approximately 60 minutes. This is a session with other participants (up to 10) where the research moderators will ask questions related to simultaneous alcohol and cannabis or marijuana use and strategies you use to limit or

reduce use and consequences. Approximately 30 (no more than 300) college students will be participating in this study.

Participation will take place over Zoom or in person. If participating via Zoom, participants should choose a session when they have good internet access and are in an area where they have privacy.

Eligibility Requirements: To be eligible for the focus groups, you must be able to read, speak, and understand English, be a current college student, be at least 18 years old and no older than 25 years old, agree to have the session recorded, and have participated in simultaneous alcohol and cannabis use at least monthly and at least twice in the past 30 days.

After signing up for a timeslot, you must take the screening survey to ensure eligibility and be directed to Calendly, a scheduling software to confirm your participation in the focus group. If you have any questions, please contact Jennifer Shipley at jship002@odu.edu. SIGNING UP FOR A TIMESLOT ON SONA DOES NOT CONFIRM YOUR PARTICIPATION IN THE FOCUS GROUP.

Eligibility may change between the time you take the screening survey and when you participate in the focus group, so eligibility will be reconfirmed the day of the focus group.

APPENDIX B

INFORMED CONSENT DOCUMENT (ONLINE EXAMPLE)

PROJECT TITLE: Protective behavioral strategies for simultaneous alcohol and cannabis use in college students

INTRODUCTION

The purposes of this form are to give you information that may affect your decision whether to say YES or NO to participation in this research and to record the consent of those who say YES. "Protective behavioral strategies for simultaneous alcohol and cannabis use in college students" assesses alcohol and cannabis health behaviors and protective behavioral strategies via focus groups. The project takes place in person or online.

RESEARCHERS

Responsible Project Investigator: Abby L. Braitman, Ph.D., Assistant Professor, Department of Psychology, Old Dominion University, abraitma@odu.edu, 132-E Mills Godwin Building

Researcher: Jennifer L. Shipley, M.S., M.P.H., Graduate Student of Health Psychology, Department of Psychology, Old Dominion University, jship002@odu.edu

Research Assistant: Jessica Cobb, Department of Psychology, Old Dominion University

Research Assistant: Samantha Sexton, Department of Psychology, Old Dominion University

Research Assistant: Tionna Lancaster, Department of Psychology, Old Dominion University

DESCRIPTION OF RESEARCH STUDY

Research is emerging regarding the co-use of alcohol and cannabis in college students. The current study examines simultaneous alcohol and cannabis use among college students to determine protective behavioral strategies they use to limit or reduce use and consequences via focus groups.

If you decide to participate, you will join a focus group, lasting approximately 60 minutes. This is a session with other participants (up to 10) where the research moderators will ask questions related to simultaneous alcohol and cannabis or marijuana use and strategies you use to limit or reduce use and consequences related to use. Examples of questions that will be asked include, "What are some consequences you have experienced because of using alcohol and cannabis or marijuana simultaneously?" and "What are some strategies you use when using alcohol and cannabis or marijuana simultaneously to reduce or limit unwanted consequences?".
Approximately 30 college students (no more than 300) will be participating in this study.

Participation will take place over Zoom or in person. If participating via Zoom, participants should choose a session when they have good internet access and are in an area where they have privacy.

EXCLUSIONARY CRITERIA

You must be able to read, speak, and understand English to participate in this study. You must be a current college student. You must be at least 18 years old and no older than 25 years old. You must have used alcohol and cannabis or marijuana simultaneously (that is, at the same time) at least monthly and at least twice in the past 30 days. You must agree to have the focus group session recorded.

RISKS AND BENEFITS

RISKS: If you decide to participate in this study, it is possible you may experience some discomfort answering questions regarding your behaviors and actions. If you do not feel comfortable answering questions, you may not answer the question. If you would like to speak to someone at ODU Counseling Services you may call 757-683-4401 or go to 1526 Webb Center. If you are not an ODU student you can contact the Substance Abuse and Mental Health Services Administration (SAMHSA). SAMHSA runs a 24-hour mental health hotline that provides education, support, and connections to treatment at the number 1(800) 662-4357. The study may involve using a computer, so the risks involved with that are similar to typical computer use.

Additionally, identifying information will be collected from each participant for the purposes of compensation. Cannabis use is illegal federally and alcohol use is illegal for individuals under 21 years of age, and so all efforts will be made to safeguard your information. Files with identifying information will be stored on a password protected survey platform account prior to processing and when it is downloaded for analyzing it will be stored on a password-protected computer. Identifying information will only be accessed by the researchers. Moderators will take notes about the content of the focus group session, but will not record any names or other identifying information in those notes. If any focus groups have only one participant, it will be cancelled. A recording will be created during the focus group session. After both moderators have reviewed the notes taken for completeness, the recordings will be destroyed. If you are using public computers owned and operated by your academic institution there may be the possibility of institutional monitoring of your responses. And, as with any research, there is some possibility that you may be subject to risks that have not yet been identified.

BENEFITS: There are no direct benefits for participating in this study.

COSTS AND PAYMENTS

The researchers want your decision about participating in this study to be absolutely voluntary. Yet they recognize that your participation may pose some inconvenience and requires your time. In order to compensate your time, there will be two options for compensation. If you are enrolled at ODU and are eligible for Sona credit, you can choose to receive Sona credit (1 for online, 1.5 for in-person) for participating in the focus group. Or you can choose to receive a $30 Amazon e-gift card.

