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Contextual influences on simultaneous alcohol and cannabis use in a predominately white sample of college students

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Abstract

Objective: Simultaneous alcohol and cannabis (i.e., marijuana [SAM]) use is highly prevalent among young adults and college students and associated with a number of negative consequences compared to single substance use. The current study examined socio-contextual factors (e.g., physical, situational, social) associated with SAM use versus cannabis-only versus alcohol-only use.

Method: Data were collected from college student SAM users (N=313, 53% women, *M* age = 19.79; 74% White; 10% Hispanic/Latinx) who completed two bursts (28-days) of online repeated daily surveys (RDS). RDS were collected five times per day during both bursts (three months apart).

Results: Results suggested that odds of being at home were greater for cannabis-only use compared to SAM and SAM compared to alcohol-only use. Odds of being at a friend's place were greater for SAM compared to alcohol-only and cannabis-only use. Odds of being at a party were greater for SAM compared to alcohol-only use and odds of being at a bar or restaurant were greater for alcohol-only compared to SAM use. Results also suggested that odds of having more people in a location consistently were greater for SAM compared to cannabis-only use, and alcohol-only compared to cannabis-only use.

Conclusion: Physical and social contexts (parties, friend's homes and being around more people) are significantly associated with SAM use occasions. These findings are well-aligned with a social-ecological framework and suggest intervention and prevention efforts should take a comprehensive approach to reduce harms associated with SAM use. Future work is needed to examine these associations in diverse samples.

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Keywords

Alcohol; cannabis; marijuana; simultaneous use; context

Introduction

A majority of young adults and college students who use alcohol and cannabis also use them at the same time, so that their effects overlap (Substance Abuse and Mental Health Services Administration, 2019; Terry-McElrath & Patrick, 2018). For example, White et al. (2019) found that 73% of college students who used alcohol and cannabis in the last year used them simultaneously. Simultaneous alcohol and cannabis (i.e. marijuana, [SAM]) use occasions are associated with more negative consequences than single substance use occasions (Linden-Carmichael et al., 2020; Lipperman-Kreda et al., 2017). Thus, it is critical to understand the contextual factors (e.g., physical and social environment) most associated with SAM use.

Context, which plays an important role in substance use, has many dimensions (e.g., Sudhinaraset et al., 2016). The Social Ecological Framework of Drinking Contexts and Alcohol-Related Problems describes the importance of considering contextual factors in tandem: whom (social), where (space/location), when, and under what circumstances substance use occurs (Freisthler et al., 2014). Although fewer studies have examined these contextual predictors together, significant work has examined them independently. One important dimension of context is location of use, or “activity space” (Freisthler et al., 2014; Mason, 2010). For example, drinking in public settings, such as bars (Demers et al., 2002; Jones-Webb et al., 1997; Kypri et al., 2007), fraternity/sorority houses and parties (Paschall & Saltz, 2007), and in multiple locations (Connor et al., 2014; Fairlie et al., 2018) is associated with greater consumption, intoxication, and negative consequences related to alcohol use. Within location, studies on college student binge drinking have shown that social contexts (e.g., greater number of intoxicated people or drinkers) predict greater alcohol consumption (Clapp et al., 2000; Marzell et al., 2015; Paschall & Saltz, 2007) and motivate heavy drinking (Mohr et al., 2005). Conversely, one ecological momentary assessment (EMA) study of young adult medical cannabis users found that home is the most common location for cannabis use (Shrier et al., 2012). Positive observed associations between using cannabis with others and amount of time spent using cannabis suggest that social contexts may lead to increased use (Phillips et al., 2018; Shrier et al., 2012). More broadly, the presence of others in general and others who are using specifically both predict cannabis use (Buckner et al., 2012; Hughes et al., 2017).

Timing (i.e., when) is another key situational context. Studies show that heavy alcohol consumption is more likely to occur on weekends and after 5pm (Heeb et al., 2008; Hoeppner et al., 2012; Room et al., 2012). This finding is unsurprising given the elevated frequency of drinking-related social events on weekends and evenings. In contrast, some research suggests that cannabis use is equally likely to occur on weekends as weekdays and most likely to occur between 6pm and midnight (Buckner et al., 2012), although earlier

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use (colloquially known as “wake and bake”) is also common among daily cannabis users (Earleywine et al., 2016).

