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Cross-Fading Motives for Simultaneous Alcohol and Marijuana Use: Associations with Young Adults' Use and Consequences across Days

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Abstract

Background: Many young adults engage in simultaneous alcohol and marijuana (SAM) use so that their effects overlap. Little is known about motivations for dual substance use and associations with use and consequences. This study examined daily-level associations between cross-fading motives and levels of alcohol and marijuana use and consequences.

Methods: Young adults who reported SAM use in the month prior were surveyed in two 14-day bursts. Data included 1,049 SAM use days from 281 young adults (age 18-25; $M_{age}=21.80$, $SD=2.16$; 50% women). Multilevel models assessed between- and within-person effects of cross-fading motives (i.e., to enhance the effects of marijuana and/or alcohol use by using them simultaneously) on alcohol and marijuana use and consequences, after adjusting for general enhancement, social, coping, and conformity motives and the amount of alcohol and marijuana used that day.

Results.—On 76% of SAM use days, participants endorsed cross-fading motives (i.e., to enhance the effect of alcohol or marijuana or to get drunk and high at the same time). Having stronger cross-fading motives was associated with greater alcohol use, perceived intoxication, and positive alcohol consequences at the between- and within-person levels. In addition, between-person,

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individuals who reported stronger cross-fading motives on average reported more negative alcohol consequences and positive marijuana consequences on average. Cross-fading motives on a given day were not associated with marijuana use or marijuana consequences that day.

Conclusions: Cross-fading motives were common and varied from day to day. Understanding the motivational context for dual substance use may support future interventions for cross-fading.

Keywords

alcohol; cannabis; simultaneous use; motivations; consequences

1. Introduction

Alcohol is the most commonly used substance among young adults, followed by marijuana (or cannabis), which has now been approved for non-medical use among those 21 and older in eleven states and the District of Columbia. National surveys of young adults show that 82.5% have used alcohol and 38.1% have used marijuana in the past year (Schulenberg et al., 2019); in the past month, 67.3% have used alcohol and 23.9% have used marijuana. Increasingly, attention has been given to simultaneous alcohol and marijuana (SAM) use, when an individual uses alcohol and marijuana at the same time so that their effects overlap (Lee et al., 2020; Linden-Carmichael et al., 2019; White et al., 2019). Individuals (adults 18 and older) who use alcohol and marijuana tend to use both substances at the same time (Subbaraman and Kerr, 2015). Approximately 20-30% of young adult alcohol users have engaged in SAM use in the past year (Terry-McElrath and Patrick, 2018). Those who use both alcohol and marijuana have been found to be at greater risk for negative consequences (Green et al., 2016; Lee et al., 2020; Midanik et al., 2007; Shillington and Clapp, 2001; Stein et al., 2014).

A growing body of research has examined daily-level associations between alcohol use and marijuana use as well as daily-level associations between SAM use and positive and negative consequences from alcohol and/or marijuana use. Methods have varied across these studies with respect to the target population, which has included young adult samples (e.g., Lee et al., 2020; Linden-Carmichael et al., 2020; Roche et al., 2019) and samples of veterans (e.g., Gunn et al., 2019). Further, the methods used for assessing daily-level behavior has also varied, including daily surveys (e.g., Lee et al., 2020; Linden-Carmichael et al., 2020) and timeline follow-back (TLFB) methods (180-day TLFB in Gunn et al., 2019; 30-day TLFB in Roche et al., 2019). Results have documented that, compared to non-SAM days, SAM use days are associated with more alcohol and/or marijuana use and more consequences (Gunn et al., 2019; Lee et al., 2020; Linden-Carmichael et al., 2020). This is consistent with laboratory research (using a sample of 22 males) showing that alcohol may increase THC absorption and contribute to increased reports of positive effects (Lukas and Orozco, 2001). In contrast, other studies have documented non-significant daily-level associations between SAM use and negative alcohol-related consequences, after controlling for how much alcohol was consumed (Lee et al., 2020; Mallett et al., 2019). The current study is the first to examine alcohol and marijuana use as predictors of consequences on SAM days, specifically.

