Unplanned Versus Planned Simultaneous Alcohol and Marijuana Use in Relation to Substance Use and Consequences: Results from a Longitudinal Daily Study

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Unplanned Versus Planned Simultaneous Alcohol and Marijuana Use in Relation to Substance Use and Consequences: Results from a Longitudinal Daily Study

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Objective: The current study expands the literature on simultaneous alcohol and marijuana (SAM) use by focusing on the distinction between unplanned and planned SAM use to identify potential intervention targets. This study explored whether unplanned or planned SAM use was associated with differences in alcohol and/or marijuana use and consequences. Method: A community sample of young adults (aged 18–25) with recent alcohol and SAM use was recruited [N = 409; mean (SD) = 21.61 (2.17) years; 50.9% female; 48.2% non-Hispanic/Latinx White]. Participants completed five 2-week bursts of online daily surveys (2×/day; 81.99% of morning and 82.23% of afternoon surveys completed) and reported on substance use intentions and behavior. Results: Descriptive findings showed that among days on which participants reported SAM use, 41.85% of the days were unplanned SAM use days. Based on daily-level results from multilevel models, on days with unplanned SAM use, young adults reported consuming fewer drinks, fewer hours high from marijuana, and lower subjective intoxication/high, compared to planned SAM use days, thus indicating that planned SAM use was riskier. Unplanned SAM use was not significantly associated with positive or negative consequences related to alcohol or marijuana, after accounting for the number of drinks or hours high from marijuana. Conclusions: Current findings suggest that interventions should target days on which young adults are planning to engage in SAM use. Future work is needed to identify factors that predict planned SAM use on specific occasions and also to disentangle the potential role of unplanned heavy use.

Public Health Significance
It is critical that we enhance our understanding of risky substance use behaviors, namely, young adults’ use of alcohol and marijuana at the same time so that effects overlap. Current findings suggest that intervention efforts should target planned simultaneous alcohol and marijuana (SAM) use to reduce the risk for increased substance use. Event-level predictors and interventions for SAM use may be particularly important.

Keywords: simultaneous alcohol and marijuana use, unplanned, intentions, daily, young adults

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Alcohol and marijuana are commonly used by young adults in the United States with recent national data showing that 67.2% of young adults report alcohol use in the past month and 26.7% report marijuana use in the past month (Schulenberg et al., 2020). With recent legalization of nonmedical marijuana use for individuals aged 21 and over in several states, coupled with high prevalence rates of alcohol use and marijuana use, there has been an increased effort to better understand simultaneous alcohol and marijuana (SAM) use among young adults (Lee, Cadigan, et al., 2017; Linden-Carmichael et al., 2019; Patrick, Terry-McElrath, et al., 2019; Sokolovsky et al., 2020; supported by Grant T32AA007455 (PI: M. Larimer) and F32AA028153 (PI: Jennifer C. Duckworth). The content of this article is solely the responsibility of the author(s) and does not necessarily represent the official views of the National Institute on Alcohol Abuse and Alcoholism and the National Institutes of Health. Correspondence concerning this article should be addressed to Anne M. Fairlie, Department of Psychiatry and Behavioral Sciences, University of Washington, Box 354944, Seattle, WA 98195, United States. Email: afairlie@uw.edu
White et al., 2019). SAM use is often defined as using alcohol and marijuana at the same time so that their effects overlap (e.g., Linden-Carmichael et al., 2019; Patrick et al., 2020; White et al., 2019), and recent studies suggest that the majority of individuals who use both alcohol and marijuana tend to use them simultaneously (Patrick, Terry-McElrath, et al., 2019; Subbaraman & Kerr, 2015). Data from the 2005 and 2015 National Alcohol Survey suggest that 15% of young adults (aged 18–29) engaged in SAM use in the past year (Subbaraman & Kerr, 2015). Patrick and colleagues examined 2005–2015 data from Monitoring the Future and found that 22.5% of 19–20 year olds reported past-year SAM use (Patrick, Terry-McElrath, et al., 2019). A recent study recruited undergraduate students who reported past-year alcohol and marijuana use from three state universities in the United States; results showed that among undergraduates who reported using both alcohol and marijuana in the past year, 73% reported past-year SAM use, 59% reported past 3-month SAM use, and 50% reported past-month SAM use (White et al., 2019).

Prior research links SAM use with consequences beyond those experienced when using alcohol or marijuana alone (Brière et al., 2011; Egan et al., 2019; Lee, Cadigan, et al., 2017; Lee, Patrick, et al., 2020; Linden-Carmichael et al., 2020; Lipperman-Kreda et al., 2017; Patrick et al., 2018). For example, Egan et al. (2019) examined retrospective event-level alcohol consequences (e.g., hangover, fighting, sex, and unprotected sex) among a sample of 15–20 year olds who reported whether they used alcohol and/or marijuana at the most recent party they attended and found that, relative to adolescents who had used only alcohol at the most recent party, those who reported SAM use at the most recent party were more likely to experience consequences. Using earlier daily-level data from the present study, Lee, Patrick, et al. (2020) used daily data to compare SAM days to alcohol-only days among a sample of young adults who reported past-month SAM use at screening. Relative to alcohol-only days, SAM use days were associated with greater alcohol use and more alcohol-related negative consequences, although the effect on consequences was no longer significant after accounting for the amount of alcohol consumed.

Identifying circumstances that influence SAM use is critical to inform interventions aimed at reducing risky substance use and related consequences. Little research has explored the extent to which SAM use tends to be a planned behavior or an incidental behavior, as in young adults may have been drinking but engaged in marijuana use (or vice versa) because it was situationally present. Alternatively, on certain occasions, SAM use may be a planned, goal-driven behavior that pertains to motives for getting “cross-faded,” whereby someone intends to become simultaneously drunk and high (Patrick & Lee, 2018; Patrick et al., 2020). The current study examines the link between planning to engage in a behavior (i.e., engaging in SAM use later that day) and subsequent engagement in the behavior (i.e., actual SAM use behavior). More specifically, the current study focuses on the degree to which SAM use may be unplanned or planned and potential associations with use and consequences.