There have been very few studies examining socio-contextual predictors of SAM use. One recent study found that, among young adults, social events in private settings with a high percentage of people who are intoxicated resulted in greater likelihood of SAM use relative to alcohol-only use (Lipperman-Kreda et al., 2018). In another EMA study of adolescent SAM use, being in social contexts with greater number of underage drinkers was associated with greater risk of SAM use, again relative to alcohol-only use (Lipperman-Kreda et al., 2017). Given the risks associated with increased SAM use, it is important to understand whether specific contexts are more likely to result in SAM use compared to separate use of alcohol and cannabis.

Current Study

The current study uses repeated daily surveys to explore how physical context (where), social context (how many people within each location), and situational context (when; day of week and time of day) are associated with substance use occasions in college students (alcohol-only versus cannabis-only versus SAM use) within the same survey period. To our knowledge, this is the first within-subject analysis to determine whether locations are associated with SAM use occasions, and one of the first papers to compare SAM use contexts relative to cannabis-only contexts. Examining the associations between physical, social, and situational contexts and SAM use extends the literature and reflects the complexity posited by social-ecological theory. In this study, we examine social context within physical context, whereas previous studies have aggregated analyses across locations (Thrul & Kuntsche, 2015), thus potentially masking the differential effects of group size by drinking location.

Based on prior research (Lipperman-Kreda et al., 2018; Shrier et al., 2012), we expect that parties and friends’ places, and being around more people, will be associated with SAM use compared to alcohol-only or cannabis-only use and that being at home and around fewer people will be associated with cannabis-only compared to alcohol-only use or SAM use occasions. We expect more people in a location to be associated with alcohol-only compared to cannabis-only use occasions and evening and weekend to be associated with alcohol-only and SAM compared to cannabis-only use.

Method

Design and Sample

Screening and Baseline Survey.—A stratified (by year in school) random sample of students from three state universities was screened online for eligibility to participate in a larger online survey about simultaneous alcohol and cannabis use (Jackson et al., 2019; Sokolovsky et al., 2020; Stevens et al., 2020; White et al., 2019). At the time of screening, cannabis was legal for medical use and illegal for recreational use at School A; illegal but decriminalized for recreational use and legal for medical use at School B; and legal for recreational (ages 21+) and medical use at School C. Students from each university were

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sent an email invitation to the screening survey (8,000 from each university, 24,000 in total). Inclusion criteria included: full-time enrollment at one of the universities, age 18–24, past-year alcohol and cannabis use, and being on the registrar's list. Of 7,000 completed screening responses, 2,874 students were eligible, and a random sample of 2,501 was invited to take the baseline survey[1]. Of those invited, 1,498 (60.0%) completed the survey and 1,390 were retained after excluding students who provided responses inconsistent with eligibility criteria or whose surveys had technical problems[2]. Participants were compensated for a complete survey with a $25 Amazon gift card. See White et al (2019) for additional screening and sample information.

Repeated Daily Surveys (RDS).—The daily survey phase of the study consisted of two 28-day measurement bursts (3 months apart). Inclusion criteria included: baseline survey completion and report of past-month simultaneous use of alcohol and cannabis ("so that their effects overlapped"; i.e., SAM). Of those who completed the baseline survey, 693 were eligible to complete the daily surveys. Daily survey recruitment was stratified by sex and frequency of past-month simultaneous use to ensure roughly equal numbers of men and women and to over-sample frequent SAM users.[3] A total of 341 students (53% women, *M* age = 19.79; 74% White; 11% Asian, 9% bi- or multi-racial, 3% Black/African American, 2% 'other', 1% American Indian or Alaskan Native, and <1% Native Hawaiian or other Pacific Islander; 10% Hispanic/Latinx) were enrolled into this phase (see Sokolovsky et al., 2020 for details).