1.1 Motivational models of substance use

Based on motivational models of substance use, individuals drink alcohol and use marijuana for a variety of reasons. The primary reasons include the following categories: social (e.g., to facilitate socializing with peers), enhancement (e.g., to get high or increase positive feelings), coping (e.g., to deal with negative affect), and conformity (e.g., to fit in with peers) (Cooper et al., 1995; Cox and Klinger, 1988; Simons et al., 2005; Wills and Shiffman, 1985). Marijuana use is also associated with interest in seeking altered perceptions and harm reduction motives tied to the belief that marijuana is lower risk than alcohol (Lee et al., 2009). Coping motives may be more strongly associated with marijuana use, while social motives may be more indicative of alcohol use, as shown in cross-sectional work with college students (Skalisky et al., 2019) and young adults (Patrick et al., 2018). Daily data have shown that SAM use is associated with general substance use motives (Patrick et al., 2019), but no daily studies have examined “cross-fading” motives (e.g., to get high by using both substances) as predictors of use, above and beyond general motives. According to young adults in one study, cross-fading refers to using multiple substances, especially alcohol and marijuana, in order to experience the overlapping effects of being simultaneously drunk and high, and the majority of young adults recognized cross-fading as a specific substance use behavior (Patrick and Lee, 2018).

Previous research has examined the extent to which SAM use motives may be unique from alcohol or marijuana motives for use. Patrick, Fairlie, and Lee (2018) examined SAM use motives cross-sectionally among young adults and found that motives for SAM use, although generally similar to alcohol and/or marijuana motives, included a desire for cross-fading effects. The extent to which cross-fading motives vary across days and are predictive of substance use related behaviors on a given day have yet to be examined. In order to do this, intensive data is needed to track daily variation in motives and behavior. These findings can then guide prevention and intervention content by better targeting the etiological pathways.

1.2 Advantages of Daily Studies

The current study uses ecological momentary assessment (EMA) data to examine motives for substance use in relation to substance use behavior and consequences on a given day. EMA data provide a picture of experiences as substances are used in the natural environment (Shiffman, 2009; Shiffman et al., 2008). EMA can help elucidate how motives for substance use vary in relation to changing patterns of substance use across days within individuals. Specifically, we investigate how cross-fading motives (rather than alcohol and marijuana motives more generally) were associated with fluctuations in alcohol use, marijuana use, and positive and negative alcohol-related consequences, after controlling for between-person differences in motives. As a result, the effect of stronger cross-fading motives on substance use and consequences on a given day can be estimated separately from effects of any overall differences in cross-fading motives (i.e., people who generally report higher cross-fading motives). As a proximal, real-time indicator of behavioral risk, cross-fading motives could be targeted in real-time interventions.

1.3 The Current Study

We examined whether days on which young adults reported elevated cross-fading motives were associated with (1) more alcohol consumption and more hours high from marijuana on that day and (2) more positive and negative consequences from alcohol use and from marijuana use (examined separately) on that day. This study collected data from a community sample of young adults who completed two 14-day bursts of daily morning and afternoon surveys. A prior study using data from the same project found that elevated enhancement motives and elevated conformity motives on a given day predicted SAM use on both alcohol days and on marijuana days (Patrick et al., 2019). Further, elevated coping motives predicted SAM use on alcohol days (i.e., more likely to also use marijuana on alcohol days) and elevated social motives predicted SAM use on marijuana days (i.e., more likely to also use alcohol on marijuana days). Building on this earlier study that focused on general substance use motives for alcohol and/or marijuana, the current study focuses on daily-level associations between cross-fading motives, which were not examined in the earlier study, and substance use and its consequences for both alcohol and marijuana, while controlling for general substance use motives.

2. Method

2.1 Participants

The analytic sample includes data from 281 young adults, who were part of a larger sample of 409 young adults in a longitudinal study on daily substance use and related health behaviors (Lee et al., 2020; Patrick et al., 2019). Eligibility criteria for the larger study included being 18-25 years of age; SAM use in the prior two weeks and alcohol use at least three times in the prior month; residing within 60 miles of the study office; agreeing to complete online daily surveys during allotted timeframes and receive text messages from the project; and coming to the study office for screening, consent, and a baseline survey. The study involves assessments twice daily, in the morning and late afternoon, for six 14-day bursts across two years. The current study used data from the first 2 bursts and demographic data collected at baseline. The current analytic sample is limited to the 281 participants who reported SAM use on at least one day during the first 2 bursts given the focus on cross-fading motives.