Theoretical Framework Linking Planned Behavior to Actual Behavior

The Theory of Planned Behavior was developed to better understand health behaviors and proposes that behavioral intention (i.e., what a person plans or intends to do) is among the strongest and most proximal predictors of actual behavior (Ajzen, 1991, 2002). Behavioral intentions are informed by a range of cognitions, including subjective norms, attitudes toward a behavior, and perceptions of behavioral control. A large body of empirical research has applied the Theory of Planned Behavior to alcohol use (see Cooke et al., 2016, for review), marijuana use (e.g., Conner & McMillan, 1999; Ito et al., 2015; Malmberg et al., 2012), and interventions aimed at decreasing substance use (e.g., Huchting et al., 2008; Kam et al., 2009; Norman, 2011). For instance, DiBello et al. (2020) tested the Theory of Planned Behavior in alcohol-induced blackouts among college students. Intention to blackout was positively linked with cross-sectional and prospective blackout frequency 1-month later. Cooke et al. (2016) conducted a systematic review and meta-analysis to investigate how well Ajzen’s Theory of Planned Behavior predicts alcohol use. Findings from 40 studies conducted between 1997 and 2013 suggested that components of the Theory of Planned Behavior are strong predictors of alcohol consumption and that alcohol use intention and alcohol consumption were strongly correlated. The model of unplanned drinking behavior (Pearson & Henson, 2013) is another theoretical framework that addresses the unplanned nature of substance use, and this model hypothesizes that unplanned drinking is related to increased negative alcohol-related consequences because to minimize negative consequences, one would need to engage in planning and impulse control. Pearson and Henson (2013) examined unplanned drinking in two cross-sectional studies with undergraduate students who reported past-month alcohol use and found that unplanned drinking was positively related to alcohol-related consequences when controlling for frequency and quantity of use.

A growing body of research has investigated unplanned substance use at the event level in the areas of marijuana use (Emery et al., 2020) and alcohol use (Fairlie et al., 2019; Lauher et al., 2020). Emery and colleagues examined affective and situational predictors in relation to quantity of unplanned marijuana use among 15–24 year olds who reported using marijuana at least 2 days a week in the past month. Unexpectedly, unplanned marijuana use days were associated with using fewer grams of marijuana relative to planned marijuana use days, especially on days when there were more marijuana cues present; the authors suggest that youth may have been trying to self-regulate their marijuana use on unplanned days and were therefore less responsive to cues.

Thus far, event-level research on unplanned alcohol use has been mixed with respect to whether unplanned drinking is associated with more use and/or consequences (Fairlie et al., 2019) or less use and/or consequences (Lauher et al., 2020). Among a sample of young adult college students, Fairlie et al. (2019) found that unplanned heavy drinking events were associated with greater negative alcohol-related consequences on that day. Contrary to that, Lauher et al. (2020) found that unplanned drinking events were associated with drinking less alcohol and experiencing fewer alcohol-related consequences compared to planned drinking events in a sample of college students. In comparing these two studies, the participants in the study by Fairlie et al. were college students aged 18–24 years who drank at least twice a week in the past month, while the participants in the study by Lauher et al. were younger college students (18–20 years) who either reported heavy episodic drinking (4±5 drinks for women/men) at least weekly or at least one recent negative consequence, suggesting that the samples were generally comparable. However, a key distinction between these studies is that Fairlie et al. focused on unplanned heavy and high-intensity drinking, while
Lauher et al. examined unplanned drinking events where any amount of alcohol was consumed, which could contribute to the disparate findings. The current study expands the research on unplanned substance use to unplanned SAM use and is exploratory in nature given the limited research in this area and mixed findings to date.

The Current Study

To date, daily-level research on SAM use behavior has typically focused on use and consequences on SAM use days, relative to non-SAM use days (such as alcohol-only days), without testing factors that may distinguish among SAM use days. The current study is unique in that it focuses on whether there are differences between SAM use days without plans to engage in SAM use, compared to SAM use days with plans for SAM use, with respect to the risk of use and consequences. Our previous work has focused on the risk of use and consequences with respect to SAM use versus alcohol-only use days (Lee, Patrick, et al., 2020) as well as SAM use in relation to general substance use motives and cross-fading motives (Patrick, Fairlie, et al., 2019; Patrick et al., 2020), with previous work using fewer bursts of daily data.

In Aim 1, the current study explored the correspondence between plans to engage in SAM use and actual SAM use in a community sample of young adults who recently engaged in SAM use. Aim 2 tested whether or not unplanned SAM use was associated with differences in alcohol and/or marijuana use compared to days with planned SAM use. Here, we defined “unplanned SAM use” as engaging in SAM use on a day when SAM use was not planned at the time of the afternoon survey. Conversely, “planned SAM use” was defined as engaging in SAM use on a day when SAM use was planned at the time of the afternoon survey. Unlike some other studies (Emery et al., 2020; Lauher et al., 2020), we used the afternoon report of plans (consistent with the study by Fairlie et al., 2019) because afternoon plans are a more proximal indicator of substance use and may better reflect plans for that day. Aim 3 tested whether or not, after controlling for alcohol/marijuana use, unplanned SAM use was associated with differences in negative and positive alcohol and/or marijuana consequences compared to days with planned SAM use. Recognizing that the extant literature in the area of unplanned substance use is mixed, this study is considered exploratory.