Data from 54 days were retained (the first two days were excluded due to technical issues). RDS comprised five surveys per day (prompted at 9:00am, 2:00pm, 5:00pm, 8:00pm, and 11:00pm) via a custom smartphone application. Participants were provided 4 hr to complete the 9:00am survey and 2 hr to complete the rest. Time periods of missed surveys were covered in the subsequent survey. Each survey took 1–2 minutes to complete except the morning survey, which included a summary of the day before as well as questions about substance use between the last prior day survey and bedtime. For additional details regarding survey administration, see Stevens et al. (2020). Participants received $1 for each completed survey in addition to weekly and overall participation bonuses totaling up to $200 in potential compensation (Amazon gift cards) per burst. Procedures were approved by the

[1]Of the 7,000 screening responses, 386 did not provide contact information, resulting in 6,614 responses considered for eligibility. There were 3,740 responses that did not meet inclusion criteria due to invalid email (n=116), not on the registrar's list (n=245), duplicate response (n=53), and not a full time-student, age 18–24 years old, and/or did not use alcohol or cannabis in the past year (n=3,326). This left 2874 screening respondents who were eligible for the baseline survey. We randomly selected 2,501 of them across the three schools who were invited to take the baseline survey.

[2]Of the 2,501 invited students, 1,610 provided consent and were considered enrolled in the study and 1,498 completed the survey with usable data (60.0%; there were an additional 25 students who completed the survey but their data could not be used due to technical issues). Upon examination of the baseline survey results, 1,390 were retained for analysis; participants were excluded from the final sample if they did not report using alcohol or cannabis in the past year or reported currently being less than a full-time student.

[3]All students who were eligible for the baseline survey were eligible for the daily survey phase if at baseline they reported using alcohol and cannabis simultaneously (SAM) at least once in the past month. Eligible participants were classified into four categories based on past-month SAM frequency (1–2 times vs. 3+ times) and birth sex. A cap was put on each category within each school, oversampling frequent SAM users (3+) and males (to balance the sample) and generally inviting an equal number of participants from each school. This resulted in a total of 596 students (of the 693 who met the initial eligibility criterion) being invited to participate in the daily surveys via an email link. Of those, 506 (84.9%) accepted the invitation, however 127 of the 506 had accepted after the quota for their category had been reached, resulting in 379 students who were invited to participate in the daily surveys. The 379 students were sent an email invitation to download the study smart phone application. There were 343 students who ultimately downloaded the app (90.5% of those who had app access). Two students were dropped because they only completed the first two days of surveys and data for the first two days were deleted due to technical issues resulting in a final sample of 341 students.

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coordinating university's Institutional Review Board. A Certificate of Confidentiality was obtained from the National Institute on Drug Abuse.

Measures

Baseline Survey.—Participants provided demographic information at the baseline survey, including age, sex assigned at birth, race and ethnicity.

RDS.—At each of the five RDS, participants reported their use of alcohol and cannabis with the item, "What did you use between X and Y?" (both alcohol and marijuana; alcohol; marijuana; neither). Participants reported on their use of other drugs with the item "Did you use drugs other than marijuana between X and Y?" (yes; no). Participants reported on their location with the item "Where were you between X and Y?" (Home; Friend's place; Party; Bar/Restaurant; Outside; Study space (e.g., library or other quiet academic location); Athletic facility; Elsewhere [check all that apply]). Locations were examined independently and modeled as separate variables. Number of people at each location was assessed with the item "How many people were you with at [location]?" with continuous response options from 0 to 20+.

Covariates.—Subject-level covariates included: sex (ref: female), age (continuous), and school (ref: School A). We also examined race (ref: white) and ethnicity (ref: non-Hispanic/Latinx) as covariates in all models, but found no significant effects; therefore, effects were subsequently removed for parsimony. Time-varying covariates included: any drug use other than cannabis (dichotomized, ref: no), weekday (dichotomized; ref: weekday [Sunday-Thursday]), and survey time (dichotomized; ref: day [ref, 2:00pm, 5:00pm] vs. evening [9:00am,[4] 8:00pm, 11:00pm]).

Analysis Plan

Data were structured such that each row represented one survey for one participant. Surveys with any alcohol or cannabis use were coded as either alcohol-only, cannabis-only, or SAM. We fit a series of generalized linear mixed models (GLMMs) with binomial distributions using maximum likelihood estimation in the glmmTMB package (Brooks et al., 2017) for R 3.6.1 (R Core Team, 2017). We computed intraclass correlations (surveys within participants) and included normally distributed random intercepts for participant in all models.