The racial/ethnic composition of the analysis sample is 59% White, 14% Asian or Pacific Islander American, 14% Mixed/multiple races, 6% African American, 5% other, and 1% Native American, with 18% identifying as Hispanic/Latinx. At baseline average age was 21.80 years ($SD=2.16$). Half the sample (50%) reported birth sex as male. For gender identity, 46% indicated female, 50% male, and 4% “other” or declined to answer. Sixty-six percent of the sample identified as heterosexual. At baseline, 59% were in a post-secondary education program, 7% in a two-year college, 45% in a four-year college, and 7% in a graduate or professional program. Sixty-seven percent were employed at baseline; of those, 42% worked part-time and 58% full-time.

2.2 Procedures

Study procedures were approved by the University of Washington's Institutional Review Board. We recruited participants from the community (e.g., Craigslist, newspaper, and social media ads; flyers). After initial online screening, an in-person session consisted of age and identity verification, informed consent procedures, and explanation of study design and compensation. The in-person session ended with a 60-minute baseline survey for which participant received a \$40 Amazon gift card.

Participants began the first burst the day after the training session with the second burst occurring four months later. Both morning and afternoon assessments took 5-10 minutes to complete and could be completed anytime within a 3-hour window (i.e., 9am-noon and 3pm – 6pm). Participants received email and text message invitations and reminders about the brief online daily surveys. The present study only includes data from the morning assessments derived from items about the previous day's substance use, consequences, and motives for use. Participants were compensated \$2.50 for each daily survey completed and a \$10 bonus if they completed at least 25 of the 28 surveys for each burst. Thus, participants could earn up to \$80 in Amazon gift cards each burst. Participants in the larger study completed over 88% ($M=12.38$, $SD=2.21$) of the morning surveys in Burst 1 and 80% ($M=11.19$, $SD=3.89$) of the morning surveys in Burst 2.

The current analysis examines cross-fading motives reported on SAM use days, so we focused on the 1,049 days on which 281 participants reported SAM use, with an average of 3.73 days ($SD=3.24$) of SAM use per individual in the analysis sample.

2.3 Measures

2.3.1 Cross-fading motives.—Participants who reported SAM use were asked three items specific to cross-fading motives that have been used previously with cross-sectional data (Patrick et al., 2018). The items were adapted for daily use and prefaced with, “Yesterday, to what extent did you use alcohol and marijuana at the same time for the following reasons?” The three cross-fading motives ($\alpha=.88$, inter-correlations $r=.67-.78$) were: “To be cross faded,” “To increase the positive effects I get from alcohol,” and “To increase the positive effects I get from marijuana.” Response options ranged from 0=*Not at all* to 4=*Extremely*. The distribution for each item was examined separately, but the items were averaged for the multilevel models.

2.3.2 General substance use motives.—General substance use motives were based on measures developed for alcohol by Cooper (1994) and for marijuana by Lee et al. (2009), as used elsewhere (Patrick et al., 2019). Participants who reported alcohol or marijuana use were asked, “Yesterday, to what extent did you use alcohol and/or marijuana for the following reasons?” Sixteen reasons were offered with response options ranging from 0=*Not at all* to 4=*Extremely*. There were four subscales: enhancement (2 items, $\alpha=.68$; e.g., “To feel good”); coping (6 items, $\alpha=.79$; e.g., “To cheer me up when I was in a bad mood”); social (2 items, $\alpha=.82$; e.g., “To make a social gathering more enjoyable”); and conformity (2 items, $\alpha=.64$; e.g., “Because others were doing it”).

2.3.3 SAM use.—In the morning surveys, participants were asked whether, during the prior day, they used alcohol and marijuana: “Did you drink any alcohol yesterday?” and “Did you use any marijuana yesterday?” If they reported using both, they were asked, “Yesterday, did you use alcohol and marijuana at the same time – that is, so that their effects overlapped?” An affirmative answer to this question was coded as a day with SAM use, and the day was included in our analyses.