NEW INFORMATION

If the researchers find new information during this study that would reasonably change your decision about participating, then they will give it to you.

CONFIDENTIALITY

All information obtained about you in this study is strictly confidential. Identifying information will be collected for the purposes of informed consent and compensation. Moderators will take notes during the focus group session, but will not record identifying information. A recording will be created during the focus group session and will be destroyed once the moderators have reviewed their notes for completeness. The results of this study may be used in reports, presentations and publications, but the researchers will not identify you.

To help us protect your privacy, we have obtained a Certificate of Confidentiality from the National Institutes of Health. The researchers can use this Certificate to legally refuse to disclose information that may identify you in any federal, state, or local civil, criminal, administrative, legislative, or other proceedings, for example, if there is a court subpoena. The researchers will use the Certificate to resist any demands for information that would identify you, except as explained below.

You should understand that a Certificate of Confidentiality does not prevent you or a member of your family from voluntarily releasing information about yourself or your involvement in this research. If an insurer, medical care provider, or other person obtains your written consent to receive research information, then the researchers will not use the Certificate to withhold that information.

WITHDRAWAL PRIVILEGE

It is OK for you to say NO. Even if you say YES now, you are free to say NO later, and walk away or withdraw from the study -- at any time. Your decision will not affect your relationship with Old Dominion University, or otherwise cause a loss of benefits to which you might otherwise be entitled. The researchers reserve the right to withdraw your participation in this study, at any time, if they observe potential problems with your continued participation.

COMPENSATION FOR ILLNESS AND INJURY

If you say YES, then your consent in this document does not waive any of your legal rights. However, in the event of harm arising from this study, neither Old Dominion University nor the researchers are able to give you any money, insurance coverage, free medical care, or any other compensation for such injury. In the event that you suffer injury as a result of participation in this research project, you may contact Abby Braitman, Ph.D. Principal Investigator at abraitma@odu.edu, Jennifer Shipley, M.S., M.P.H., , Co-Investigator at jship002@odu.edu, or Dr. Tancy Vandecar-Burdin, the current IRB chair at 757-683-3802 at Old Dominion University, or the Old Dominion University Office of Research, at 757-683-3460, who will be glad to review the matter with you.

VOLUNTARY CONSENT

By agreeing to participate in this study by signing or typing your name, you are saying several things. You are saying that you have read this form, that you are satisfied that you understand this form, the research study, and its risks and benefits. If you have any questions about this research study now or in the future, please contact the co-investigator, Jennifer Shipley, M.S., M.P.H., at jship002@odu.edu or the principal investigator,
Abby L. Braitman, Ph.D., at abraitma@odu.edu.

If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. Tancy Vandecar-Burdin, the current IRB chair, at 757-683-3802, or the Old Dominion University Office of Research, at 757-683-3460.

And importantly, by signing or typing your name, you are telling the researcher YES, that you agree to participate in this study. Please print a copy of this form for your records or ask the researchers for a copy.

APPENDIX C

DEMOGRAPHIC SURVEY FOR FOCUS GROUPS

Q1. Are you an undergraduate or graduate student?

- Undergraduate
- Graduate
- Neither
- Other (please describe): _____

Q2. [If yes to Q1] What is your student status?

- Full-time
- Part-time

Q3. What is your involvement in social fraternities or sororities?

- A current member
- Currently pledging
- Not a member, but regularly or occasionally attend social fraternity and sorority events
- Not a member, and do not attend social fraternity and sorority events

Q4. What is your current residence?

- On-campus residence hall/dormitory
- Off-campus house or apartment (with roommates or on own)
- Off-campus with family
- Other (please describe):

Q5. Are you Hispanic or Latinx?

- Yes
- No
- Prefer not to answer

Q6. What racial group best describes you? (select all that apply)

- African American or Black
- Asian
- Native Hawaiian or another Pacific Islander
- White
- Native American or Alaska Native
- Middle Eastern or North African
- Other – please describe:

Q7. What is your class standing?

- Freshman
- Sophomore
- Junior
- Senior
- Graduate
- Other – please describe:

Q8. Are you an athlete on a college or university team?

- Yes
- No

Q9. What is your gender?

- Cisgender man (your gender identity corresponds to your sex assigned at birth)
- Cisgender woman (your gender identity corresponds to your sex assigned at birth)
- Transgender Man
- Transgender Woman
- Nonbinary
- Other (Please describe):

Q10. What is your marital status?

- Single
- In a committed relationship
- Married
- Divorced
- Other (Please describe):

Q11. There are many ways that individuals think of their sexual identity. Choose the identity(ies) that best describe you:

- Gay
- Lesbian
- Bisexual
- Queer
- Asexual
- Pansexual
- Questioning
- Heterosexual/straight
- Other (Please describe):

Q12. Can you read, speak, and understand English?

- Yes
- No

Q13. Do you agree to having the focus group session recorded (this is necessary for the researchers to have an accurate transcript for data analysis)?

- Yes
- No

Q14. Have you had an alcoholic drink in the past 30 days?

- Yes
- No

Q15. Have you used marijuana in the past 30 days?

- Yes
- No

Q16. [If yes to both alcohol and marijuana] How many days in the past 30 days did you use alcohol and marijuana at the same time **so that their effects overlapped**? _____

Q17. How frequently do you use alcohol and marijuana at the same time **so that their effects overlap?**

- At least daily
- At least once a week
- At least once a month
- At least every other month
- At least once every 6 months
- At least once a year
- Less than once a year
- Other (please describe)

Q18. How old are you? _____

Thank you for your participation! [If online] Please click the arrow below to submit your answers. [If in person] Please turn the form in to the research team.