Methods

Participants and Procedure

Young adults were recruited from the community for a daily study focusing on substance use and health behaviors (N = 409). Eligibility criteria for being in the study included being 18–25 years old; reporting SAM use at least once in the past month; reporting drinking alcohol 3 or more times in the past month; living within 60 miles of the study office; being willing to complete online daily surveys; being willing to receive study-related text messages; and attending an in-person session for consent, identity/age verification, and an online baseline survey. Longitudinal study procedures consisted of online surveys twice a day (morning and afternoon) in six 14-day bursts across 2 years. The current analyses use morning and afternoon survey data from the first five bursts of daily data as well as demographic data collected at baseline. All daily data used in the current article were collected prior to March 2020 (i.e., before the COVID-19 pandemic and primarily in 2018–2019). Half (50.9%) of the sample reported their biological sex as female. Almost half (48.2%) of participants identified as non-Hispanic/Latinx White, 15.9% Hispanic/Latinx, 15.9% Asian or South Asian, 4.4% Black or African American, 11.2% more than one race, and 4.2% another race. The mean age of participants at baseline was 21.61 (SD = 2.17). At baseline, 36.4% of the participants reported that they were not currently students, 48.9% were in a 4-year college or university, 6.6% 2-year, community college, or trade/vocational school, 7.1% graduate or professional school, and the remaining 0.9% were in high school or a General Educational Development (GED) program.

Participants were recruited through a variety of methods in the greater Seattle, Washington area, such as social media and Craigslist advertisements, newspaper advertisements in community and college newspapers, flyering or community postings, and in-person outreach at community colleges and other local events. Interested participants were asked to call the study office for information or go to our website for details and a link to complete a confidential eligibility survey. The eligibility survey began with an information statement outlining study procedures and all necessary elements for consent. Once participants completed the eligibility survey, those who met screening criteria were invited to come to study offices to complete an in-person session where their identity and age were verified with photo identification, informed consent for the longitudinal study was obtained, and a 30-min training was provided about the daily aspects of the study and measures. After completing the training session, participants completed an online baseline assessment while still at the study office (detailed procedures can be found at Lee, Patrick, et al., 2020). Participants received a $40 Amazon gift card upon completion.

The day following the participants’ training session, they began their first 14-day burst of twice daily online assessments. Participants had two 3-hr windows each day during which they could complete their web-based surveys. In Burst 1, the morning survey window was from 9 am to 12 pm and the afternoon survey window was from 3 pm to 6 pm. In Bursts 2–6, the 3-hr survey windows had flexibility that allowed participants to specify a morning start of 8 am, 9 am, or 10 am and an afternoon start time of 2 pm, 3 pm, or 4 pm. Every 4 months for 2 years, participants completed a 2-week burst for a total of six bursts. At the beginning of each survey window, participants received an email and text message with the link for the current survey. Reminder texts were sent 30 min prior to the close of each survey window if the participant had not yet completed the survey, and participants could opt in to receive additional reminders. Each survey took approximately 5–10 min to complete. The present analyses used data from the morning and afternoon surveys from the first five bursts of data. The final burst was excluded because a portion of the participants completed it during the COVID-19 pandemic, and it is unclear to what extent societal changes and physical distancing may have impacted substance use intentions, substance use, consequences, and related constructs.

Across all morning surveys in the five bursts, 81.99% were completed either in whole (79.64%) or in part (2.35%); across all afternoon surveys in the five bursts, 82.23% were completed either in whole (80.07%) or in part (2.16%). The morning surveys assessed alcohol, marijuana, and SAM use and consequences for the prior day,
while the afternoon surveys assessed substance use intentions or plans for the upcoming evening. Participants could earn $2.50 for each completed survey and a bonus of $10 for each burst if at least 25 assessments (out of 28) were completed for a possible total of $80 paid in Amazon e-gift cards. The University Institutional Review Board (IRB) approved this study and no adverse events were reported.

Measures

Baseline Measures

Demographic information, including age, biological sex coded 0 (female) and 1 (male), race/ethnicity, and college status, was collected at baseline and used as covariates. Current educational status at baseline was coded as 0 (not in a 4-year college/university) and 1 (currently in a 4-year college/university). Participants reported whether or not they identified as Hispanic or Latinx and also reported race. Ethnicity and race were coded with “non-Hispanic/Latinx White” as the reference group and contrasted with “non-Hispanic/Latinx Asian or South Asian” and “non-Hispanic/Latinx Other.” The “non-Hispanic/Latinx Other” category for race consisted of Black or African American; American Indian or Alaskan Native; Native Hawaiian or other Pacific Islander; Arab, Middle Eastern or North African; more than one race; and Other.

Daily Morning Measures

Substance Use Behaviors. Each morning young adults were asked about their behavior on the previous day and reported on their actual engagement in alcohol, marijuana, and SAM use. On days when participants missed the morning survey, items about the previous days’ substance use, but not consequences, were included in the afternoon survey.

Participants were asked “Did you drink any alcohol yesterday?” coded 0 (no) and 1 (yes). On days participants reported drinking, they were asked “How many total drinks did you have yesterday?” with responses ranging from 1 (1 drink) to 25 (25 or more drinks). The National Institute on Alcohol Abuse and Alcoholism (NIAAA) definition of a standard drink was provided with a corresponding figure: 12 fl. oz. of regular beer, 8–9 fl. oz. of malt liquor, 5 fl. oz. of table wine, and 1.5 fl. oz. shot of distilled spirits. To assess subjective intoxication, participants also reported how intoxicated they had become on a 5-point Likert scale from 0 (not at all intoxicated) to 4 (extremely intoxicated).

Participants were asked “Did you use marijuana yesterday?” coded 0 (no) and 1 (yes). On days participants reported using marijuana, they were asked “How many total hours were you high yesterday?” with responses ranging from 0 (less than an hour) to 23 (23–24 hr). Participants also reported how high they got when they used marijuana on a 5-point Likert scale from 0 (not at all high) to 4 (extremely high). The item asking about hours spent high was asked on all days marijuana use was reported, while other items (e.g., grams used) were only asked on days when certain methods of use were reported (e.g., smoking or vaping). The correlation between number of grams used and hours high on SAM use days was .78, p < .001. As such, we report hours high rather than grams used to maximize the number of useable days.

A single item was used to assess SAM use on days participants reported using alcohol and marijuana: “Yesterday, did you use alcohol and marijuana at the same time—that is, so that their effects overlapped?” coded 0 (no) and 1 (yes). Furthermore, days when an individual did not report using either alcohol or marijuana (and were therefore not asked the SAM use question) were coded as “0” to indicate no SAM use. For each day, substance use was categorized as follows: (a) no alcohol or marijuana use, (b) alcohol use only, (c) marijuana use only, (d) alcohol and marijuana use but no SAM use, or (e) SAM use.