2.3.4 Alcohol use, perceived intoxication, and consequences.—Participants who drank alcohol during the prior day were asked, “How many total drinks did you have yesterday?” Response options ranged from 1=*one drink* to 25=*25 or more drinks*. Perceived intoxication was based on the question, “Yesterday, when you were drinking alcohol, how intoxicated did you become?” Response options ranged from 0=*Not at all intoxicated* to 4=*Extremely intoxicated*. Alcohol consequences were based on 21 possible consequences (adapted from Lee et al., 2019). Sum scores were based on the numbers of positive (6 items; relax, social, better mood, buzz, energetic, express feelings) and negative (15 items; hangover, nausea/vomit, hurt/injury, forget, aggressive, rude, embarrassed, fight, faint, blackout, vandalism, clumsy, difficulty concentrating, confused, dizzy) consequences experienced.

2.3.5 Marijuana use, intensity of high, and consequences.—Marijuana use was assessed by asking participants who reported marijuana use for the prior day, “How many hours were you high yesterday?” Response options ranged from 0=*less than 1 hour* to 23=*24 hours*. Second, intensity of the high was assessed with the question, “Yesterday, how high did you get when you used marijuana?” Response options ranged from 0=*Not at all high* to 4=*Extremely high*. Respondents who reported smoking or vaping marijuana (reported on 88% of SAM use days) were asked, “When you smoked or vaped yesterday, how many grams of marijuana did you personally use?” Response options for this item ranged from 0=*Up to 1/8 of a gram* to 10=*More than 28 grams (1 ounce)*.

Participants were asked if they had experienced 13 possible marijuana-related consequences (0=no, 1=yes). A sum of positive consequences was based on three items (i.e., “Felt relaxed,” “Was in a better mood,” “Forgot my worries or problems”), and a sum of negative consequences was based on 10 items (e.g., “Had difficulty concentrating” and “Felt lethargic or sedated;” Lee et al., 2017).

2.3.6 Covariates.—In models predicting substance use and consequences, we included the following person-level covariates, assessed at baseline: age, biological sex (0=female, 1=male), and four-year college attendance (0=not attending, 1=attending). We included a Level 1 covariate for whether the reference day (i.e., day SAM use occurred) was a weekend day (1=Thursday, Friday, or Saturday; 0=other day of the week). Other Level 1 covariates were burst (0=burst 1, 1=burst 2) and the survey day within the given burst (coded 0 to 13).

2.4 Analysis

We first examined item frequencies for the three cross-fading motives to determine how frequently these motives were endorsed. To assess associations between cross-fading

motives and substance use and consequences, we used multilevel models estimated with HLM 7.0 (Raudenbush et al., 2011). The substance use models predicted number of drinks, perceived intoxication, hours high, intensity of high, and grams of marijuana used. For all models, within-person predictors were the four general substance use motives (all person centered), the burst number, the day within burst, and whether the reference day was a weekend. Person-level predictors were the average scores on each motives scale across SAM use days (grand-mean centered) and baseline covariates of age (grand mean centered), biological sex, and four-year college status. For models predicting positive and negative consequences of alcohol and marijuana, the following covariates were added to adjust for alcohol and marijuana use: number of drinks and hours high on the given day (person-centered) and average number of drinks and average hours high on SAM use days at the person level (grand-mean centered).

Perceived intoxication, intensity of high, and grams consumed were treated as continuous outcomes. Drinks consumed, hours high, and the four consequence outcomes were treated as counts (with overdispersion) in Poisson models. For count models, we report Rate Ratios (RRs; sometimes referred to as count ratios or incident rate ratios).

3. Results

3.1 Descriptive statistics

Across all SAM use days, the mean number of drinks consumed was 4.21 ($SD=3.00$) and the mean number of hours high was 3.32 ($SD=2.55$). On these days, respondents reported an average of 3.60 ($SD=1.82$; none on 7% of days) positive alcohol consequences, 0.93 ($SD=1.54$; none on 59% of days) negative alcohol consequences, 1.95 ($SD=0.89$; none on 9% of days) positive marijuana consequences, and 1.29 ($SD=1.56$; none on 41% of days) negative marijuana consequences.