APPENDIX D

FOCUS GROUP SCRIPT AND QUESTIONS

Introduction. Hello everyone. Thank you for participating in this study. I'm Jennifer, I am a graduate student in the Health Psychology Ph.D. program at Old Dominion University. [*RA will introduce themselves*]. We are designing a measure that will examine strategies college students use to protect themselves from experiencing harms when drinking alcohol and using marijuana. Today, we are interested in learning more about the strategies you use. To be eligible to participate today, you have all reported using alcohol and cannabis at the same time, such that their effects overlap, are 18-25 years old, are a current college student, and agreed to have this session recorded. Your responses will be used to design the measure and any statements you make here today will not be linked to your name.

[If on Zoom, continue with the following script. If not, skip to page 2] Is everyone using a laptop or other computer for this session? Please use the "raise your hand" feature in the reaction section at the bottom of your screen to confirm that you are using a laptop or computer.

[If some people say no:] We think using a phone or other small device will make taking the survey take much longer. Do you have access to a laptop or other computer that you can take the surveys on?

> [if they say yes, they have access:] You will probably complete the session faster if you log on from your computer. You can go ahead and access the study link from there. If you are using a phone/tablet now to have webcam access, you can stay logged in on that device, too (so we can chat on your phone, but you can complete the tasks on your computer). I can wait.
>
> [if they say no, they don't have access:] Okay.

[if their webcam is off:] If you have a webcam, we prefer that you use it.

> [if they turn their camera on:] Great, thank you.
>
> [if they indicate they are on a device without a camera:] If you like, and if your phone has a webcam, you could use also connect to the session on your phone and use the webcam on your phone to chat with me, but also stay on your laptop/computer to take the surveys. So you'll be logged into the session with both devices, so you can access the links you need through the Zoom chat on your computer, but talk to me on your phone with your camera on.

Is everyone in a place where you can comfortably participate in the study?

> [if yes, move on to Step 6]

[If no, wait for them to relocate if necessary (for example, move to a different room) and/or get headphones if needed.]

You will receive Sona credit or an Amazon e-gift card for your participation today. If you choose to receive Sona credit (and are in ODU's Sona system), you will receive 1 Sona credit if you are participating virtually, or 1.5 credits if you are participating in-person. If you choose to receive monetary compensation, you will receive a $30 Amazon e-gift card. You can only receive one form of compensation.

This is intended to be an open discussion, so everyone here should feel free to participate. Discussion and disagreement are encouraged. There is no need for the group to reach a consensus on an answer to any question. There are no right or wrong opinions, just different points of view. Please allow each individual in the group a chance to speak. Throughout this process, one of our moderators will facilitate the discussion and the other will be taking notes. We will also create a recording (through Zoom or other recording device) so that we can write a transcript to use when we analyze the data. Lastly, we ask that you please respect the confidentiality of the other people in the group and keep all information shared here today confidential. Please do not use people's names when discussing your experiences.

In order to participate and be compensated, you must complete the informed consent form. Please do that now (in person or through a link on Zoom). Once you have signed the informed consent form, you will be directed to complete a short survey (it should take about two minutes). You may see some items that are similar to the screening survey you completed, but we need to ask again just to confirm. It will ask questions about your background and substance use. We will also ask for email address if you chose to receive gift card compensation for your time today, or Sona ID if you choose Sona credit.

[*As participants complete the informed consent form and the demographic survey, the research team will double check eligibility to make sure that participants are still eligible for the study.*]

Everyone will be assigned a number so that we can use it for our notes and transcript without listing your name, to keep your responses confidential.

[*In person*] We will place a placard in front of you with that number now and ask that before you speak you say your number.

[*Virtual*] We will change your name to that number now and ask that before you speak you say your number.

Lastly, if you have a cell phone, please put it on silent or quiet mode. Are there any questions or concerns before we get started?

Topic Discussion

We will begin recording now. Let's start with an ice breaker. What is your favorite book or movie genre?

[*Make sure each participant says something before moving on to the next question*]

Do you have a favorite book or movie where the characters either use alcohol or cannabis, or talk about it? Which one(s)? Just as a note, throughout the discussion, we may switch off saying marijuana and cannabis. When we ask you about cannabis or marijuana, we mean any marijuana or cannabis product (pot, weed, hash) containing THC in any form (like smoking a joint or blunt, eating or drinking edibles, or using a bong, vaping, dabs, or concentrates). Do not consider use of CBD products with no THC. What words do you all typically use to refer to cannabis?

Outside of this study, have you heard of the phrase "simultaneous alcohol and cannabis use"? Where have you heard it used?

a. Do you see this as different from co-use? If yes, how do you define co-use?

Let's review some definitions to make sure we are all on the same page. When we say simultaneous alcohol and cannabis or marijuana use or using alcohol and cannabis at the same time, we mean using both alcohol and cannabis or marijuana so that their effects overlap. It could mean using them moments apart, but it could mean using one much later, like an hour or two later, but you can still feel the effects of the first substance. Sometimes people refer to this as being "cross-faded". What terms do you use for using alcohol and cannabis together (if any)?