Substance Use Consequences (Positive and Negative). Participants reported which of 21 alcohol-related consequences they had experienced yesterday, coded 0 (no) and 1 (yes) (Lee, Patrick, et al., 2020). Psychometric analyses for a 13-item scale provided evidence of a positive subscale and a negative subscale for alcohol consequences measured at the daily level (Lee, Cronce, et al., 2017). The current study added items (e.g., felt dizzy, had a blackout, and got in a serious fight) to provide a broader assessment of negative alcohol-related consequences. Six positive alcohol-related consequences (e.g., felt relaxed and was in a better mood) and 15 negative alcohol-related consequences (e.g., had a hangover, felt nauseated or vomited, passed out or fainted suddenly, and felt confused) were assessed. Sum scores were created for total numbers of positive (out of 6) and negative (out of 15) consequences experienced.

Participants reported which of 13 marijuana-related consequences they had experienced yesterday, coded 0 (no) and 1 (yes) (adapted from the study by Lee, Kilmer, et al., 2020, and other marijuana consequence measures to assess a range of items relevant for acute daily harms). Three positive marijuana-related consequences (felt relaxed, was in a better mood, and forgot my worries or problems) and 10 negative marijuana-related consequences (e.g., felt anxious or worried, had low motivation, felt lethargic or sedated, and felt confused) were assessed. Sum scores were created for total numbers of positive (out of 3) and negative (out of 10) consequences experienced. Note that seven of the consequence items were shown for both alcohol and marijuana, so participants could have endorsed experiencing that consequence for both alcohol and marijuana if they used both substances on a given day.

Daily Afternoon Measures

Plans to Engage in Substance Use. Each afternoon young adults were asked the following three questions: “Thinking about tonight do you think you will, drink alcohol, use marijuana, use alcohol and marijuana at the same time?” coded 0 (no) and 1 (yes). For each day, responses to these items were used to determine whether or not alcohol and/or marijuana use were unplanned and also whether or not SAM use was unplanned.

Coding for Unplanned Versus Planned SAM Use

The main predictor variable of interest in the analyses was coded by comparing afternoon reports of substance use plans to the corresponding morning reports of substance use behavior from the previous day (described above). Unplanned SAM use is defined as engaging in SAM use on a day when SAM use was not planned at the time of the afternoon survey, while planned SAM use corresponded to engaging in SAM use on a day when SAM use was planned at the time of the afternoon survey. Unplanned SAM use was coded as 1 (unplanned SAM use) and 0 (planned SAM use).
Within-Person Covariates

Within-person covariates consisted of whether or not participants had used alcohol by the time of the afternoon survey (“Have you used alcohol today?”) and also whether they had used marijuana by the time of the afternoon survey (“Have you used marijuana today?”), both coded 0 (no) and 1 (yes). Weekend was coded 0 (Sunday to Wednesday) and 1 (Thursday, Friday, or Saturday). Day within the burst was coded 1 (Day 1) to 14 (Day 14). Burst number was coded 1 (Burst 1) to 5 (Burst 5).

Data Analysis Plan

For Aim 1, descriptive analyses were conducted to summarize the frequency of days on which participants reported plans to engage in SAM use and actual SAM use based on data from all the daily surveys and to estimate the correspondence between plans to engage in SAM use and actual SAM use. Aims 2 and 3 were tested using multilevel modeling with maximum likelihood estimation to investigate within- and between-person associations between unplanned SAM use and actual substance use behaviors (Aim 2) and positive and negative consequences for alcohol and marijuana (Aim 3). For Aims 2 and 3, unplanned SAM use was defined as engaging in SAM use on a day when SAM use was not planned at the time of the afternoon survey. Multilevel models only included days on which young adults reported engaging in SAM use. Between-person effects of unplanned SAM use were accounted for by including the proportion of unplanned SAM use days as a person-level covariate, which disaggregates the within-person (i.e., day-level) effect that is central to the aims of this research (Enders & Tofghi, 2007).

To test Aim 2, four multilevel models were fit to estimate within-person associations between unplanned SAM use and (a) number of drinks consumed, (b) subjective intoxication (from alcohol), (c) number of hours high (from marijuana), and (d) subjective level of high (from marijuana). Several covariates were held constant to accurately assess the effects of unplanned SAM use (relative to planned SAM use) on these outcomes. Between-person covariates included birth sex, race/ethnicity, age at baseline, and 4-year college status at baseline. Within-person covariates included whether the reference day was a weekend, whether alcohol or marijuana had been used by the time of the afternoon survey, day within the burst, and the burst number.

To test Aim 3, separate multilevel models were fit to estimate within-person associations between unplanned SAM use and positive/negative consequences experienced as a result of alcohol and marijuana use. In addition to the covariates described for Aim 2, we fit models both with and without accounting for number of drinks and hours high from marijuana. That is, models examining alcohol use consequences were fit both with and without average drinks per day across sampled days (person-level) and number of drinks consumed that day (day-level). Number of hours spent high was similarly accounted for in the models examining marijuana use consequences. These covariates were included to examine whether the effect of unplanned SAM use on consequences would hold when accounting for alcohol/marijuana use on the referent day.

Whereas subjective intoxications from alcohol and marijuana use were assessed on a Likert-type scale and were normally distributed, number of drinks, hours spent high, and all four consequence variables were nonnegative integers with inherent positively skewed distributions and are considered count variables (Atkins et al., 2013). As such, multilevel negative binomial regression was used to connect these count outcomes via a log link, which are then exponentiated to yield rate ratios indicating the proportional change in the count outcome in response to a one-unit increase in each covariate (i.e., conditional on person-level random effects). For example, a rate ratio of 1.10 indicates a 10% increase in the outcome variable for each one-unit change in the predictor variable. Rate ratios with 95% confidence intervals falling completely below 1.00 are interpreted as significant inverse/negative associations, while those above 1.00 are interpreted as significant positive associations. Multilevel modeling was done in R using the “nlme” and “glmmTMB” packages (Brooks et al., 2017; Pinheiro et al., 2020).

