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Simultaneous Use of Alcohol and Marijuana: Patterns and Individual Differences

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Abstract

Background: Simultaneous alcohol and marijuana (SAM) use, or using alcohol and marijuana in such a way that their effects overlap, is associated with negative health and behavioral outcomes.

Objectives: Our study sought to fill gaps in our knowledge on this emerging public health concern by comparing SAM users and alcohol-only users on individual-level factors and substance use outcomes as well as examining associations of SAM use frequency, within users.

Methods: Participants were recruited through online postings. Our analytic sample consisted of 1,017 young adults (18–25 years) who reported past-month alcohol use. Most were male (67.8%), Caucasian (71.5%), and had attended at least some college (74.8%).

Results: Past-year SAM users reported higher levels of sensation seeking and greater perceptions of their close friends' drinking behavior in comparison to alcohol-only users. SAM users reported heavier and more frequent alcohol use than alcohol-only users. Within past-year SAM users, 70% reported SAM use at least weekly. More frequent SAM use was associated with all alcohol use outcomes (e.g., weekly quantity, frequency, alcohol-related problems) and marijuana use outcomes (e.g., quantity, frequency, peak use) and higher drinking norms.

Conclusions/Importance: It is clear that SAM users are a vulnerable sub-population of young adult drinkers. SAM users are differentiated from alcohol-only users in terms of their personality characteristics and perceptions of peer groups' drinking. SAM users and more frequent users are also at heightened risk for substance use outcomes. Prevention and intervention efforts targeting high-risk drinking may benefit from also assessing whether they simultaneously use alcohol and marijuana.

Keywords

simultaneous alcohol and marijuana use; marijuana use; heavy episodic drinking; young adults

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Substance use and risk for substance use disorders peak during young adulthood, or approximately 18 to 25 years old (Substance Abuse and Mental Health Services Administration, 2018). Alcohol and marijuana are the two most commonly used substances, with 59.6% and 19.6% of U.S. young adults reporting use in the past 30 days, respectively. Importantly, most individuals who use alcohol and marijuana tend to use both substances within the same occasion (i.e., simultaneous use), in such a way that the effects of both substances overlap (Briére, Fallu, Descheneaux, & Janosz, 2011; Subbarman & Kerr, 2015). Simultaneous alcohol and marijuana (SAM) users are at greater risk for a number of negative health and behavioral outcomes relative to drinkers who do not simultaneously use marijuana. Consequences include heavier alcohol use (Midanik, Tam, & Weisner, 2007; Terry-McElrath, O'Malley, & Johnson, 2013), drinking more than intended, having more plans to become intoxicated (Haas, Wickham, Macia, Shields, Macher, & Schulte, 2015), drinking-related academic problems (Briére et al., 2011), and symptoms of an alcohol use disorder (Midanik et al., 2007). Within-person laboratory-based evidence also points to unique risks for SAM use, such that driving is more impaired when combining alcohol and marijuana than when using either substance alone (Downey, King, Papafotiou, Swann, Ogden, Boorman, & Stough, 2013).

Prior findings highlight SAM users to be a vulnerable population (Midanik et al., 2007; Subbaraman & Kerr, 2015; Terry-McElrath et al., 2013), but in order to develop prevention and intervention efforts targeting this at-risk group, more information is needed regarding the individual-level factors associated with SAM use and SAM use behavioral patterns. Prevention and early intervention efforts, such as the Brief Alcohol Screening and Intervention for College Students (BASICS; Dimeff, Baer, Kivlahan, & Marlatt, 1999) and other brief motivational interventions are well-developed for reducing heavy alcohol use. However, alcohol interventions have not been efficacious in also reducing marijuana use (White et al., 2015) and interventions developed for alcohol and marijuana co-users have failed to reduce heavy drinking, marijuana use, or dual use (Stein et al., 2018). Thus, there may be unique challenges to reducing SAM use or use in general among SAM users. Identifying individuals who are most likely to be SAM users relative to individuals who use only alcohol, and identifying key individual risk factors that are associated with frequency of SAM use may help guide prevention and intervention content. There are some known demographic differences, such that individuals who are young adults (Subbaraman & Kerr, 2015), White (Terry-McElrath et al., 2013), male, and less educated (Midanik et al., 2007; Lipperman-Kreda, Paschall, Saltz, & Morrison, 2018) are more likely to be SAM users than single substance users or co-users who do not use both substances at the same time. Far less, however, is known about individual characteristics that may increase one's odds of being a SAM user or their frequency of SAM use.