3.2 Cross-fading motives

Frequency distributions across the three cross-fading motives were similar (Table 1) and show that each of the cross-fading motives was endorsed on over 60% of SAM use days. For the 3-item scale, the mean score was 1.32 ($SD=1.15$), and on 76% of SAM use days young adults reported at least some degree of cross-fading motives. There was substantial stability in cross-fading motives across SAM use days with nearly two-thirds of the variation being between-person. Based on the intraclass correlation (ICC) from an unconditional multilevel model, 63% of the variance in cross-fading motives was between individuals and 37% was within individuals across days. Cross-fading motives were higher among college attenders than non-attenders and among younger than older respondents, but did not differ by sex or race/ethnicity (Supplemental Table 1).

3.3 Motives predicting alcohol and marijuana use

Table 2 shows estimates for models predicting alcohol and marijuana use. At the between-person level, there was a positive association between cross-fading motives and number of drinks consumed and perceived intoxication, indicating that individuals who reported greater cross-fading motives on average also reported greater number of drinks and intoxication on

average. In addition, individuals who reported more general substance use motives reported greater alcohol or marijuana use on average on SAM days (i.e., general enhancement associated with how high, general coping associated with number of drinks and more marijuana use [hours high, how high, grams], and general conformity associated with less high).

At the within-person level, cross-fading motives on a given day were associated with more alcohol use and greater perceived intoxication from alcohol that day, but not with any marijuana use indicators. Days with greater general enhancement motives on SAM use days were positively associated with greater intoxication and greater marijuana use on all three indicators. Social motives were positively associated with number of drinks, intoxication, and hours high. Coping motives were associated with consuming more drinks but lower intoxication.

3.4 Motives predicting consequences

At the between-person level, average cross-fading motives were positively associated with positive and negative alcohol consequences and positive (but not negative) marijuana consequences on average across SAM days (Table 3). In addition, at the between-person level, general substance use motives were associated with some of the consequence outcomes on SAM days (i.e., general enhancement associated with positive alcohol and marijuana consequences, general social associated with positive and negative alcohol and negative marijuana consequences, general coping associated with all four types of consequences, and general conformity associated with negative alcohol and marijuana consequences).

At the within-person level, cross-fading motives on a given day were associated with more positive alcohol consequences that day, but not with negative alcohol consequences or positive or negative marijuana consequences. Regarding general motives on a given day, general enhancement motives were associated with more positive alcohol and marijuana consequences; general social motives were associated with more positive and negative alcohol consequences; general coping motives were associated with more positive and negative marijuana consequences; and general conformity motives were associated with more negative alcohol consequences and negative marijuana consequences.

4. Discussion

Although previous research has documented that there are motives specific to SAM use (e.g., Patrick et al., 2018), this is the first study to examine cross-fading motives assessed at the daily level and document both between- and within-person associations of cross-fading motives with alcohol and marijuana use and their consequences. In particular, results demonstrated that, above and beyond general substance use motives (e.g., Patrick et al., 2019), both a person's average level of cross-fading motives (i.e., endorsing using alcohol and marijuana simultaneously to enhance the effects of alcohol and/or marijuana) and their cross-fading motives on a given day were associated with greater alcohol use and intoxication. Although the majority of the variation in cross-fading motives was between individuals, there were fluctuations within individuals across SAM use days and this within-

person variation predicted number of drinks consumed and intoxication. In addition, general enhancement motives were associated with intoxication and more marijuana use, general social motives were associated with greater alcohol and marijuana use, general coping motives were associated with more alcohol use but less perceived intoxication on days with SAM use, and conformity motives were associated with being high longer on SAM use days. Young adults adjust their drinking behavior from day-to-day based on desires for both substance-specific outcomes (i.e., perceived positive consequences) and cross-faded effects with marijuana. Cross-fading motives are distinct from general motives, and cross-fading motives are associated with behavior, particularly number of drinks consumed.

Furthermore, even after controlling for alcohol and marijuana use, both average and day-to-day variation in cross-fading motives were associated with reports of positive alcohol consequences. That is, on days young adults reported elevated cross-fading motives, they perceived more positive effects from alcohol, even after controlling for the amount of alcohol and marijuana used. This finding may be the result of an expectancy effect (e.g., Jones et al., 2001; Lee et al., 2019, 1999; Leigh and Stacy, 2004; Stacy et al., 1990), or it may be related to contextual differences or interactions between their alcohol and marijuana use on a given day. Cross-fading motives were not associated with marijuana consequences, which may be due to a weaker or different type of expectancy effect for marijuana use. General motives on a given day were also associated with consequences on SAM use days, namely enhancement motives with positive consequences, conformity motives with negative consequences, social motives with alcohol-related consequences, and coping motives with marijuana consequences. These effects of general motives associated with consequences on SAM use days have not been reported previously, but suggest that different types of motives place young adults at risk for different consequences, which could be considered in interventions. In particular, conformity motives are associated with negative alcohol and marijuana consequences on SAM use days.