1. When you use alcohol and cannabis at the same time, which one do you usually use first?
    a. Why do you choose to use alcohol/cannabis first?
    b. Does everyone agree? Again, it's okay if your experience is different.
2. When you use alcohol and cannabis simultaneously, what type of alcohol (like wine, beer, or liquor in mixed drinks or as shots) do you drink?
3. When you use alcohol and cannabis at the same time, what type of cannabis or marijuana do you use, such as smoking plant, applying a topical, eating a gummy or edible, etc.?
    a. Follow up if needed: How do you use cannabis? For example, if using plant or flower, do you use joints, blunts, etc.?
4. Why do you typically use alcohol and cannabis together?
    a. Prompts (if needed): For example, is it because others are doing it, you like the feeling, things like that.
    b. What are some things you like about using alcohol and cannabis at the same time?
5. What is different about using alcohol with cannabis compared to using alcohol alone?
    a. Prompts (if needed): For example, do you feel differently? Or do you feel more or less of the effects of one of the substances?
6. What is different about using cannabis with alcohol compared to using cannabis alone?
    a. Prompts (if needed): For example, do you feel differently? Or do you feel more or less of the effects of one of the substances?
7. Where do you use alcohol and cannabis simultaneously?
8. Who is with you when you use alcohol and cannabis at the same time?
    a. Prompts (if needed): Are you always with other people? Do you sometimes use both when you're alone and what are the differences between use alone and with others?

9. What are some things you do not like about using alcohol and cannabis simultaneously?
    a. Are the things you don't like about use alcohol and cannabis simultaneously different from when you use the alcohol and cannabis on their own?

Now let's spend some time talking about the things you may do before, during, after, or instead of using alcohol and cannabis at the same time. These can be things you do to try to reduce the experience of some of the things you do not like about using alcohol and cannabis simultaneously. Or things you do to make sure you don't get too intoxicated on a night when that's not your goal.

10. Are there specific strategies you use to protect yourself from harms or make sure you don't get too intoxicated when you're using simultaneously?
11. What are some strategies you use before using alcohol and cannabis at the same time to reduce or limit use or unwanted consequences?
    a. If they need examples: For example, a strategy you might use is set your limit for the night before going out.
    b. Are these strategies effective? Why do you think these strategies are effective?
12. What are some strategies you use during alcohol and cannabis simultaneous use to reduce or limit use or unwanted consequences?
    a. If they need examples: For example, a strategy you might use for alcohol use is to alternate between alcohol and a non-alcoholic beverage.
    b. Are these strategies effective? Why do you think these strategies are effective?
13. What are some strategies you use after using alcohol and cannabis at the same time to reduce or limit use or unwanted consequences?
    a. If they need examples: For example, a strategy you might use is using a designated driver.
    b. Are these strategies effective? Why do you think these strategies are effective?
14. What are some things you do instead of using alcohol and cannabis simultaneously?
    a. Are these strategies effective? Why do you think these strategies are effective?
15. What are things you do when deciding to use cannabis once you've already been drinking to help avoid consequences or make sure you don't get too intoxicated?
16. What are things you do when deciding to use alcohol once you've already used cannabis to help avoid consequences or make sure you don't get too intoxicated?

17. We've been talking about the strategies you all actually use, but what are other strategies you have seen others use that seem to be effective for them? Or perhaps strategies you've been thinking of trying but haven't yet?
18. What else would you like to talk about related to simultaneous alcohol and cannabis use that we did not discuss today?

Closing. Thank you all for coming today. Your participation is greatly appreciated. You should receive your participation credit within one week. The information you provided is very valuable for developing our measure. If you have any questions about this project, you may contact Jennifer Shipley at jship002@odu.edu.

If time questions:

1. Are there any barriers that you experience when trying to use the strategies we discussed today?
2. What is the potency (or percent THC) of the cannabis or marijuana you use when using it at the same time as alcohol?
3. How many standard drinks of alcohol do you drink when using it at the same time as cannabis?

APPENDIX E

EXPERT PANELISTS

Abby L. Braitman, Ph.D.: Dr. Braitman's research background includes assessment of protective behavioral strategies for alcohol use in college students, including in studies that assessed the effectiveness of interventions that included PBS, exploring appropriate response options for PBS assessment, and validity comparisons across multiple measures.

Adrian J. Bravo, Ph.D.: Dr. Bravo's research background includes assessment of protective behavioral strategies as well as assessment of alcohol and cannabis co-use in college students.

Ashley Linden-Carmichael, Ph.D.: Dr. Linden-Carmichael's research background includes expertise in assessment of alcohol and cannabis co-use among college students and young adults, as well as work on the unique impacts of specific PBS subscales.

Eric R. Pedersen, Ph.D.: Dr. Pedersen's research background includes assessments of protective behavioral strategies for both alcohol and cannabis use, especially the development of the PBSM.

Mark Prince, Ph.D.: Dr. Prince's research background includes assessment of protective behavioral strategies as well as assessment of alcohol and cannabis co-use among college students, including a review of the methodological issues regarding PBS assessment, and establishment of best practices for cannabis use assessment.

Hayley Treloar Padovano, Ph.D.: Dr. Treloar Padovano's research background includes psychometric examinations of assessments for protective behavioral strategies, specifically the PBSS-20.