One such individual-level factor related to SAM use may be sensation seeking. Sensation seekers are characterized by traits of seeking out novel or stimulating experiences (Roberti, 2004). Guided by theory (Horvath & Zuckerman, 1993; Zuckerman, 2007), sensation seeking may be relevant for SAM use for a couple of reasons. First, young adult sensation seekers are generally drawn toward engaging in higher levels of substance use, as substances can fulfill their need for stimulation (Adams, Kasier, Lynam, Charnigo, & Milich, 2012; Stamates & Lau-Barraco, 2017; Stautz & Cooper, 2013). Importantly, when using alcohol

and marijuana together, the effects of one substance can intensify the effects of the other (Downey et al., 2013); thus, this drug combination may be particularly reinforcing for sensation seekers. For example, in one experimental study among adults, relative to using either substance alone, the combination of alcohol and marijuana use produced the most intense drug effects after intake (Ronen et al., 2010). Sensation seekers may be drawn toward these intensified effects more so than using either substance alone. Second, sensation seekers perceive less risk associated with substance use, valuing the rewarding effects of substances over potential harms (Caspi, Roberts, & Shiner, 2005). Sensation seeking may be relevant for SAM use in particular given prior research demonstrating that young adults who perceived lower risk from co-using alcohol and marijuana had stronger daily associations between alcohol and marijuana use (Yeomans-Maldonado & Patrick, 2015). The intensified drug effects from combining substances and sensation seekers' propensity toward lower perceived risk may make sensation seekers more likely to engage in SAM use. Despite sensation seeking's strong association with increased alcohol and other substance use involvement, widely-used intervention programs (e.g., BASICS) typically do not include information about personality characteristics that may heighten their risk for substance use. Incorporating specific information about how one's level of sensation seeking may be related to their overall risk profile or substance use behaviors could be beneficial in reducing harms (e.g., Conrod, Castellanos, & Mackie, 2011).

Social drinking norms (i.e., perceptions of others' use) may be another individual-level factor tied to SAM use for a couple of reasons. First, engagement in SAM use appears to be social in nature. Among adults, SAM use is linked to using in bars, clubs, and at parties (Pakula, MacDonald, & Stockwell, 2009). Among adolescents, SAM use is linked to going out more often (Patrick, Kloska, Terry-McElrath, Lee, O'Malley, & Johnston, 2018; Terry-McElrath et al., 2013). Event-level research has identified socio-environmental characteristics uniquely tied to SAM use (Lipperman-Kreda, Gruenewald, Grube, & Bersamin, 2017). For example, in comparison to events involving only alcohol, SAM use events were more likely to involve being around others who were intoxicated, including events with >50% of those perceived to be intoxicated. Thus, social environments, particularly those characterized by alcohol use, may be high-risk for SAM use involvement. Further, given the strong social nature of SAM use, SAM users may be vulnerable to overestimating alcohol use by their peers which in turn may increase their own substance use (Borsari & Carey, 2001, 2003). Second, if SAM use is positively associated with sensation seeking, it is plausible that young adult SAM users also have higher normative perceptions of peer drinking given their susceptibility to risky situations and peer influences. Using the corresponsive principle (Caspi et al., 2005), certain personality characteristics (e.g., sensation seeking) can predict the likelihood of selecting into high-risk activities that in turn reinforce these traits. Sensation seekers may opt into risky situations, such as drinking with peer groups prone to heavier use, that reinforce their own behavior. Higher perceptions of friends' drinking has been found to elicit changes in sensation seeking among college students (Quinn, Stappenbeck, & Fromme, 2011). Therefore, sensation seekers may be more susceptible to peer influences. Given the utility of using this principle to understand heavy drinking behavior (Quinn et al., 2011), it may be a useful starting point for better understanding psychosocial factors salient to SAM use.