Results

Aim 1: Descriptive Analyses Across All Days and on SAM Use Days

The first series of descriptive analyses were based on all 409 participants and, specifically, the 20,645 days for which participants provided information on (a) whether or not they had plans for SAM use (as reported in the afternoon) and (b) whether or not they actually engaged in SAM use (as reported the next day). Overall, across all available days, young adults reported planning to engage in SAM use on 10.6% of days and actually engaging in SAM use on 9.5% of days.

With respect to Aim 1, descriptive findings showed that, among the 18,456 days on which participants did not report planning to engage in SAM use, 4.4% (817 days) corresponded to actual SAM use later that day (i.e., unplanned SAM use). Furthermore, among the 2,189 days on which participants were planning to engage in SAM use, 51.9% (1,135 days) corresponded to actual SAM use that day. Conversely and of particular interest, among the days on which participants had engaged in SAM use, 41.85% of days were unplanned SAM use days while 58.15% were planned SAM use days.

The next set of descriptive analyses focus on the 817 days that corresponded to unplanned SAM use (i.e., 277 participants had at least one unplanned SAM use occasion). We specifically examined the extent to which alcohol, marijuana, and/or SAM use were unplanned, because young adults may have planned to engage in SAM use or use alcohol alone, marijuana alone, or both substances on the same day but not simultaneously. Of the 817 unplanned SAM use days (i.e., engaging in SAM use on a day when SAM use was not planned at the time of the afternoon survey), 19.1% were days on which participants did not plan to use either alcohol or marijuana; 26.2% were days participants planned to use alcohol but not marijuana; 40.8% were days participants planned to use marijuana but not alcohol; 13.5% were days on which participants planned to use both substances on the same day but not simultaneously; and the remaining 0.5% of days had missing data.

Bivariate correlation coefficients were calculated at both the within- and between-person levels using all 1,952 SAM use days across 322 participants who reported SAM use at least one time during the study period and are shown in Table 1 along with descriptive statistics. The mean number of total positive consequences for alcohol was 3.49 (range 0–6) and 1.86 for marijuana (range 0–3). For total negative consequences for alcohol the mean was 0.81 (range 0–10) and 1.17 for marijuana (range 0–10). See Supplementary Tables 1 and 2 for the percentages of SAM
use days that each positive and negative consequence was reported (e.g., hangover from alcohol on 11.71% of days and felt lethargic or sedated from marijuana on 36.03% of days). Of note, significant positive within-person correlations indicated that consuming more drinks and being high for more hours were associated with more positive and negative consequences. Intraclass correlation coefficients (ICCs) estimated that the variance in study variables was attributed to between-person differences, relative to variance at the within-person level. The ICC values shown in Table 1 revealed that between-person differences accounted for between 19% and 42% of the variability across study variables, thus indicating that the majority of variability was at the within-person level (i.e., differences from one SAM use day to the next).

Aim 2: Unplanned Versus Planned SAM Use Predicting Alcohol and Marijuana Use

Results from the multilevel models testing Aim 2 are shown in Table 2 and recall that these models include only days on which young adults reported engaging in SAM use, meaning that data only come from the 322 participants who had endorsed SAM use at least once during the study period. Days on which individuals did not report whether or not they had plans to engage in SAM use were not included in the models as the occasion could not be categorized as unplanned or planned SAM use. Between-person (Level 2) coefficients indicated that participants whose SAM use occasions were more frequently planned, rather than unplanned, tended to consume more drinks and spent more hours high from marijuana, relative to participants whose SAM use occasions were less frequently planned. Men typically consumed more drinks and spent more hours high from marijuana, relative to women on SAM use days. Relative to non-Hispanic/Latinx White young adults, Hispanic/Latinx young adults reported greater subjective highs from marijuana use. Older participants reported consuming fewer drinks and experiencing lower levels of subjective intoxication from alcohol use.

Central to the aims of the current study are the within-person (Level 1) coefficients shown in Table 2 for unplanned SAM use that estimate day-level associations above and beyond the person-level effects. Results for Aim 2 revealed that on days with unplanned SAM use, young adults reported consuming fewer drinks, fewer hours high from marijuana, and lower subjective intoxication/high from alcohol and marijuana, compared to days with planned SAM use. Notably, on unplanned SAM use days, young adults reported consuming 20% fewer drinks and being high for 9% fewer hours compared to planned SAM use days. In addition, the Level 1 results indicate that on days young adults reported having already used alcohol by the time of the afternoon report, they engaged in heavier alcohol use and spent more hours high that day. Similarly, on days young adults reported having already used marijuana by the time of the afternoon report, they reported having spent more hours high and experiencing stronger subjective highs from marijuana. Relative to weekdays with SAM use, weekend days with SAM use were associated with consuming more drinks.

Aim 3: Unplanned Versus Planned SAM Use Predicting Alcohol- and Marijuana-Related Consequences

The third aim of this research entailed examining whether days with unplanned SAM use would be associated with differences in alcohol- and marijuana-related consequences compared to planned SAM use days. As with Aim 2, these models were estimated using data from participants who endorsed at least one SAM use occasion and, additionally, were only modeled using days in which consequences responses were available.¹

¹ In total, sufficient data were available on 1,950 days from 321 participants for Aim 2 analyses.
² Consequences were assessed in the morning survey but, unlike use variables, consequences items were not piped into afternoon surveys when participants missed a morning survey. As such, sufficient data for Aim 3 models were available on 1,767 days from 308 participants.
First, models were fit to examine these effects on alcohol-related consequences both with and without including a covariate to account for number of drinks (Table 3). At Level 2, models without this covariate did not show significant effects on any alcohol consequences outcome for the proportion of SAM use days that were unplanned. However, men and younger participants tended to experience relatively fewer negative consequences related to alcohol use.