APPENDIX F

RECRUITMENT MATERIALS – CROSS-SECTIONAL STUDY

Crowdsource Platforms

Screening Survey: Research is emerging regarding the co-use of alcohol and cannabis in college students. The main study examines simultaneous alcohol and cannabis use among college students, including consequences experienced, cognitions, contexts, types of alcohol and cannabis, and protective behavioral strategies they use to limit or reduce use and consequences. If you decide to participate, you will complete an online survey to assess your eligibility to participate in the main study, lasting approximately 2 minutes. Questions in the survey assess your alcohol and cannabis use (note, cannabis use is illegal at the federal level) and demographics. You must be able to read, speak, and understand English to participate in this study. You must be a current college student. You must be at least 18 years old and no older than 25 years old. You must reside in the United States. You must have used alcohol and cannabis or marijuana simultaneously (that is, at the same time) at least monthly and at least twice in the past 30 days. You must not have participated in the previous focus group study.

Main Survey: YOU MUST HAVE FIRST COMPLETED THE SCREENING SURVEY TO BE ABLE TO ACCESS THIS STUDY. Research is emerging regarding the co-use of alcohol and cannabis in college students. The current study examines simultaneous alcohol and cannabis use among college students, including consequences experienced, cognitions, contexts, types of alcohol and cannabis, and protective behavioral strategies they use to limit or reduce use and consequences. If you decide to participate, you will complete an online survey, lasting approximately 15 minutes. Questions in the survey assess your alcohol and cannabis use (note, cannabis use is illegal at the federal level), including related consequences, cognitions, contexts, types, and internalizing symptoms, such as depression, and social desirability. You must be able to read, speak, and understand English to participate in this study. You must be a current college student. You must be at least 18 years old and no older than 25 years old. You must reside in the United States. You must have used alcohol and cannabis or marijuana simultaneously (that is, at the same time) at least monthly and at least twice in the past 30 days. You must not have participated in the previous focus group study.

Sona Announcement

OFF - Protective behavioral strategies for simultaneous alcohol and cannabis use - Study 2

Credits: .5

Duration: 17 hour

Brief Abstract: The current study examines simultaneous alcohol and cannabis use among college students to determine strategies students use to limit or reduce use and consequences via a survey.

Description: Research is emerging regarding the co-use of alcohol and cannabis in college students. The main study examines simultaneous alcohol and cannabis use among college students, including consequences experienced, cognitions, contexts, types of alcohol and cannabis, and protective behavioral strategies they use to limit or reduce use and consequences.

If you decide to participate, you will complete an online survey to assess your eligibility to participate in the main study, lasting approximately 2 minutes. Questions in the survey assess your alcohol and cannabis use (note, cannabis use is illegal at the federal level) and demographics. No more than 10000 participants will be recruited for the study.

Eligibility Requirements: You must be able to read, speak, and understand English to participate in this study. You must be a current college student. You must be at least 18 years old and no older than 25 years old. You must reside in the United States. You must have used alcohol and cannabis or marijuana simultaneously at least monthly and at least twice in the past 30 days. You must not have participated in the previous focus group study.

Eligibility Requirements: Be able to read, speak, understand English; current college student; 18-25 years old; participated in simultaneous alcohol and cannabis use at least monthly and at least twice in the past 30 days

APPENDIX G

DAILY DRINKING QUESTIONNAIRE

Did you consume alcohol within the previous 30-days?

- Yes
- No

On how many days of the past 30-days did you consume alcohol? (dropdown options; range from 0-30).
For all questions that ask, **standard drinks** will be equal to:

- 12 ounces of hard seltzer, which is usually about 5% alcohol
- 12 ounces of regular beer, which is usually about 5% alcohol
- 8-9 ounces of craft beer, which is typically about 7% alcohol
- 4-5 ounces of wine, which is typically about 13% alcohol
- 1.5 ounces of liquor in a mixed drink, which is about 40% alcohol
- 1.5 ounces of 80 proof liquor, which is about 40% alcohol

The following questions refer to your alcohol use **in the past month**.
We ask that you select the number of standard drinks you consumed each day for a *typical week* in the past month. Please also indicate how many hours typically pass while you are drinking.
On a ***typical Monday***…
how many drinks do you have? [dropdown menu 0 - 30+]
how many hours typically pass while you are drinking? [dropdown menu 0 - 24]

On a ***typical Tuesday***…
how many drinks do you have? [dropdown menu 0 - 30+]
how many hours typically pass while you are drinking? [dropdown menu 0 - 24]

On a ***typical Wednesday***…
how many drinks do you have? [dropdown menu 0 - 30+]
how many hours typically pass while you are drinking? [dropdown menu 0 - 24]

On a ***typical Thursday***…
how many drinks do you have? [dropdown menu 0 - 30+]
how many hours typically pass while you are drinking? [dropdown menu 0 - 24]

On a ***typical Friday***…
how many drinks do you have? [dropdown menu 0 - 30+]
how many hours typically pass while you are drinking? [dropdown menu 0 - 24]

On a ***typical Saturday***…
how many drinks do you have? [dropdown menu 0 - 30+]

how many hours typically pass while you are drinking? [dropdown menu 0 - 24]

On a ***typical Sunday***…
how many drinks do you have? [dropdown menu 0 - 30+]
how many hours typically pass while you are drinking? [dropdown menu 0 - 24]

APPENDIX H

MARIJUANA USE GRID

Please think about your **typical marijuana use** over the **past 30 DAYS** for the following questions.
For each time window of each day of a typical week, please indicate how much marijuana you typically use at that time. Please select the number of grams, rounded to the nearest 0.25g. (ex. 0.25, 1.5, 2.75, etc.). If less than 0.25g, please select either 0.10 or 0.20, depending on how much you used.