Study limitations include a focus on individuals who reported recent SAM use and a focus on SAM use days, which likely led to heavier and more consistent users being represented in the analytic sample. Whether results generalize to young adults who engage in SAM use more sporadically and to young adults who reside in states without legal nonmedical marijuana use is unknown. Due to the administration of brief, daily surveys, the measures of cross-fading and general substance use motives are brief. Substance use is self-reported for the previous day and is subject to recall bias. However, study strengths include the EMA design yielding repeated measures of SAM days within people over time to give an unprecedented look at day-to-day fluctuations in motives and substance use patterns.

Variance in cross-fading motives is largely between people, suggesting that some people are more motivated for SAM-specific substance use than others. Further, the variability in cross-fading motives within-persons across days is tied to how much young adults drink on a given day. Alcohol-specific interventions, in particular, should consider integrating an understanding of cross-fading motives and providing information about SAM use and consequences. Although cross-fading motives were associated with behavior, on nearly one-quarter of SAM use days participants reported not having any cross-fading motives. This suggests that SAM use is sometimes instrumental to achieve a cross-faded (drunk and

high) effect, and other times may be unplanned or more influenced by the context of use. Future research should examine how days with and without cross-fading motives differ, and how days of endorsing motives to enhance the effects of alcohol and/or marijuana may lead to different consequences. Furthermore, determining whether real-time interventions can or should be used to provide intervention messages to young adults on days they have greater cross-fading motives is an area of clinical significance. Overall, the current study provides evidence that young adults have shifting motives for substance use and specific cross-fading motives across occasions, and the day-to-day changes in these motives could be targeted in future intervention efforts

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Cross-fading motives: to enhance marijuana/alcohol effects by using simultaneously
- On most (76% of) SAM use days, young adults had cross-fading motives
- Cross-fading motives predicted more alcohol use and perceived intoxication that day
- Cross-fading motives were not associated with level of marijuana use on SAM days

Table 1.

Frequencies for three cross-fading motives items, based on 1,049 simultaneous alcohol and marijuana (SAM) use days.

Response	To be cross faded	To enhance the effects of alcohol	To enhance the effects of marijuana
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Not at all	382 (37)	386 (37)	379 (37)
A little bit	220 (21)	238 (23)	224 (22)
Moderately	188 (18)	215 (21)	244 (24)
Quite a bit	148 (14)	142 (14)	139 (13)
Extremely	100 (10)	57 (6)	52 (5)
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
	1.39 (1.36)	1.27 (1.24)	1.29 (1.23)

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Table 2. Fixed effects estimates for multilevel models predicting alcohol and marijuana use on SAM use days.