A key gap in our knowledge regarding SAM use involves SAM use patterns. To date, we know that SAM users are at greater risk for heavier overall alcohol use quantity and harms from drinking (Midanik et al., 2007; Subbaraman & Kerr, 2015) and that SAM users use marijuana more often than drinkers who do not simultaneously use marijuana (Subbaraman & Kerr, 2015). Much information remains unknown, such as how often individuals engage in SAM use and whether differences exist between SAM users and alcohol-only users in terms of their alcohol use behaviors such as peak levels or their engagement in drinking at potentially dangerous levels (high-intensity drinking [8+/10+ drinks in an occasion for women/men]) (Patrick, 2016). Furthermore, limited research has examined associations within SAM users, such as the relationship between SAM use frequency and substance use outcomes. Knowing how SAM user status and SAM use frequency associates with substance use behaviors as well as how often such SAM use episodes occur is important for prevention scientists and interventionists working with SAM users. This information could also help provide the groundwork for more fine-grained studies, such as daily diary investigations aiming to understand day- or moment-level SAM use behavior.

Current Study

Our study aimed to fill several gaps in our knowledge on SAM use behavior, an emerging area of public health concern. Specifically, we aimed to extend in two ways our basic knowledge of demographic differences in SAM users and alcohol-only users as well as frequency of SAM use within SAM users. First, as guided by principles from sensation seeking theories and the corresponsive principle, we aimed to identify sensation seeking and drinking norms as individual-difference factors associated with SAM user status. We hypothesized that past-year SAM users would report higher levels of sensation seeking and descriptive drinking norms than alcohol-only users. We also hypothesized that, within past-year SAM users, more frequent SAM use would be associated with higher sensation seeking and descriptive drinking norms. Second, we aimed to examine previously unexplored patterns of SAM use. We sought to identify, within past-year SAM users, (a) how often SAM use episodes occur and (b) how frequency of SAM use associates with alcohol use outcomes (number of drinks consumed per drinking day, frequency of drinking, typical weekly quantity, frequency of engagement in heavy episodic drinking (4+/5+ drinks in an occasion for women/men), engagement in high-intensity drinking, peak levels of alcohol use, duration of drinking episodes, alcohol-related harms) and marijuana use outcomes (average number of joints per use occasion, frequency of marijuana use, typical weekly quantity, peak number of joints used in a day). We also examined differences between past-year SAM users and alcohol-only users in terms of alcohol use outcomes. We hypothesized that SAM users would report poorer alcohol use outcomes than alcohol-only users and that within SAM users, more frequent SAM use would associate with poorer alcohol and marijuana use outcomes.

Method

Participants and Procedure

Participants were 1,035 young adults aged 18–25 years who reported consuming alcohol at least once during the past 30 days. Of our sample of 1,035 past-month drinkers, 41.7% (n = 432) were “alcohol-only” users, or did not report any SAM use in the past 12 months. Approximately 57% (n = 585) reported SAM use. Thus, our final analytic sample consisted of 1,017 alcohol-only users or SAM users. Demographics for the analytic sample and by SAM user status are reported in Table 1.

Data were collected in February-July 2016. Participants were recruited using public postings via Craigslist, a widely used webpage featuring primarily free online advertisements. Study advertisements were posted mainly in the volunteer section and were posted weekly in each U.S. city available. Each state, within the exception of New Hampshire, was represented by at least one individual in our analytic sample. Regarding U.S. geographic distribution, 13.6% of participants resided in the Northeast, 18.6% resided in the Midwest, 35.9% resided in the South, and 31.9% resided in the West, which is fairly comparable with current U.S. Census data (www.census.gov). Interested participants read a brief description and were directed to an online screening form. Participants responded to a set of screening questions that took approximately five minutes to complete to determine their eligibility. After providing consent, participants were administered an online battery of measures that took approximately 40 minutes to complete. Participants were compensated $15. This study was approved by the university’s institutional review board and followed American Psychological Association (APA, 2010) ethical guidelines.

Measures

Alcohol use.—The Daily Drinking Questionnaire (DDQ) (Collins, Parks, & Marlatt, 1985) assessed typical alcohol consumption. Participants reported the number of standard alcoholic beverages they usually consumed each day during a typical week over the past three months. Weekly alcohol use indicators included the average number of drinks consumed per drinking day, total number of drinks consumed during a typical week, frequency, frequency of heavy episodic drinking (i.e., number of drinking days in which they consumed 4+/5+ drinks for women/men), peak number of drinks on a drinking day, and whether they engaged in high-intensity drinking (i.e., 8+/10+ drinks for women/men; Patrick, 2016) during at least one occasion.

Marijuana use.—The DDQ was adapted to assess typical marijuana use during an average week (Collins, Bradizza, & Vincent, 2007; Pearson, Hustad, Neighbors, Conner, Bravo, & Marijuana Outcomes Study Team, 2018). Participants were asked to report the number of joints they used each day during a typical week in the past three months. Weekly marijuana use indicators included the average number of joints used per occasion, use quantity, frequency, and peak use.