Typical Monday…
6am-noon (drop down 0g-5.00+g)
noon-6pm (drop down 0g-5.00+g)
6pm-midnight (drop down 0g-5.00+g)
midnight-6am (drop down 0g-5.00+g)

Typical Tuesday…
6am-noon (drop down 0g-5.00+g)
noon-6pm (drop down 0g-5.00+g)
6pm-midnight (drop down 0g-5.00+g)
midnight-6am (drop down 0g-5.00+g)

Typical Wednesday…
6am-noon (drop down 0g-5.00+g)
noon-6pm (drop down 0g-5.00+g)
6pm-midnight (drop down 0g-5.00+g)
midnight-6am (drop down 0g-5.00+g)

Typical Thursday…
6am-noon (drop down 0g-5.00+g)
noon-6pm (drop down 0g-5.00+g)
6pm-midnight (drop down 0g-5.00+g)
midnight-6am (drop down 0g-5.00+g)

Typical Friday…
6am-noon (drop down 0g-5.00+g)
noon-6pm (drop down 0g-5.00+g)
6pm-midnight (drop down 0g-5.00+g)
midnight-6am (drop down 0g-5.00+g)

Typical Saturday…
6am-noon (drop down 0g-5.00+g)
noon-6pm (drop down 0g-5.00+g)

6pm-midnight (drop down 0g-5.00+g)
midnight-6am (drop down 0g-5.00+g)

Typical Sunday…
6am-noon (drop down 0g-5.00+g)
noon-6pm (drop down 0g-5.00+g)
6pm-midnight (drop down 0g-5.00+g)
midnight-6am (drop down 0g-5.00+g)

APPENDIX I

ASSESSMENT OF SIMULTANEOUS ALCOHOL AND CANNABIS USE

How many days in the past 3 months did you use alcohol and marijuana **so that their effects overlapped**? (dropdown menu; range from 0-92)

How many days in the past 30 days did you use alcohol and marijuana **so that their effects overlapped**? (dropdown menu; range from 0-30)

How frequently do you use alcohol and marijuana **so that their effects overlap**?

- At least daily
- At least once a week
- At least once a month
- At least every other month
- At least once every 6 months
- At least once a year
- Less than once a year
- Other (please describe):

APPENDIX J

PROTECTIVE BEHAVIORAL STRATEGIES FOR MARIJUANA SCALE – 13 ITEM VERSION

Please indicate the degree to which you engage in the following behaviors when using marijuana/cannabis over the past 3 months.

	0 = *Never*	2 = *Rarely*	3 = *Occasionally*	4 = *Sometimes*	5 = *Usually*	5 = *Always*
Use marijuana only among trusted peers						
Avoid using while spending time with family						
Avoid using marijuana before work or school						
Avoid using marijuana to cope with emotions such as sadness or depression						
Only purchase marijuana from a trusted source						
Use a little and then wait to see how you feel before using more						
Avoid mixing marijuana with other drugs						
Avoid using marijuana in public places						
Buy less marijuana at a						

time so you smoke less						
Have a set amount of "times" you take a hit (e.g., passing on a shared joint if you have already hit that limit)						
Avoid methods of using marijuana that can make you more intoxicated than you would like (e.g., using large bongs, volcano, 'edibles,' etc.)						
Only use one time during a day/night						
Limit the amount of marijuana you smoke in one sitting						

APPENDIX K

PROTECTIVE BEHAVIORAL STRATEGIES SURVEY-20

Please indicate the degree to which you engage in the following behaviors when using alcohol or "partying" over the past 3 months.

	0 = *Never*	2 = *Rarely*	3 = *Occasionally*	4 = *Sometimes*	5 = *Usually*	5 = *Always*
Use a designated driver						
Determine not to exceed a set number of drinks						
Alternate alcoholic and nonalcoholic drinks						
Have a friend let you know when you've had enough to drink						
Avoid drinking games						
Leave the bar/party at a predetermined time						
Make sure that you go home with a friend						
Know where your drink has been at all times						
Stop drinking at a predetermined time						
Drink water while						

drinking alcohol						
Put extra ice in your drink						
Avoid mixing different types of alcohol						
Drink slowly, rather than gulp or chug						
Avoid trying to keep up or out-drink others						
Refuse to ride in a car with someone who has been drinking						
Only go out with people you know and trust						
Avoid combining alcohol with marijuana						
Avoid “pre-gaming” (i.e., drinking before going out)						
Make sure you drink with people who can take care of you if you drink too much						
Eat before or during drinking						

APPENDIX L

PROTECTIVE BEHAVIORAL STRATEGIES FOR SIMULTANEOUS ALCOHOL AND CANNABIS USE (PBS4SAMM)

Instructions

The following questions are about using alcohol and cannabis such that their effects overlap, sometimes called being "cross-faded," and below called "simultaneous use." "Cannabis" is any product that contains THC used in any way (for example, weed, flower, bud, marijuana, carts, oils, or other products containing THC that are smoked, eaten, vaped, applied to skin or used in any way). Thinking back over the past 3 months, when you used alcohol and cannabis such that their effects overlap, how often did you use the following strategies to reduce or limit use or unwanted consequences (e.g., a hangover):