As it pertains to the primary focus of Aim 3, Level 1 results showed that, relative to days with planned SAM use, on days with

### Table 2

#### Alcohol and Marijuana Use Indices Predicted by Unplanned SAM Use

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Number of drinks</th>
<th>Subjective intoxication</th>
<th>Hours spent high</th>
<th>Subjective level of high</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>95% CI</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>7.77***</td>
<td>(4.27, 14.12)</td>
<td>2.64***</td>
<td>(0.46)</td>
</tr>
<tr>
<td>Male</td>
<td>1.18***</td>
<td>(1.07, 1.30)</td>
<td>-0.04</td>
<td>(0.07)</td>
</tr>
<tr>
<td>Asian non-Hispanic</td>
<td>0.99</td>
<td>(0.85, 1.15)</td>
<td>0.11</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Other non-Hispanic</td>
<td>0.90</td>
<td>(0.79, 1.03)</td>
<td>-0.01</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.13</td>
<td>(0.99, 1.30)</td>
<td>0.15</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Age at baseline</td>
<td>0.96***</td>
<td>(0.93, 0.98)</td>
<td>-0.06**</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Attends 4-year college (vs. not)</td>
<td>1.01</td>
<td>(0.89, 1.15)</td>
<td>0.03</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Proportion of SAM use days that were unplanned</td>
<td>0.82*</td>
<td>(0.70, 0.95)</td>
<td>-0.26*</td>
<td>(0.12)</td>
</tr>
</tbody>
</table>

#### Level 2, within-person

| Alcohol use at afternoon report (vs. not) | 1.33*** | (1.25, 1.42) | 0.24*** | (0.06) | 1.08* | (1.01, 1.15) | -0.02 | (0.05) |
| Marijuana use at afternoon report (vs. not) | 0.92* | (0.87, 0.98) | -0.02 | (0.05) | 1.68*** | (1.57, 1.79) | 0.23*** | (0.04) |
| Burst number | 0.97** | (0.95, 0.99) | -0.02 | (0.02) | 1.01 | (0.99, 1.03) | -0.02 | (0.01) |
| Day number within burst | 1.00 | (1.00, 1.01) | 0.01 | (0.01) | 1.00 | (0.99, 1.00) | 0.00 | (0.00) |
| Weekend day (vs. not) | 1.22*** | (1.16, 1.28) | 0.27*** | (0.04) | 1.03 | (0.98, 1.09) | 0.02 | (0.03) |
| Unplanned SAM use (vs. planned SAM use) | 0.80*** | (0.76, 0.85) | -0.24*** | (0.05) | 0.91*** | (0.85, 0.96) | -0.08* | (0.04) |

#### Note

Models were based on 321 persons and 1,950 SAM use days. RR = rate ratio; CI = confidence interval; B = unstandardized beta coefficient; SE = standard error; SAM = simultaneous alcohol and marijuana.

* Reference category was coded as non-Hispanic/Latinx White.

*p < .05. **p < .01. ***p < .001.

### Table 3

#### Alcohol Consequences Predicted by Unplanned SAM Use

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Positive alcohol consequences</th>
<th>Negative alcohol consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without number of drinks as a covariate (Model 1)</td>
<td>With number of drinks as a covariate (Model 2)</td>
</tr>
<tr>
<td></td>
<td>RR 95% CI</td>
<td>RR 95% CI</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.09***</td>
<td>(2.36, 7.09)</td>
</tr>
<tr>
<td>Male</td>
<td>0.96</td>
<td>(0.88, 1.04)</td>
</tr>
<tr>
<td>Asian non-Hispanic</td>
<td>1.14</td>
<td>(1.00, 1.31)</td>
</tr>
<tr>
<td>Other non-Hispanic</td>
<td>0.95</td>
<td>(0.85, 1.07)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.03</td>
<td>(0.92, 1.17)</td>
</tr>
<tr>
<td>Age at baseline</td>
<td>0.99</td>
<td>(0.97, 1.02)</td>
</tr>
<tr>
<td>Attends 4-year college (vs. not)</td>
<td>1.06</td>
<td>(0.94, 1.19)</td>
</tr>
<tr>
<td>Proportion of SAM use days that were unplanned</td>
<td>0.94</td>
<td>(0.82, 1.09)</td>
</tr>
<tr>
<td>Average drinks per day</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| Level 1, within-person

| Alcohol use at afternoon report (vs. not) | 1.08* | (1.01, 1.15) | 0.98 | (0.92, 1.06) | 1.10 | (0.94, 1.28) | 0.74*** | (0.63, 0.87) |
| Burst number | 0.97** | (0.95, 0.99) | 0.98* | (0.96, 1.00) | 0.92*** | (0.88, 0.96) | 0.94** | (0.90, 0.98) |
| Day number within burst | 1.00 | (0.99, 1.00) | 0.99 | (0.99, 1.00) | 0.99 | (0.97, 1.00) | 0.99 | (0.97, 1.00) |
| Weekend day (vs. not) | 1.06 | (1.00, 1.11) | 0.99 | (0.94, 1.05) | 1.38*** | (1.23, 1.55) | 1.09 | (0.96, 1.23) |
| Number of drinks on this day | --- | --- | 1.06*** | (1.05, 1.08) | 1.25*** | (1.22, 1.28) |
| Unplanned SAM use (vs. planned SAM use) | 0.93* | (0.87, 0.99) | 0.98 | (0.92, 1.05) | 0.80*** | (0.71, 0.91) | 0.97 | (0.85, 1.11) |

#### Note

Models were based on 308 persons and 1,767 SAM use days. Model 1 does not control for alcohol use, while Model 2 does control for alcohol use (Level 1 = number of drinks consumed that day; Level 2 = average number of drinks per day). RR = rate ratio; CI = confidence interval; SAM = simultaneous alcohol and marijuana.

* Reference category was coded as non-Hispanic/Latinx White.