The focal analyses examined the associations between context and SAM versus alcohol-only versus cannabis-only use. First, we ran a series of separate models in which the three-level substance use variable (parsed into pairwise comparisons: SAM versus alcohol-only, SAM versus cannabis only, and alcohol-only versus cannabis-only) was regressed onto a single indicator of location (i.e., dummy codes for home, friend's place, party, and bar/restaurant) and person-level (sex, age, school), day-level (day of week), and survey-level (other drug use, time of survey) covariates[5]. Model improvement due to inclusion of the location variable was tested by comparing the model against a partially-adjusted model including

[4]The 9:00am survey asked about the prior evening (11:00pm – bedtime).

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only covariates and situational context indicators. Second, we examined how number of people within a location was associated with type of substance use survey using a parallel analytic approach but restricted to observations occurring in the focal location. For surveys at home, we also examined a binary indicator (alone versus with others), given the potential discontinuity between these values that may not be captured fully by a linear effect.

Because some days did not have full coverage (i.e., all five surveys answered) and, thus, did not allow us to align context data exactly with type of substance use during the survey period, we removed 9,763 [62%] days (which included 29,404 (49%) surveys and 28 [8%] participants) from the analyses, resulting in 30,175 surveys across 313 participants and 6,035 days. The final sample of substance use surveys (6,817) came from 2,535 days and 300 participants. Including only full coverage days resulted in roughly equivalent time period coverage across surveys. Because most surveys covered approximately a 3 hr period, it was possible for participants to report multiple locations. Therefore, the type of substance use reported for a survey period may not have occurred in a specific location but instead reflected being in that location during a survey where that substance was used. We made the decision not to exclude multiple location surveys to increase real-world generalizability and sample size. Furthermore, although selecting surveys with only a single location endorsed would have isolated the substance use to that location, this restriction would have significantly reduced the sample (by 9,436 surveys, 31%) and would have disproportionately removed SAM use surveys, which are more likely to occur in surveys with multiple locations. Therefore, we also ran a set of supplemental analyses that paralleled our approach but were limited to only surveys where a single location was reported (see results).

Results

Most surveys involving substance use were cannabis-only (57%) and the most common location across substances was at home (73%), although home was endorsed much more frequently for cannabis-only surveys (82%) than alcohol-only surveys (57%). As expected, prevalence rates for substance use occurring outside, in a study space, and at the gym were low for alcohol-only and SAM use and the rate of cannabis-only use at bar/restaurants was low (Table 1). Including low base rate categories is not recommended for multilevel models (Agresti, 2002), which precluded further examination of these effects. We also omitted cannabis-only comparisons as an outcome for bar/restaurant or party for this reason.

Association between location and substance use

Results from GLMMs indicated that the odds of being at home were greater for cannabis-only use relative to SAM and alcohol-only use, and for SAM relative to alcohol-only use. Odds of being at a friend’s place were greater for SAM relative to alcohol-only use and cannabis-only use, and alcohol-only use relative to cannabis-only use. Odds of being at a party were greater for SAM relative to alcohol-only use and odds of being at a bar or

[5]Effects of each location were tested individually in order to isolate the effects of each location on substance use. Including all locations in a single model would result in difficult to interpret effects (reduced variability as there would be no appropriate reference group for each effect).

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restaurant were greater for alcohol-only relative to SAM use (Table 2). Odds of weekend days were greater for SAM relative to cannabis-only use, and alcohol-only relative to cannabis-only use. Odds of using substances in the evening were greater for SAM relative to alcohol-only use, SAM relative to cannabis-only use, and alcohol-only relative to cannabis-only use. Covariate results for all models are provided in Supplemental Materials (Tables S1–S7).

In the supplemental analyses examining only surveys with a single location, we found the same direction and level of significance of effects for all primary indicators. However, the effects of friend's place and party on SAM versus alcohol-only surveys were not significant. Importantly, as noted above, removing surveys with more than one location endorsed systematically eliminates more SAM surveys, weakening the power to see significant effects in these comparisons.

Because sex was a significant covariate in several of the models, we ran additional supplemental analyses examining the interaction of sex and number of people present in each location. We found a significant interaction between sex and being at home when comparing alcohol-only versus cannabis-only use, indicating females were more likely to use alcohol-only compared to cannabis-only at home than males (Figure S1). We also found two significant interactions between sex and being at friend's place: 1) for cannabis-only versus SAM, indicating females were more likely to use cannabis-only compared to SAM at a friend's place than males (Figure S2); and 2) for and alcohol-only versus cannabis-only use indicating females were more likely to use alcohol-only compared to cannabis only at a friend's place than males (Figure S3). The remainder of the models indicated no interaction between sex and location.