Simultaneous alcohol and marijuana (SAM) use.—The Simultaneous Polydrug Use Questionnaire (DUQ) (Martin, Clifford, Maisto, Earleywine, Kirisci, & Longabaugh, 1996)

assessed frequency of SAM use over the past 12 months. Simultaneous use was defined as use of the two substances occurring within a few hours of each other. Participants were coded based on whether they simultaneously used alcohol and marijuana in the past 12 months (1 = "SAM users", 0 = "alcohol-only users"). For participants who ever engaged in SAM use, we asked a follow-up question about their past-year frequency with responses of *never in the past year* (0), *once a month or less* (1), *2–3 times per month* (2), *once a week* (3), *2–4 times per week* (4), and *5–7 times per week* (5).

Alcohol-related problems.—The Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ) (Kahler, Strong, & Read, 2005) was used to assess alcohol-related problems. The BYAACQ is a 24-item questionnaire that measures problems experienced in the past year. Response options consist of "*yes*" (2) or "*no*" (1) (e.g., "When drinking, I have done impulsive things that I regretted later"). Total scores were summed, with higher scores indicative of more harms experienced. In the current study, $\alpha = .87$.

Sensation seeking.—The Brief Sensation Seeking Scale (BSSS) (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002) was used to assess typical sensation seeking behaviors. The BSSS is an 8-item measure that asks participants to report the degree to which they agree with a variety of statements (e.g., "I would love to have new and exciting experiences, even if they are illegal"). Response options were *strongly disagree* (1), *disagree* (2), *uncertain/unsure* (3), *agree* (4), and *strongly agree* (5). Scores were summed to create a total sensation seeking score, with higher scores indicating a greater propensity to engage in sensation seeking behaviors. In the current study, $\alpha = .79$.

Descriptive norms.—The Descriptive Norms Rating Form (DNRF) (Baer, Stacy, & Larimer, 1991) was used to evaluate perceptions of alcohol use by close friends. Participants were asked to estimate the typical number of drinks their close friends consumed each day during an average week over the previous three months. Number of drinks consumed during a typical week was used as an index of alcohol use quantity for their close friends.

Data Analytic Plan

Given that the data were collected online, several validity checkpoints were included to ensure the integrity of the data. Specifically, participants were asked to provide unique identifying information twice in the survey, and it was required for these data to match. Another validity checkpoint included was that all surveys must have taken at 30 minutes to complete, given the length of the survey. Lastly, there were five validity questions asked throughout the survey to ensure participants were responding appropriately to survey items. Basic questions such as, "How many days are in a week?" were asked, and participants were required to respond correctly. Individuals who did not pass these validity checkpoints were removed from the study. These strategies support the integrity of study data.

Prior to conducting analyses, data were inspected for outliers and missing data. To reduce the impact on statistical estimates, extreme scores were Winsorized to match the next highest score (Barnett & Lewis, 1994). Pairwise deletion was used to account for missing data. A series of chi-square tests were conducted to determine whether there were

associations between SAM user status and demographic variables reported in Table 1 (sex, age, ethnicity, employment, highest grade completed, current college enrollment, relationship status, and living situation). Frequencies were used to assess overall descriptive SAM use patterns among SAM users. Independent samples *t*-tests were used to examine differences on alcohol use outcomes, marijuana use outcomes, sensation seeking, and descriptive drinking norms. A Bonferroni correction was applied to account for multiple comparisons (i.e., eight comparisons; adjusted critical *p*-value = .006). When the assumption of homogeneity of variance was violated, the Welch *F*-ratio was analyzed. All results remained significant. A chi-square analysis was used to determine the relationship between SAM user status on whether the participant engaged in high-intensity drinking during a typical week. For alcohol-related problems, an analysis of covariance (ANCOVA) was used to test differences between SAM users and alcohol-only users on alcohol-related problems, while controlling for unique demographic covariates, the average number of drinks on a drinking occasion, and the average number of joints on a use occasion. Associations between SAM use frequency and substance use outcomes (i.e., alcohol use indicators, marijuana use indicators) were tested in separate regression models after controlling for unique demographic covariates. Logistic regression was used to test the association between SAM use frequency and odds of reporting high-intensity drinking. To test the specific association between SAM use frequency and alcohol-related problems, a regression model was tested that controlled for demographic covariates and the typical number of drinks and joints used during an average use occasion.