*p < .05. **p < .01. ***p < .001.
unplanned SAM use young adults reported experiencing 7% fewer positive alcohol consequences and 20% fewer negative alcohol consequences. However, the secondary models that included a covariate accounting for the amount of alcohol consumed indicated that these effects of unplanned SAM use on alcohol consequences were largely explained by the number of drinks young adults had consumed that day. Specifically, results from the secondary models showed that, at the between-person level, average number of drinks was associated with more positive and negative alcohol consequences. Similarly, within-person effects indicated that on days in which young adults consumed relatively more drinks, they experienced more negative and positive alcohol consequences and the effects of unplanned SAM use were no longer statistically significant. With respect to additional covariates at the within-person level, on SAM use days that participants had begun drinking by the time of the afternoon report, they reported more positive consequences related to alcohol. On SAM use days during earlier bursts, young adults reported more positive and negative consequences related to alcohol. Weekend days with SAM use were also related to more negative alcohol-related consequences compared to weekdays with SAM use.

The third aim of this research also involved examining associations between unplanned SAM use and marijuana-related consequences (Table 4). At Level 2, models without hours spent high as a covariate did not show significant effects on any marijuana consequences outcome for the proportion of unplanned SAM use days. Relative to women, men typically experienced fewer negative marijuana consequences on SAM use days, and non-Hispanic/Latinx Asian young adults typically reported more negative marijuana consequences compared to non-Hispanic/Latinx White young adults.

At Level 1, days with unplanned SAM use were not significantly associated with positive or negative marijuana-related consequences, relative to planned SAM use days. Within-person associations revealed that positive consequences of marijuana use decreased across the five bursts. Secondary models were nevertheless fit with the inclusion of a covariate to account for hours spent high from marijuana. These models revealed that young adults who tended to spend more hours high also tended to report more positive and negative consequences of marijuana use (at the between-person level), and on days in which young adults spent relatively more hours high, they reported more positive and negative consequences (at the within-person level).

### Discussion

The current study is the first, to our knowledge, that examines the correspondence between plans to engage in SAM use and actual SAM use in a sample of young adults 18–25 years old who reported recent alcohol and SAM use. Specifically, this study used five 14-day bursts of daily data to distinguish between occasions of unplanned SAM use (i.e., engaging in SAM use on a day when SAM use was not planned at the time of the afternoon survey) from those that were planned SAM use days. Notably, SAM use occurred on about half (51.9%) of the days on which young adults had planned to engage in SAM use at the afternoon survey. Furthermore, across all the days that young adults had not planned to engage in SAM use by the time of the afternoon survey, SAM use occurred on only 4.4% of the days. Moreover, among actual SAM use days, planned SAM use occurred on 58.15% of the SAM use days, while unplanned SAM use occurred on 41.85% of the SAM use days.

### Table 4

**Marijuana Consequences Predicted by Unplanned SAM Use**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Positive marijuana consequences</th>
<th>Negative marijuana consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without hours high as a covariate (Model 1)</td>
<td>With hours high as a covariate (Model 2)</td>
</tr>
<tr>
<td></td>
<td>RR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.17**</td>
<td>(1.22, 3.84)</td>
</tr>
<tr>
<td>Male</td>
<td>0.95</td>
<td>(0.87, 1.03)</td>
</tr>
<tr>
<td>Asian non-Hispanic*</td>
<td>1.10</td>
<td>(0.96, 1.26)</td>
</tr>
<tr>
<td>Other non-Hispanic*</td>
<td>0.94</td>
<td>(0.84, 1.06)</td>
</tr>
<tr>
<td>Hispanic*</td>
<td>1.03</td>
<td>(0.91, 1.15)</td>
</tr>
<tr>
<td>Age at baseline</td>
<td>1.00</td>
<td>(0.97, 1.02)</td>
</tr>
<tr>
<td>Attends 4-year college (vs. not)</td>
<td>1.03</td>
<td>(0.92, 1.16)</td>
</tr>
<tr>
<td>Proportion of SAM use days that were unplanned</td>
<td>1.04</td>
<td>(0.89, 1.21)</td>
</tr>
<tr>
<td>Average hours high</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**Level 1, within-person**

| Marijuana use at afternoon report (vs. not) | 1.05 | (0.97, 1.13) | 1.02 | (0.94, 1.10) | 1.05 | (0.94, 1.17) | 0.98 | (0.87, 1.09) |
| Burst number                             | 0.97* | (0.95, 1.00) | 0.97* | (0.95, 1.00) | 0.98 | (0.95, 1.02) | 1.00 | (0.96, 1.03) |
| Day number within burst                   | 0.99 | (0.98, 1.00) | 0.99 | (0.98, 1.00) | 0.99 | (0.98, 1.00) | 0.99 | (0.98, 1.01) |
| Weekend (vs. not)                         | 1.00 | (0.93, 1.07) | 1.00 | (0.93, 1.07) | 0.93 | (0.84, 1.02) | 0.90* | (0.82, 0.99) |
| Hours high on this day                    | —    | —      | 1.06* | (1.01, 1.12) | —    | —      | 1.53*** | (1.43, 1.64) |
| Unplanned SAM use (vs. planned SAM use)  | 0.97 | (0.89, 1.06) | 0.97 | (0.89, 1.06) | 0.97 | (0.87, 1.08) | 1.00 | (0.90, 1.11) |

**Note.** Models were based on 308 persons and 1,767 SAM use days. Model 1 does not control for marijuana use, while Model 2 does control for marijuana use (Level 1 = hours high on that day; Level 2 = average hours high). RR = rate ratio; CI = confidence interval; SAM = simultaneous alcohol and marijuana. *Reference category was coded as non-Hispanic/Latinx White.

*p < .05. **p < .01. ***p < .001.
Thus, SAM use occurred very infrequently on days in which SAM use was not planned, suggesting the intention to engage in SAM use is a strong predictor of actually engaging in SAM use, which is congruent with Ajzen’s Theory of Planned Behavior and the intention–behavior link (Ajzen, 2002). Previous work on unplanned drinking using a college student sample found that 20% of the drinking events were unplanned drinking events (Lauher et al., 2020; Stevens, 2021). It is possible that the lower percentage of unplanned drinking events (compared to unplanned SAM use) is partially due to the fact that college students tend to drink on the weekend and social norms and the culture of college student drinking may contribute to an increased expectation of weekend drinking. Although not tested in the current study, it may be worthwhile to explore why young adults had not engaged in SAM use despite afternoon plans to do so. SAM use occasions may tend to reflect planned use for some young adults, while for other young adults, SAM use may reflect a combination of planned and incidental use, which could be in response to the situational context. Although speculative, the anticipated context that may favor SAM use may not come to fruition, and likewise, the situational factors that facilitate SAM use may occur unexpectedly (e.g., party where marijuana is readily available despite thinking it would be difficult or costly to obtain that night).