Associations between number of people conditional on location and substance use

Results from GLMMs presented in Table 3 indicated that odds of being with more people at home (in surveys where home was endorsed) were greater for SAM relative to cannabis-only use, and alcohol-only relative to cannabis-only use. Treating number of people as binary (alone versus with others) indicated that odds of being with others were greater for SAM relative to cannabis-only use and alcohol-only relative to cannabis-only use. Similarly, odds of having more people present at a friend's place were greater for SAM relative to cannabis-only use and alcohol-only use relative to cannabis-only use (see Table 3). Covariate effects are presented in Supplemental Materials (Tables S4–S7).

In the supplemental analyses examining only surveys with a single location, we found the same direction of effects for all primary indicators. In supplemental analyses examining the interaction of sex and number of people present in each location, we found a single significant interaction between sex and number of others at a restaurant or bar comparing alcohol-only to SAM use. For females the number of people at a bar or restaurant was positively associated with alcohol-only use relative to SAM use, where for males, the association was negative (Figure S4).

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Discussion

This study examined how exposure to location and social context within specific locations is associated with alcohol-only versus cannabis-only versus SAM use in RDS. Taking a social-ecological approach, we concurrently considered additional important contextual predictors as covariates (situational context: day of week and time of day). Taking into account important person-level covariates (sex, age, and school), other drug use, and situational context, we found that being at home during a survey period was significantly more likely for SAM compared to alcohol-only use occasions, and cannabis-only compared to SAM and alcohol-only use occasions. Overall, these results suggest that cannabis use is most likely to occur when individuals are in their home. This finding is consistent with recent EMA reports showing that home is common location for cannabis use (Shrier et al., 2012), but our study showed that this is less often the case if the cannabis user has also drank alcohol in the same period of time. We also found that being at a friend's place was more likely for SAM compared to alcohol-only and cannabis-only use occasions as well as alcohol-only compared to cannabis-only use occasions. Overall, this is consistent with work from Lipperman-Kreda and colleagues (2018), which found that being at social events in private settings (e.g., friend's place) increases the likelihood of simultaneous use. This is also consistent with recent work showing social motives for simultaneous use are associated with greater likelihood of simultaneous use compared to cannabis-only use at the daily level (Patrick et al., 2019). Interestingly, we also found that parties were associated with SAM compared to alcohol-only use but not when examining single-location surveys. Thus, drinking at a party may lead to later cannabis use (i.e., SAM use during the time period).

Our results examining the impact of exposure to number of people in each context further tested the hypothesis that, during a period of time, social context is associated with SAM use. However, the number of people around was not significantly associated with SAM compared to alcohol-only use in any location. Overall, these results are consistent with prior research suggesting that social contexts are associated with more drinking and co-use and that using cannabis only is more common when alone (Lipperman-Kreda et al., 2017, 2018). Consistent with prior literature (Heeb et al., 2008; Room et al., 2012), we found that weekend days were associated with alcohol-only and SAM use, whereas cannabis-only use was more likely during the week. We also found that evening surveys more often included SAM and alcohol-only versus cannabis-only use. These findings are consistent with research suggesting that cannabis use tends to occur earlier in the day (Earleywine et al., 2016), as well as in the evening hours (Buckner et al., 2012). Our findings are well-aligned with a social-ecological framework, suggesting that it is important to consider with whom, when, and where substance use occurs (Freisthler et al., 2014).

Limitations and conclusions

This work should be understood in the context of a few limitations. First, our surveys included parties as a physical location, whereas more recent work suggests parties may be better classified as a social context (Freisthler et al., 2014; Lipperman-Kreda et al., 2017). Second, the sample was predominately white college students, albeit diverse in location and cannabis legislation; these results may not translate to more heterogeneous populations.

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Third, our models did not examine substance use by others in the environment, which may be associated with type of substance use.

In conclusion, results suggest that physical and social contexts (parties, friend's homes and around more people) and timing of use (evenings and weekends) are significantly associated with SAM use occasions. Intervention and prevention efforts should reflect how these socio-contextual factors may contribute to SAM use and associated consequences and highlight a comprehensive approach when considering how to reduce substance-related harms.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Public Health Statement:

This study indicates that both location and presence of others are important predictors of simultaneous alcohol and cannabis use versus single-substance use.