To determine which demographic covariates to include in models comparing SAM users and alcohol-only users, all demographics listed in Table 1 were entered simultaneously in a logistic regression model predicting SAM user status. To enhance interpretation, categorical variables (e.g., living situation) were coded dichotomously with the largest group coded as "1" and all others coded as "0." Sex, age, race/ethnicity, employment status, highest grade in school, and relationship status were uniquely associated with SAM user status and were thus included in all analyses involving comparisons between SAM users and alcohol-only users. For models testing SAM use frequency, demographic factors uniquely associated with SAM use frequency (i.e., sex, race/ethnicity, employment status, highest grade in school, and living situation) were included as covariates.

Results

Sample Descriptive Statistics

Comparisons between SAM-users and alcohol-only users on demographics revealed significant differences on sex, age, ethnicity, employment, highest grade completed, current college enrollment, relationship status, and living situation, $p < .001$ (see Table 1). Typical substance use behavior for the sample and by user status is provided in Table 2. Among participants who reported SAM use at least once in the past 12 months, 2.7% reported SAM use 5–7 times per week, 63.6% reported SAM use 2–4 times per week, 5.6% reported once a week, 8.7% reported 2–3 times per month, and 19.3% reported about once a month or less.

SAM Users vs. Alcohol-Only Users

Across all alcohol use outcomes, results revealed a significant difference on user status, such that SAM users reported poorer alcohol use outcomes across all measures (see Table 2). SAM users, compared to alcohol-only users, also reported significantly higher levels of sensation seeking and higher descriptive norms of close friends. All models remained significant at the $p < .001$ level after controlling for demographic factors uniquely associated with SAM user status (i.e., sex, age, race/ethnicity, employment status, highest grade, and relationship status). A one-way ANCOVA revealed a significant difference between SAM users and alcohol-only users on alcohol-related problems while controlling for demographic factors, typical number of drinks, and typical number of joints used per use occasion, $F(1,995) = 17.41$, $p < .001$, $\eta^2 = .02$.

SAM Users

Among past-year SAM users, more frequent SAM use was positively correlated with descriptive norms and unassociated with sensation seeking. More frequent SAM use was associated with all alcohol use outcomes including weekly quantity, frequency, HED frequency, time spent drinking, peak use, drinks per drinking day, and odds of engagement in high-intensity drinking. More frequent SAM use was also positively associated with all marijuana use outcomes, including marijuana use quantity, frequency, peak use, and joints per use day. After controlling for amount of alcohol and marijuana used on an average use day, more frequent SAM use was positively associated with number of alcohol-related problems experienced. Demographic factors uniquely associated with SAM use frequency (i.e., sex, race/ethnicity, employment status, highest grade, and living situation) were included as covariates in all regression models. Findings are displayed in Table 3.

Discussion

Our study findings revealed key differences between past-month SAM users and alcohol-only users. Demographically, SAM users were more likely to be male, younger, White, employed part-time, completed some college/college, currently enrolled in college, single, and living in a campus-affiliated residence. Our findings with respect to gender and race/ethnicity are generally consistent with that of prior work (e.g., Midanik et al., 2007; Terry-McElrath et al., 2013). Findings that individuals who had completed some college or were currently enrolled in college are interesting in light of previous literature suggesting that individuals less educated were more likely to report SAM use (Subbaraman & Kerr, 2015). It is important to note, however, that findings from Subbaraman and Kerr were derived from the 2005 and 2010 National Alcohol Survey. Slightly more recent research (2007 – 2016) from the Monitoring the Future data is more in line with our findings such that SAM users were more likely to attend college full-time and report not living with their parents (Patrick, Terry-McElrath, Lee, & Schulenberg, 2019). In light of legalization changes and historical increases in SAM use among early and mid-young adult drinkers (Terry-McElrath & Patrick, 2018), it is possible that SAM use is becoming more normative, thereby shifting the demographic makeup of SAM users.