The main findings from the current study showed that, on days that young adults engaged in unplanned SAM use, they reported consuming fewer drinks with alcohol, being high from marijuana for fewer hours, and lower subjective intoxication/high from alcohol and marijuana, as compared to planned SAM use days. Therefore, days with planned SAM use were associated with more substance use. In addition, days with unplanned (vs. planned) SAM use did not differ with respect to positive and negative consequences related to alcohol and marijuana, after controlling for number of drinks and hours spent high. The study was considered exploratory given that the extant literature in this area is limited (Emery et al., 2020; Fairlie et al., 2019; Lauher et al., 2020), and two of these studies have found evidence contrary to their hypotheses (Emery et al., 2020; Lauher et al., 2020). Notably, Fairlie et al. (2019) did find that days with unplanned heavy/high-intensity drinking were associated with more negative consequences in a sample of 18–24 year old college students. Given differences across studies with respect to the target behaviors and the target populations, it is difficult to draw firm conclusions at this time. Potential areas of investigation for future studies that may help shed light on these disparate findings include distinguishing unplanned heavy use (of alcohol and/or marijuana) from unplanned use of any amount of a substance and attempting to characterize incidental use to determine whether young adults tend to use less alcohol or marijuana on occasions of incidental use. This study found that unplanned SAM use, which may reflect incidental use, occurred on 41.85% of the SAM use days. The characteristics of incidental use may also differ for adolescents and young adults, such that incidental use may be more common among adolescents or individuals 18–20 years and may relate to greater use, while incidental use may be relatively less common among young adults 21 and older due to increased availability.

Regarding the association between use and consequences, we found that, as would be expected, on SAM days that young adults consumed relatively more drinks, they also experienced more negative and positive alcohol consequences, and similarly for marijuana, on SAM days that young adults spent more hours high, they reported more positive and negative marijuana consequences. Notably, our findings suggest level of use (number of drinks and hours high) was a better indicator of the likelihood of experiencing alcohol- and marijuana-related consequences rather than whether or not SAM use was unplanned. Research has demonstrated that days with elevated alcohol-specific expectancies were associated with a greater likelihood of experiencing that specific subjective effect from alcohol (e.g., feeling more relaxed; becoming aggressive, rude, or obnoxious; embarrassing oneself), after controlling for amount of alcohol consumed, but not for less subjective physical/cognitive effects (e.g., having a hangover, getting hurt/ injured, or forgetting; Lee, Fairlie, et al., 2020). As such, future research could test whether or not, after controlling for level of use, planned SAM use is more (or less) strongly linked to specific subjective consequences, particularly the positive effects that young adults may experience like feeling more relaxed and being in a better mood.

Limitations

This study had the advantages of a community-based sample and high daily survey completion over five 14-day bursts. However, several limitations should be noted. First, the analytic sample was limited by the need to compare afternoon intentions to actual behavior reported the next morning, so instances where only one of the reports was available could not be included. Second, the substance use outcomes were retrospective self-reports, and therefore, there is potential for inaccurate recall and reporting bias, especially with respect to subjective intoxication and hours high. The SAM use measure also relied on the participant’s subjective determination of whether or not effects from alcohol and marijuana overlapped. In addition, the daily measures of alcohol and marijuana consequences were adapted from previous measures (e.g., Lee, Cronce, et al., 2017), and the daily measure for positive consequences for marijuana use was limited to three items. Additional work validating the measurement of daily SAM-specific consequences is needed. Third, it should be noted that, among SAM use days, young adults had already used marijuana by the time of the afternoon survey on 40% of the days, compared to using alcohol and having engaged in SAM use by the time of the afternoon survey on 19.4% and 13.6% of the days, respectively; as such, on a subset of days intention was reported after the initiation in the substance use behavior. Third, consistent with previous literature, we use the terminology of “unplanned” SAM use, but note that the measure asked participants whether they thought they would engage in substance use, and planning on using a substance may not be synonymous with anticipating using a substance to the extent that planning may be considered a more conscious, decisional process. Finally, the study uses a local community sample, who lived within 60 miles of the study offices in a state where individuals 21 and older are permitted to use marijuana. Findings may not generalize to the broader community and states where marijuana laws differ or more broadly across other samples (e.g., samples with greater racial/ethnic diversity and different age groups).

Clinical Implications and Future Research

Avenues of future work include exploring the factors that are associated with planned SAM use. For example, young adults may...
be more likely to plan on engaging in SAM use when they experience elevated positive or negative mood states, elevated enhancement motives, or coping motives for drinking. Future research could also address factors that predict following through with planned SAM use (e.g., availability of alcohol and marijuana). Ultimately, we can gain information about the features of the context under which SAM use was anticipated. It may be important for intervention messaging to address the potential for young adults to engage in SAM use by examining SAM use intentions; moreover, real-time intervention content could be delivered with mobile technology and address specific factors pertaining to anticipated SAM use on a given day, especially given that certain characteristics surrounding the context of SAM use (like cross-fading motives) may be known ahead of time.

Conclusions
The current findings contribute to the small body of literature testing whether unplanned substance use on a given day is associated with differences in alcohol and marijuana use and consequences. Unplanned SAM use was associated with less alcohol use, being high from marijuana for fewer hours, and lower subjective intoxication/high from alcohol and marijuana, as compared to planned SAM use on that day. Overall, this area of research is in its infancy, and the few studies to date have shown mixed results, underscoring the need for future work that examines situation-level predictors of SAM use and consequences.

References


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