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Table 1.

Descriptives of context by substance use survey type

	ALC-only (n = 1948)	CB-only (n = 3934)	SAM (n =935)	All surveys (n=6817)
		A: Locations: % (n) of surveys		
Home	57.3 (1116)	82.4 (3241)	65.0 (608)	72.9 (4965)
Friends place	31.6 (616)	22.4 (881)	40.2 (376)	27.5 (1873)
At a party	9.9 (193)	0.8 (32)	12.6 (118)	5.0 (343)
Bar/restaurant	16.9 (387)	7.2 (283)	11.6 (108)	11.4 (778)
Outside	4.3 (84)	9.9 (388)	6.7 (63)	7.9 (535)
Study space	3.6 (70)	11.6 (455)	2.5 (23)	8.0 (548)
Gym	0.8 (16)	3.0 (116)	0.6 (6)	2.0 (138)
		B: Number of people: M (sd)		
Home	3.81 (4.42)	2.37 (2.76)	3.78 (4.49)	2.86 (3.51)
Friends place	7.25 (5.92)	3.85 (3.83)	7.04 (5.93)	5.16 (5.32)
At a party	15.47 (7.20)	12.44 (8.22)	16.36 (6.67)	15.49 (7.18)
Bar/restaurant	9.34 (8.36)	5.65 (7.61)	11.92 (8.89)	8.36 (8.46)
Outside	6.11 (7.35)	2.98 (5.23)	4.75 (6.88)	3.68 (5.93)
Study space	9.13 (9.33)	12.15 (9.04)	8.87 (8.46)	11.63 (9.11)
Gym	8.25 (9.18)	7.21 (8.22)	10.50 (8.73)	7.47 (8.32)
		C: Situational Context: % (n)		
Weekend	48.7 (965)	28.1 (1105)	49.8 (465)	37.2 (2535)
Evening	81.9 (1617)	69.7 (2738)	92.1 (861)	76.5 (5216)

Note: Panel A represents the % and number of surveys where the location was reported across the three substance use survey types; Panel B represents the average number of people reported at each location by substance use; Panel C represents the % and number of surveys **completed** on the weekend and in the evening (after 5pm) by substance use. **Alc=alcohol-only occasion; CB=cannabis-only occasion; SAM=simultaneous alcohol and cannabis use occasion.**

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Table 2.

GLMM results for association between location and substance use

	Alc [ref] v. SAM[a]			CB [ref] v. SAM[b]			Alc [ref] v. CB[c]		
	OR	***CI***	***p***	***OR***	***CI***	***p***	***OR***	***CI***	***p***
Covariate and Situational Indicator Model									
Sex	**1.99**	**1.17 – 3.38**	**0.011**	0.85	0.58 – 1.24	0.390	**2.65**	**1.33 – 5.27**	**0.006**
Age	1.06	0.87 – 1.31	0.555	**1.31**	**1.14 – 1.52**	**<0.001**	0.78	0.60 – 1.02	0.070
School B	**2.01**	**1.06 – 3.80**	**0.032**	0.95	0.60 – 1.50	0.822	**2.56**	**1.11 – 5.88**	**0.027**
School C	0.91	0.47 – 1.76	0.789	0.92	0.57 – 1.48	0.719	0.97	0.41 – 2.27	0.945
ODU	**2.19**	**1.25 – 3.83**	**0.006**	**5.79**	**3.45 – 9.71**	**<0.001**	**0.42**	**0.22 – 0.81**	**0.009**
Weekend	1.06	0.85 – 1.31	0.607	**2.82**	**2.36 – 3.35**	**<0.001**	**0.42**	**0.36 – 0.50**	**<0.001**
Evening	**2.85**	**2.03 – 4.01**	**<0.001**	**5.59**	**4.26 – 7.33**	**<0.001**	**0.72**	**0.59 – 0.88**	**0.002**
Primary Indicator Models									
Home	**1.28**	**1.01 – 1.62**	**0.042**	**0.37**	**0.29 – 0.45**	**<0.001**	**3.31**	**2.69 – 4.08**	**<0.001**
Friend's place	**1.53**	**1.20 – 1.94**	**0.001**	**2.60**	**2.11 – 3.21**	**<0.001**	**0.77**	**0.62 – 0.95**	**0.014**
Party	**1.43**	**1.00 – 2.06**	**0.049**	-	-	-	-	-	-
Bar/restaurant	**0.46**	**0.34 – 0.64**	**<0.001**	-	-	-	-	-	-