Predictor	Number of drinks		Intoxication		Hours high		How high		Grams of marijuana	
	RR	95% CI	b	se	RR	95% CI	b	se	b	se
<i>Between person predictors</i>										
Intercept	3.47 ^{***}	(3.00,4.00)	1.43 ^{***}	0.10	2.74 ^{***}	(2.28,3.30)	1.87 ^{***}	0.09	1.47 [*]	0.23
Male (vs. females)	1.16 [*]	(1.02,1.31)	-0.02	0.08	1.35 ^{***}	(1.17,1.56)	0.11	0.08	0.65 ^{**}	0.20
Age ^d	0.94 ^{**}	(0.90,0.98)	-0.09 ^{***}	0.03	1.00	(0.94,1.05)	0.01	0.02	-0.15 [*]	0.07
Four-year college (vs. other)	0.98	(0.84,1.14)	-0.06	0.11	0.95	(0.76,1.20)	0.14	0.11	-0.68 [*]	0.32
Race/ethnicity (ref.=White)										
Hispanic	1.00	(0.85,1.17)	0.11	0.11	1.00	(0.82,1.22)	0.32 ^{**}	0.11	0.31	0.27
Asian	0.82 [*]	(0.69,0.98)	-0.18	0.13	0.82	(0.65,1.03)	0.00	0.11	-0.08	0.36
Other	0.88	(0.75,1.03)	-0.03	0.10	1.06	(0.87,1.29)	0.05	0.11	0.25	0.26
Avg. cross-fading ^d	1.11 ^{**}	(1.03,1.19)	0.24 ^{***}	0.05	1.04	(0.95,1.15)	0.08	0.05	0.19	0.11
Avg. general enhancement ^d	0.97	(0.88,1.07)	0.04	0.06	1.09	(0.99,1.19)	0.14 ^{**}	0.05	-0.17	0.14
Avg. general social ^d	1.10 [*]	(1.02,1.18)	0.09	0.05	0.94	(0.85,1.04)	-0.01	0.06	-0.21	0.13
Avg. general coping ^d	0.81 ^{***}	(0.72,0.91)	-0.13	0.07	1.23 ^{**}	(1.07,1.41)	0.26 ^{***}	0.07	0.85 ^{***}	0.17
Avg. general conformity ^d	1.00	(0.92,1.10)	0.04	0.06	0.88	(0.75,1.03)	-0.25 ^{***}	0.06	-0.32	0.17
<i>Within person predictors</i>										
Burst 2	1.00	(0.93,1.08)	0.02	0.06	1.00	(0.89,1.12)	-0.02	0.05	-0.13	0.12
Weekend	1.17 ^{***}	(1.10,1.24)	0.23 ^{***}	0.05	1.00	(0.93,1.08)	0.09	0.05	0.08	0.08
Day number within burst (0-13)	1.01 ^{**}	(1.00,1.02)	0.02 [*]	0.01	0.99	(0.98,1.00)	0.01	0.01	0.02	0.01
Cross-fading ^b	1.24 ^{***}	(1.18,1.31)	0.36 ^{***}	0.05	1.00	(0.94,1.07)	0.00	0.04	0.08	0.08
General enhancement ^b	1.06	(1.00,1.12)	0.09 [*]	0.04	1.10 ^{**}	(1.03,1.18)	0.18 ^{***}	0.04	0.31 ^{***}	0.08
General social ^b	1.09 ^{***}	(1.04,1.14)	0.13 ^{***}	0.04	1.07 [*]	(1.01,1.13)	0.05	0.04	0.03	0.05
General coping ^b	0.89 ^{**}	(0.81,0.97)	-0.13 [*]	0.06	1.01	(0.90,1.13)	0.09	0.05	0.16	0.11

Predictor	Number of drinks		Intoxication		Hours high		How high		Grams of marijuana	
	RR	95% CI	b	se	RR	95% CI	b	se	b	se
General conformity ^b	0.98	(0.92, 1.05)	-0.01	0.06	0.90*	(0.83, 0.99)	0.02	0.05	0.04	0.10

^a Grand mean centered

^b Person mean centered

* p<.05

** p<.01

*** p<.001

Note. RR = rate ratio, b = unstandardized regression coefficient, se = standard error, Avg.= average, SAM = simultaneous alcohol and marijuana, SU = substance use, ref.= reference group, Hisp = Hispanic

Table 3.

Estimates for multilevel models predicting alcohol and marijuana use consequences on SAM use days.