For individual-level factors and substance use outcomes associated with SAM use, SAM users reported higher levels of sensation seeking than alcohol-only users. Interestingly, SAM use frequency was found to be unassociated with sensation seeking, possibly suggesting that sensation seekers may be drawn toward engaging in SAM use in general but not necessarily more often. SAM users also indicated their closest friends to drink over four times more standard alcoholic drinks during a week than alcohol-only users. Far less work has focused on identifying individual characteristics of SAM users; these findings suggest that SAM users differ not only on the negative substance use outcomes they experience, but also the individual characteristics that may predict their odds of *being* a SAM user. As the field moves toward developing interventions that target unique characteristics of SAM users, it is critical that we continue to explore the personality characteristics, motivations (Patrick, Fairlie, & Lee, 2018), and situations (Lipperman-Kreda et al., 2018) that distinguish SAM users from alcohol-only users.

In terms of substance use behavior, within only past-year SAM users, most (71.9%) individuals reported SAM use at least once a week: of these, 63.6% used 2 to 4 times per week and 2.7% used 5 to 7 times per week. Compared to alcohol-only users, SAM users also drank more than three times as heavily during a typical week, drank twice as frequently, had more than twice as frequent HED occasions, consumed more than twice as much during a typical drinking occasion, and spent nearly twice as much time drinking during a typical week than alcohol-only users. Moreover, more SAM users reported high-intensity drinking than alcohol-only users (25% vs. 6%, respectively). SAM users experienced more alcohol-related harms during the past year than drinkers. This difference occurred above the number of drinks *and* joints used on a typical occasion, indicating that the risks posed by SAM use extend beyond SAM users simply using more substances. Differences between SAM users and alcohol-only users are consistent with prior work finding that SAM users are a heavier substance using group (Subbaraman & Kerr, 2015), but less attention has been placed on examining predictors and outcomes of SAM use *within* SAM users. This study revealed that in addition to SAM users being a risky subgroup in comparison to drinkers, within SAM users, more frequent SAM use was also associated with poorer alcohol use and marijuana use outcomes. This between- and within-person is an important distinction to make, as this suggests that SAM users are not only at increased risk for experiencing harms, but that this risk is especially problematic among frequent SAM users. It is also interesting to note very few (<2%) individuals in our larger sample (18 of 1,035) reported recent alcohol and marijuana use, but not simultaneous use. In concert with prior work examining concurrent versus simultaneous use (Subbaraman & Kerr, 2015), individuals who use both substances tend to use them at the same time. Importantly, simultaneous users are at higher risk for certain negative outcomes, such as drunk driving, than concurrent users.

Our findings suggest that relative to individuals who only use alcohol, individuals who simultaneously use alcohol and marijuana are at a disproportionately higher risk for heavy, frequent, and problematic substance use. Further, this risk appears to increase with the frequency in which individuals engage in SAM use. Our findings highlight the need for prevention and intervention efforts that address the co-use of alcohol and marijuana. As interventions aimed at reducing one specific substance have limited or no secondary effects on reducing use of the other substance (White et al., 2015) and interventions have not

successfully reduced combined alcohol and marijuana use (Stein et al., 2018), it is possible that SAM users may benefit from clinical work that is tailored to unique circumstances of SAM use. Our findings and those of past research focused on perceptions of risk (Yeomans-Maldonado & Patrick, 2015) suggest that there are individual-level characteristics that may differentiate alcohol users from SAM users. Correcting misperceptions of risk in addition to focusing on the role of sensation seeking behavior and one's perceptions of peer drinking may be critical pieces to focus on in the context of prevention and intervention.

Results from our study have important implications for future research investigating SAM use. It is clear that there are demographic, personality, and social perceptions that are associated with greater odds of being a SAM user and that SAM users on average experience heavier use and more consequences. Less understood are within-person differences in SAM use behavior. Knowledge of whether SAM use on a given occasion *increases* one's risk for heavy alcohol use and harms (i.e., within-person differences) or whether SAM users are at greater risk overall (i.e., between-person differences) is imperative for intervention development targeting young adult drinkers. Recent daily diary evidence suggests the former, with findings indicating that college students reported more alcohol-related harms, such as blacking out from drinking and getting more intoxicated than planned, in comparison to occasions involving only alcohol use (Mallett, Turrisi, Hultgren, Sell, Reavy, & Cleveland, 2017). Further, although our findings support sensation seeking as an important between-person risk factor, sensation seeking may also vary within-person at the daily level (Lydon-Staley & Bassett, 2019). Thus, it may be beneficial to identify whether daily fluctuations in sensation seeking coincide with the likelihood of a SAM use occasion or greater SAM-related harms on the same day. Other factors uniquely associated with SAM use, such as motivations (Patrick et al., 2018), expectancies, and contexts (Lipperman-Kreda et al., 2018; Pakula et al., 2009), should also be explored in future daily diary investigations of young adult SAM users.