	0 = *Never*	1 = *Rarely*	2 = *Occasionally*	3 = *Sometimes*	4 = *Usually*	5 = *Almost Always*	6 = *Always*
Eat before or during, simultaneous use							
Drink water after simultaneous use							
Drink non-alcoholic beverages to slow down the use of alcohol or cannabis							
Purposefully choose the order of what you use first (in other words, choosing specifically to use alcohol then cannabis, or cannabis then alcohol)							
Limit the amount of alcohol and/or cannabis you use							
Pace yourself by spacing out the use of alcohol and cannabis							
Plan ahead to stay							

where you are or how to get home at the end of the night safely							
Set a specific time to stop using alcohol and cannabis							
Plan ahead to make sure you are in a safe place during use							
Be with people who will watch out for you							
Tell someone your limit of alcohol and/or cannabis use							
Listen to your body/check in with yourself to know when to stop using alcohol and cannabis							
Only use cannabis and alcohol that are from a trusted source							
Have at least one friend with you who is not drunk or high							
Set a limit for how much alcohol you plan to drink and/or how much cannabis you plan to use							
Avoid trying to keep up with or out do others							
Avoid using certain types of alcohol and cannabis (e.g., not edibles, not liquor)							
Use only when in a good headspace (e.g., not feeling emotional)							

Keep track of how much alcohol and cannabis you use							

The following questions are about when you had the opportunity to use alcohol and cannabis such that their effects overlap, sometimes called being "cross-faded," and below called "simultaneous use." "Cannabis" is any product that contains THC used in any way (for example, weed, flower, bud, marijuana, carts, oils, or other products containing THC that are smoked, eaten, vaped, applied to skin or used in any way). Thinking back over the past 3 months, when you had the opportunity to use alcohol and cannabis such that their effects overlap, how often did you use the following strategies:

	1 = *Never*	2 = *Rarely*	3 = *Occasionally*	4 = *Sometimes*	5 = *Usually*	6 = *Always*
Participate in a hobby						
Watch TV, movies, or videos on social media						
Go for a walk, run, or other form of exercise						
Choose to only use one substance (alcohol or cannabis)						
Tell your friends that you are not going to use alcohol and cannabis simultaneously						
Limit the number of days you use alcohol and cannabis simultaneously						

APPENDIX M

CONSEQUENCES OF SIMULTANEOUS ALCOHOL AND CANNABIS USE

Below is a list of things that sometimes happen to people either during, or after they have been drinking alcohol or using marijuana. Please check whether or not these things have happened to you because of your alcohol use alone, your marijuana use alone, and/or because of using alcohol and marijuana together so that their effect overlapped yesterday.

	Yes, due to alcohol use alone	Yes, due to marijuana use alone	Yes, due to using alcohol and marijuana so that their effect overlapped	No, I have not experienced this as a result of my alcohol and/or marijuana use
1. Had a hangover or felt in a fog this morning after I had been using yesterday				
2. My school work has suffered because of my use				
3. I had less energy or felt tired because of my use				
4. Have often ended up using on nights when I had planned not to use				
5. While using, I have said or done embarrassing things				
6. Have missed classes because of use, a hangover, or illness caused by use				
7. When using, I have done impulsive things I regretted later				
8. My use has created problems between myself and my romantic partner or parents				
9. Have felt like I needed to use after I'd gotten up (i.e., before breakfast)				
10. Have neglected my obligations to my family, work, or school because of my use				
11. Have often found it difficult to limit how much I use				
12. Have become very rude, obnoxious, or insulting after				

use				
13. Have felt very sick to my stomach or thrown up after using				
14. Have taken foolish risks when I have been using				
15. Have passed out from using				
16. Could no longer get high on the amount that used to get me high				
17. My use has gotten me into sexual situations that I later regretted				
18. Have woken up in an unexpected place after using heavily				
19. Have driven a car while under the influence				
20. Have gotten into physical fights because of my use				
21. Have been less physically active because of my use				
22. Have had trouble sleeping after stopping or cutting down on use				
23. Awoke today and found I could not remember a part of the evening yesterday				
24. Haven't been as sharp mentally because of my use				
25. Have received a lower grade on an exam or paper than I normally would have because of my use				
26. Have tried to quit using because I thought I was using too much				
27. Have felt anxious, irritable, lost my appetite or had stomach pains after stopping or cutting down use				
28. Have lost motivation to do things because of my use				

APPENDIX N

CESD-10

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past month.

	Rarely or None of the Time (1)	Some or a Little of the Time (2)	Occasionally or a Moderate Amount of Time (3)	Most or All of the Time (4)
I was bothered by things that usually don't bother me.				
I had trouble keeping my mind on what I was doing.				
I felt depressed.				
I felt that everything I did was an effort.				
I felt hopeful about the future.				
I felt fearful.				
My sleep was restless.				
I was happy.				
I felt lonely.				
I could not get “going”.				

APPENDIX O

MARLOWE-CROWNE SOCIAL DESIRABILITY SCALE

Listed below are a number of statements concerning personal attitudes and traits. Read each item and decide whether the statement is *true* or *false* as it pertains to you personally.