Note. Covariate model intraclass correlations (ICCs), conditional R^2, Number of individuals (N_{id}), and $N_{observations}$ (N_{obs}) for each outcome –

[a] ICC = .48, R^2 = .515, N_{id} = 268, N_{obs} = 2862;

[b] ICC = .26, R^2 = .398, N_{id} = 244, N_{obs} = 4827;

[c] ICC = .68, R^2 = .699, N_{id} = 298, N_{obs} = 5837. The primary indicators in the second panel show results from four separate models that included all of the covariates from the first panel. Full model effects for each primary indicator are provided in supplemental materials, Tables S1–S3. ODU = other drug use, school A = illegal; school B = decriminalized, school C = legal, reference group for both school effects = school A (illegal); evening = survey completed after 5pm. Statistically significant effects are in bold typeface. Cells with no data were models that were not conducted due to small number of observations in those comparisons. **Alc=alcohol-only occasion; CB=cannabis-only occasion; SAM=simultaneous alcohol and cannabis use occasion.**

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Table 3.

GLMMs results for association between number of people at location and substance use

	Alc [ref] v. SAM[a]			CB [ref] v. SAM[b]			Alc [ref] v. CB[c]		
	OR	***CI***	***p***	***OR***	***CI***	***p***	***OR***	***CI***	***p***
≥ 1 person at home	1.14	0.72 – 1.80	0.578	**2.10**	**1.54 – 2.87**	**<0.001**	**0.41**	**0.30 – 0.57**	**<0.001**
No. at Home	1.01	0.98 – 1.05	0.435	**1.19**	**1.14 – 1.23**	**<0.001**	**0.78**	**0.75 – 0.82**	**<0.001**
No. at Friend's place	0.99	0.96 – 1.02	0.567	**1.17**	**1.13 – 1.22**	**<0.001**	**0.84**	**0.80 – 0.88**	**<0.001**
No. at Party	1.02	0.97 – 1.08	0.485	-	-	-	-	-	-
No. at Bar/restaurant	1.00	0.96 – 1.05	0.902	-	-	-	-	-	-

Note. These predictor effects are from five different models each of which included all of the covariates shown in Table 2. Full model effects for each primary indicator are provided in supplemental materials Tables S4–S7. Statistically significant effects are in bold typeface. Cells with no data were models that were not conducted due to small number of observations in those comparisons. **Alc=alcohol-only occasion; CB=cannabis-only occasion; SAM=simultaneous alcohol and cannabis use occasion.**

Covariate model intraclass correlations (ICCs), conditional R^2, Number of individuals (N_{id}), and $N_{observations}$ (N_{obs}) for each outcome by model primary indicator, **superscripts denote which comparison:**

≥ 1 person at home: [a] ICC = .58, R^2 = .62, N_{id} = 232, N_{obs} = 1714; [b]: ICC = .26, R^2 = .41, N_{id} = 216, N_{obs} = 3815; [c] ICC = .72, R^2 = .75, N_{id} = 281, N_{obs} = 4327

No. at home: [a]ICC = .57, R^2 = .61, N_{id} = 234, N_{obs} = 1731; [b]: ICC = .30, R^2 = .46, N_{id} = 216, N_{obs} = 3815; [c]: ICC = .73, R^2 = .76, N_{id} = 282, N_{obs} = 4344

No. at friends: [a]ICC = .52, R^2 = .55, N_{id} = 196, N_{obs} = 987; [b]: ICC = .31, R^2 = .49, N_{id} = 170, N_{obs} = 1244; [c]: ICC = .70, R^2 = .76, N_{id} = 224, N_{obs} = 1483

No. at Party: [a]ICC: = .47; R^2: = .51; N_{id} = 124; N_{obs}: = 308

No. at Bar/restaurant: [a]ICC: = .45; R^2: = .48; N_{id} = 128; N_{obs}: = 487.

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