There are limitations to the present research that should be noted. Primarily, our substance use data are based on self-report, which have the potential to be impacted by recall biases or social desirability concerns. Some evidence supports the validity of self-reported drinking behavior (Simons, Wills, Emery, & Marks, 2015), but future work may consider the use of daily diary approaches to decrease the reliance on recall. Second, our results are based on cross-sectional data; therefore, causality cannot be inferred. Third, our sample consisted of mostly men (67%), which may limit generalizability to women. Fourth, we only inquired about number of joints used when assessing marijuana use. While assessing quantity of marijuana use through asking about the number of joints consumed is consistent with prior research (Collins et al., 2007) and shown to be a reliable assessment tool (Robinson, Sobell, Sobell, & Leo, 2014), the rapidly changing landscape surrounding marijuana use such as the growing number of options for cannabis use (e.g., edibles) necessitates future research on a broader assessment of marijuana use. Fifth, our sample reported considerably higher number of joints per week that prior work (Collins et al., 2007). It is unclear whether these differences are attributed to a higher-risk sample, or are an artifact of participants overestimating their marijuana use quantity (Prince, Conner, & Pearson, 2018). Sixth, we had a small ($n = 18$) sample who reported recent alcohol and marijuana use but not SAM use, precluding us from making comparisons between SAM, concurrent, and alcohol-only

users. Finally, our sample consists of individuals residing in states with different marijuana legislation; future research with larger samples should consider the role of legality in study findings. Despite limitations, our findings add to the growing body of literature on SAM use by highlighting key psychosocial factors associated with SAM use and SAM use frequency, and documenting large differences in substance use outcomes. Given rapidly changing legislature surrounding recreational marijuana use, it is imperative that researchers continue to expand our understanding of factors that predict and maintain SAM use, and the consequences that can occur.

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Table 1

Demographic Frequencies of Final Analytic Sample

Variable	Total (n=1017) n (%)	Alcohol-Only Users (n=432) n (%)	SAM Users (n=585) n (%)	*df*	χ^2
Sex				1	159.88*
Male	690 (67.8)	200 (46.3)	490 (83.8)		
Female	327 (32.2)	232 (53.7)	95 (16.2)		
Ethnicity				5	155.25*
Caucasian/White	727 (71.5)	220 (50.9)	507 (86.7)		
African American/Black	145 (14.3)	94 (21.8)	51 (8.7)		
Native American/Indian	57 (5.6)	44 (10.2)	13 (2.2)		
Asian/Pacific American	51 (5.0)	46 (10.6)	5 (0.9)		
Hispanic/Latino	55 (5.4)	32 (7.4)	23 (3.9)		
“Other”	9 (0.9)	5 (1.2)	4 (0.7)		
Employment				3	173.22*
Full-time only	176 (17.3)	131 (30.3)	45 (7.7)		
Part-time only	546 (53.7)	140 (32.4)	406 (69.4)		
Part-time and full-time	92 (9.0)	34 (7.9)	58 (9.9)		
Unemployed	201 (19.8)	127 (29.4)	74 (12.6)		
Highest grade completed				3	176.50*
< high school	34 (3.3)	25 (5.8)	9 (4.0)		
GED/high school diploma	220 (21.7)	156 (36.1)	64 (10.9)		
Some college/college	713 (70.1)	209 (48.4)	504 (86.2)		
Graduate school	48 (4.7)	42 (9.7)	6 (1.0)		
Current College Enrollment				1	88.51*
Yes	609 (59.9)	186 (43.1)	423 (72.3)		
No	408 (40.1)	246 (56.9)	162 (27.7)		
Relationship Status				4	41.29*
Single/never married	866 (85.2)	371 (85.9)	495 (84.6)		
Living with partner	92 (9.0)	19 (4.4)	73 (12.5)		