Predictor	Alcohol positive consequences		Alcohol negative consequences		Marijuana positive consequences		Marijuana negative consequences	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
<i>Between person predictors</i>								
Intercept	3.67 ^{***}	(3.37,4.00)	0.94	(0.71,,1.25)	2.10 ^{***}	(1.93,2.29)	1.28 [*]	(1.00,1.63)
Male	0.96	(0.90,1.04)	0.60 ^{***}	(0.48,0.76)	1.01	(0.95,1.09)	0.76 ^{**}	(0.63,0.93)
Age ^d	1.01	(0.99,1.03)	0.95	(0.90,1.01)	0.99	(0.97,1.02)	1.02	(0.96,1.09)
Four-year college	0.99	(0.91,1.08)	1.07	(0.81,1.41)	0.96	(0.87,1.06)	1.07	(0.81,1.43)
Race/ethnicity (ref.=White)								
Hispanic	1.06	(0.96,1.17)	0.90	(0.68,1.20)	1.03	(0.92,1.15)	0.95	(0.72,1.25)
Asian	1.08	(0.98,1.20)	0.84	(0.59,1.19)	1.07	(0.96,1.19)	1.28 [*]	(1.01,1.62)
Other	0.98	(0.89,1.08)	0.80	(0.57,1.13)	0.93	(0.85,1.01)	0.78	(0.60,1.01)
Avg. hours high ^d	1.00	(0.98,1.01)	1.05	(0.99,1.11)	1.01	(1.00,1.03)	1.07 ^{***}	(1.04,1.11)
Avg. number of drinks ^d	1.06 ^{***}	(1.04,1.07)	1.16 ^{***}	(1.12,1.21)	0.99	(0.97,1.01)	1.00	(0.95,1.05)
Avg. Cross-fading ^d	1.07 ^{***}	(1.03,1.11)	1.25 ^{***}	(1.10,1.43)	1.05 ^{**}	(1.02,1.09)	1.05	(0.95,1.16)
Avg. general enhancement ^d	1.12 ^{***}	(1.06,1.18)	0.95	(0.81,1.13)	1.14 ^{***}	(1.08,1.20)	1.03	(0.90,1.19)
Avg. general social ^d	1.10 ^{***}	(1.05,1.15)	1.19 [*]	(1.02,1.39)	0.97	(0.93,1.02)	1.16 [*]	(1.02,1.33)
Avg. general coping ^d	1.08 [*]	(1.02,1.15)	1.37 ^{**}	(1.13,1.66)	1.23 ^{***}	(1.17,1.31)	1.41 ^{***}	(1.20,1.66)
Avg. general conformity ^d	1.02	(0.97,1.07)	1.22 ^{**}	(1.07,1.41)	0.97	(0.92,1.02)	1.18 [*]	(1.03,1.36)
<i>Within person predictors</i>								
Burst 2	0.95	(0.90,1.01)	0.96	(0.80,1.15)	0.93 [*]	(0.88,0.99)	0.99	(0.86,1.14)
Weekend	1.03	(0.98,1.09)	1.16 [*]	(1.01,1.35)	1.02	(0.97,1.08)	1.11	(0.99,1.24)
Day number within burst (0-13)	1.00	(0.99,1.00)	0.99	(0.97,1.01)	0.99 ^{***}	(0.98,1.00)	1.00	(0.98,1.01)
Number of drinks ^b	1.05 ^{***}	(1.04,1.07)	1.22 ^{***}	(1.18,1.27)	1.01	(1.00,1.02)	0.94 ^{**}	(0.91,0.98)
Hours high ^b	0.99	(0.98,1.00)	0.98	(0.95,1.02)	1.01	(0.99,1.02)	1.09 ^{***}	(1.06,1.12)

Predictor	Alcohol positive consequences		Alcohol negative consequences		Marijuana positive consequences		Marijuana negative consequences	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Cross-fading ^b	1.08 ^{***}	(1.04,1.13)	1.05	(0.93,1.18)	1.00	(0.95,1.05)	1.06	(0.96,1.18)
General enhancement ^b	1.10 ^{***}	(1.05,1.15)	1.00	(0.87,1.15)	1.13 ^{***}	(1.07,1.18)	0.95	(0.87,1.04)
General social ^b	1.04 [*]	(1.01,1.07)	1.10 [*]	(1.00,1.22)	0.97	(0.94,1.00)	0.99	(0.91,1.07)
General coping ^b	1.00	(0.95,1.05)	1.05	(0.91,1.21)	1.11 ^{***}	(1.05,1.17)	1.38 ^{***}	(1.23,1.55)
General conformity ^b	1.04	(0.99,1.10)	1.16 [*]	(1.01,1.34)	0.98	(0.93,1.03)	1.26 ^{***}	(1.12,1.43)

^a Grand mean centered

^b Person mean centered

* p<.05

** p<.01

*** p<.001

Note. RR = count ratio, *b* = unstandardized regression coefficient, *se* = standard error, Avg = average, SAM = simultaneous alcohol and marijuana, SU = substance use, ref. = reference group