1. Before voting I thoroughly investigate the qualifications of all the candidates.
2. I never hesitate to go out of my way to help someone in trouble.
3. It is sometimes hard for me to go on with my work if I am not encouraged.
4. I have never intensely disliked anyone.
5. On occasion I have had doubts about my ability to succeed in life.
6. I sometimes feel resentful when I don't get my way.
7. I am always careful about my manner of dress.
8. My table manners at home are as good as when I eat out in a restaurant.
9. If I could get into a movie without paying and be sure I was not seen I would probably do it.
10. On a few occasions, I have given up doing something because I thought too little of my ability.
11. I like to gossip at times.
12. There have been times when I felt like rebelling against people in authority event though I knew they were right.
13. No matter who I'm talking to, I'm always a good listener.
14. I can remember "playing sick" to get out of something.
15. There have been occasions when I took advantage of someone.
16. I'm always willing to admit it when I make a mistake.
17. I always try to practice what I preach.
18. I don't find it particularly difficult to get along with loud mouthed, obnoxious people.
19. I sometimes try to get even rather than forgive and forget.
20. When I don't know something I don't at all mind admitting it.
21. I am always courteous, even to people who are disagreeable.
22. At times I have rally insisted on having things my own way.
23. There have been occasions when I felt like smashing things.
24. I would never think of letting someone else be punished for my wrongdoings.
25. I never resent being asked to return a favor.
26. I have never been irked when people expressed ideas very different from my own.
27. I never make a long trip without checking the safety of my car.
28. There have been times when I was quite jealous of the good fortune of others.
29. I have almost never felt the urge to tell someone off.
30. I am sometimes irritated by people who ask for favors of me.
31. I have never felt that I was punished without cause.
32. I sometimes think when people have a misfortune they only got what they deserved.
33. I have never deliberately said something that hurt someone's feelings.

APPENDIX P

DEMOGRAPHIC INFORMATION

What is your age?

Did you participate in the focus groups for this study (between August 2023-February 2024)? This would have been a live session via Zoom or in person where you were asked open-ended questions and provided your opinions and experiences about simultaneously using alcohol and cannabis. It was not offered through Mturk (recruitment was through a single institution in Virginia).

- Yes
- No

Are you an undergraduate or graduate student?

- Undergraduate
- Graduate
- Neither
- Other (please describe):

What is your student status?

- Full-time
- Part-time

How many credits are you enrolled in this semester?

What is your class standing?

- Freshman
- Sophomore
- Junior
- Senior
- Graduate
- Other (Please describe):

Can you read, speak, and understand English?

- Yes
- No

Are you Hispanic or Latinx?

- Yes
- No

Which racial group best describes you? (select all that apply):

- African-American/Black
- Asian
- Native Hawaiian or other Pacific Islander
- White
- Middle Eastern/North African
- Native American
- Other race not listed (Please describe): _____

What sex were you assigned at birth?

- Male
- Female
- Intersex

What is your gender?

- Cisgender man (your gender identity corresponds to your sex assigned at birth)
- Cisgender woman (your gender identity corresponds to your sex assigned at birth)
- Transgender Man
- Transgender Woman
- Nonbinary
- Another gender not listed (Please describe): _____

There are many ways that individuals think of their sexual identity. Choose the identity(ies) that best describe you:

- Gay
- Lesbian
- Bisexual+ (this could include but not limited to bisexual, pansexual, sexually fluid, or gender queer)
- Asexual
- Questioning
- Heterosexual/straight
- Other identity not listed (Please describe): _____

What is your marital status?

- Single
- In a committed relationship
- Married
- Divorced
- Other (Please describe): _____

Current residence:

- On-campus dormitory/residence hall
- On-campus living-learning community
- On-campus themed community
- Off-campus house or apartment
- Greek affiliated residence (fraternity/sorority)
- With family
- Other (Please describe): _____

What is your GPA? (fill in)

What is your involvement with social fraternities or sororities?

- A current member
- Currently pledging
- Not a member, but regularly or occasionally attend social fraternity or sorority social events
- Not a member, and do not attend social fraternity or sorority events

Are you an athlete on an ODU NCAA or club team?

- Yes
- No

What is your weight in pounds? (only enter the number): _____

What is your height in feet and inches? (drop down menu for both)

Which state do you currently live in?

In what year were you born?

Have you participated in a study where you have answered these exact same questions in the same order about the simultaneous use of alcohol and marijuana (excluding the screening survey for this study)? In other words, have you taken this same study before through a different platform?

- Yes
- No

APPENDIX Q

ATTENTION CHECKS

[Routes of cannabis administration] Select be sure to check this box to show you are paying attention

[Within PBSS-20 (Treloar et al., 2015)] Select 3 = Occasionally for this item

[Within CESD-10 (Andresen et al., 1994)] Select 2 = Some or a little of the time item

VITA

Jennifer L. Shipley

Department of Psychology
250 Mills Godwin Building
Norfolk, VA 23529

Email: jship002@odu.edu

Education

2024 (Anticipated)	**Ph.D.** Psychology, Old Dominion University; Norfolk, VA *A Mixed-Methods Study to Examine Protective Behavioral Strategies for Simultaneous Alcohol and Cannabis Use in College Students* Committee Chair: Abby L. Braitman, Ph.D.
2022	**M.S.** Psychology, Old Dominion University; Norfolk, VA Thesis Title: *Simultaneous Alcohol and Cannabis Use in College Students: Examining Context, Route of Administration, Cognitive Factors, and Consequences via Daily Diary* Committee Chair: Abby L. Braitman, Ph.D.
2016	**M.P.H.** Health Behavior-Health Promotion, The University of Arizona; Tucson, AZ Internship report title: *Comparison of Physical Activity Measures among Ovarian Cancer Survivors* Committee: Cynthia A. Thomson, Ph.D., RD, David O. Garcia, Ph.D., FACSM, and Jennifer W. Bea, Ph.D.
2014	**B.S.** Exercise Science, California Lutheran University; Thousand Oaks, CA Capstone title: *The Effect of Video Images on Motivation during Exercise* Presented to: Louise A. Kelly, Ph.D., and Hugh Lamont, Ph.D.