Variable	Total (n=1017) n (%)	Alcohol-Only Users (n=432) n (%)	SAM Users (n=585) n (%)	*df*	χ^2
Married	38 (3.7)	30 (6.9)	8 (1.4)		
Widowed	1 (0.1)	1 (0.2)	0		
Separated/divorced	18 (1.8)	10 (2.3)	8 (1.4)		
Living Situation				4	80.40 *
Parent's or relative's home	388 (38.2)	181 (41.9)	207 (35.4)		
College dorm/residence hall/apartment	319 (31.4)	74 (17.1)	245 (41.9)		
House/apartment/room (not college-affiliated)	302 (29.7)	174 (40.3)	128 (21.9)		
Fraternity/sorority house	3 (0.3)	2 (0.5)	1 (0.2)		
Other	3 (0.3)	1 (0.2)	2 (0.3)		
	M (SD)	*M (SD)*	*M (SD)*	*df*	*t*
Age	21.66 (1.76)	22.11 (1.84)	21.32 (1.62)	1014	7.21 *

Note. SAM = simultaneous alcohol and marijuana (within past year). Does not include missing values.

* $p < .001$

Table 2

Descriptive Statistics among SAM Users and Alcohol-Only Users on Study Variables

Variable	Overall	Alcohol-Only Users	SAM Users			
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*df*	*t*	*d*
Psychosocial Factors						
BSSS	28.02 (5.81)	25.56 (7.06)	29.83 (3.76)	1000	−12.33*	0.75
Descriptive Drinking Norms	28.41 (26.36)	9.30 (12.41)	41.87 (25.25)	985	−24.08*	1.64
Marijuana Use Weekly						
Marijuana Use Quantity	-	-	42.89 (27.48)	-	-	-
Marijuana Use Frequency	-	-	5.78 (2.40)	-	-	-
Peak Use	-	-	8.69 (5.16)	-	-	-
Joints per Use Day	-	-	6.27 (3.75)	-	-	-
Alcohol Use Weekly						
Alcohol Use Quantity	18.51 (18.01)	7.63 (10.83)	26.17 (18.12)	976	−18.38*	1.24
Alcohol Use Frequency	4.56 (2.77)	2.53 (2.45)	5.99 (1.98)	976	−24.40*	1.55
HED Frequency	0.25 (0.34)	0.13 (0.28)	0.34 (0.35)	1009	−10.44*	0.66
Number of Hours Drinking	8.80 (5.91)	6.00 (6.67)	10.43 (4.71)	902	−11.66*	0.77
Peak Drinks	5.12 (4.72)	2.99 (3.57)	6.68 (4.84)	1005	−13.29*	0.87
Drinks per Drinking Day	3.26 (2.60)	2.06 (2.21)	4.11 (2.51)	976	−13.20*	0.85
		n (%)	*n* (%)	*df*	χ^2	
High-Intensity Drinking Occasion				1	58.98*	
No		404 (93.5)	440 (75.2)			
Yes		28 (6.5)	145 (24.8)			

Note. SAM = simultaneous alcohol and marijuana (within past year). HED = heavy episodic drinking. BSSS = Brief Sensation Seeking Scale. Descriptive drinking norms refer to the total number of drinks per week that participants perceived their close friends to use. Marijuana use indicators refer to the number of joints used and alcohol use indicators refer to the number of standard alcoholic drinks used. Bonferroni correction yielded a critical *p*-value of .006. All *p*-values were < .001. Models remained significant at the $p < .001$ level after controlling for demographic variables.

*$p < .001$.

Table 3

Associations between SAM Use Frequency and Study Outcomes among Past-Year SAM Users

Study Outcomes	*B* (*SE*)
Psychosocial Factors	
BSSS	−0.01 (0.15)
Descriptive Drinking Norms	8.46 (0.72) *
Marijuana Use Weekly	
Marijuana Use Quantity	9.07 (0.73) *
Marijuana Use Frequency	0.89 (0.07) *
Peak Use	1.86 (0.13) *
Joints per Use Day	1.28 (0.10) *
Alcohol Use Weekly	
Alcohol Use Quantity	5.58 (0.61) *
Alcohol Use Frequency	0.70 (0.05) *
HED Frequency	0.09 (0.01) *
Number of Hours Drinking	1.05 (0.18) *
Peak Drinks	1.13 (0.18) *
Drinks per Drinking Day	0.63 (0.09) *
Alcohol-related Problems[a]	0.73 (0.16) *
	OR (*CI*)
High-Intensity Drinking	1.59 (1.28–1.98) *

Note. Models were conducted separately after controlling for key demographic variables. HED = heavy episodic drinking. BSSS = Brief Sensation Seeking Scale.

* $p < .001$.

[a]For the outcome of alcohol-related problems, typical number of drinks per use day and typical number of joints per use day were included as additional covariates.