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The role of alcohol and cannabis co-use in drinking rate and its impact on consequences

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Abstract

Background: The impact of alcohol and cannabis co-use on college student drinking and related outcomes is complex. Specific characteristics or patterns of co-use events beyond drinking quantity may be important to the experience of consequences. The present study used repeated daily surveys to examine the association between co-use (versus use of alcohol only) and drinking rate on negative consequences.

Methods: The sample included 318 college students (M_{age} = 19.8, 47% female, 76% non-Hispanic White) who were co-users of alcohol and cannabis, recruited from three U.S. college campuses. Participants completed 56 days of data collection (number of drinking days ranged from 1 to 38). Two measures of drinking rate were examined: (1) daily rate (number of drinks divided by number of hours spent drinking per day); and (2) peak hour rate (maximum number of drinks consumed in a single hour) to account for anomalous drinking days of long duration. Generalized linear mixed models examined: (1) associations of co-use with peak hour rate (model 1a) and daily rate (model 1b); (2) associations of peak hour rate (model 2a) and daily rate (model 2b) with experiencing any negative consequence; and (3) interactions of co-use with peak hour rate (model 3a) and daily rate (model 3b) on experiencing a consequence.

Results: Co-use was positively associated with peak hour rate but not daily rate. Both peak hour and daily rate positively predicted likelihood of experiencing a negative consequence. The interaction of both peak hour and daily rate by co-use was significant such that the association of rate with experiencing a consequence was stronger on alcohol-only days compared to co-use days.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Conclusions: Daily drinking rate and peak hour drinking rate are unique and should be considered when discussing drinking patterns. Both predict negative consequences and may be important aspects of interventions for negative drinking-related outcomes among college students.

Keywords

alcohol; cannabis; college students; consequences; drinking rate

INTRODUCTION

Co-use of alcohol and cannabis is common among young adults and college students (Terry-McElrath & Patrick, 2018; White et al., 2019). Public health interest in the impact of cannabis use on alcohol use and related consequences is increasing in the wake of expanded legalization of cannabis for recreational and medical purposes. In particular, the impact of co-use on college student drinking and related consequences is imperative to study, as college students report higher rates of use-related consequences compared to their age-matched noncollege attending peers (Blanco et al., 2008; Linden-Carmichael & Lanza, 2018; Slutske, 2005; Slutske et al., 2004). Although several studies have suggested that co-use of alcohol and cannabis is associated with increased alcohol use (Brière et al., 2011; Gunn et al., 2018b; Metrik et al., 2018; Patrick et al., 2017; Subbaraman & Kerr, 2015), the mechanisms by which co-use is associated with drinking and related outcomes are complex and findings are mixed (Gunn et al., 2021a). Specific characteristics or patterns of alcohol use within co-use events (e.g., how fast or how much an individual drinks) are valuable predictors of alcohol-related outcomes and aid in clarifying these competing findings (e.g., Groefsema & Kuntsche, 2019; Mallett et al., 2017).

Intensive longitudinal data collection methods are ideal for studying these characteristics and patterns of drinking, as they allow for the examination of specific varying details of drinking events by isolating effects at the level of the event (repeated observations within-person, such as comparing co-use days to single substance use days) versus at the level of the individual (between-person observations, such as comparing people whose drinking levels differ on average). Disaggregating these different units of analysis allows for the examination of the effects of co-use for each individual as well as between-person differences (e.g., frequency of co-use) on drinking outcomes. Within-person data permit testing of influences on type of event (co-use, alcohol only, cannabis only, and nonuse), a great advance over simply describing the influences on type of user. Isolation of within-person effects from between-person effects aids in identifying the event-level factors that predict an outcome of interest independent of the individual-level risk factors. At the within-person level, co-use of alcohol and cannabis (relative to alcohol-only use) has been linked to increased consequences in young adult (Lee et al., 2020; Linden-Carmichael et al., 2020) and college student (Gunn et al., 2018a; Ito et al., 2021) populations. Further, recent studies have highlighted the importance of controlling for drinking quantity at the within-person level, as it is a consistent predictor of consequences (Jackson et al., 2020). When number of drinks is considered an independent predictor, it is consistently predictive of consequences, and even sometimes attenuates the additive effect of co-use of cannabis in predicting consequences (Gunn et al., 2021c; Lee et al., 2020; Lipperman-Kreda et al., 2017;

Mallett et al., 2019; Sokolovsky et al., 2020). To some extent, increased number of drinks may be driving the association between co-use and consequences, more so than the addition of cannabis to a drinking event, suggesting that alcohol quantity is an important mechanism to consider when studying co-use (versus drinking-only) events.

Another important characteristic of drinking episodes in the study of acute consequences is the "rate" or "pace" of drinking (i.e., how quickly an individual consumes alcohol on an occasion or in a day of drinking). Faster or accelerated rate of drinking has been associated with increased negative alcohol consequences in two recent studies (Carpenter & Merrill, 2020; Kuntsche et al., 2015). Kuntsche et al. (2015) found that Saturday evenings with an 'accelerated' drinking pattern (at least one drink per hour and an average of 11.5 total) were associated with 17 times more negative alcohol consequences compared to evenings with 'stable low' (average of 0.2 drinks per hour and 1.5 total) drinking rates (Kuntsche et al., 2015). More recently, Carpenter and Merrill (2020) found that rate of drinking (calculated as change in estimated blood alcohol concentration across the day) was associated with a greater likelihood of experiencing a negative consequence at the daily level in a sample of college student drinkers under the legal drinking age. Importantly, this study also controlled for number of drinks. Overall, this work suggests that quantity and rate of alcohol consumed are important predictors of consequences. However, no studies, to date, have examined how co-use of alcohol and cannabis may impact rate of alcohol consumption or how rate of drinking during co-use occasions may impact negative consequences experienced.

Current study

The current study sought to examine the association between co-use and drinking rate and negative consequences using repeated daily surveys of college students. First, we tested whether co-use within a day leads to faster drinking rate compared to alcohol use only. This is a largely exploratory question, as there is no literature examining the association of co-use and drinking rate. However, given that co-use has been linked to more drinking (Brière et al., 2011; Gunn et al., 2018b; Metrik et al., 2018; Patrick et al., 2017; Subbaraman & Kerr, 2015) compared to alcohol-only days, we hypothesize that co-use will be associated with faster drinking rate. Second, we sought to replicate and extend Carpenter and Merrill (2020) by examining whether rate of drinking is associated with increased likelihood of a negative consequence, while controlling for cannabis use (i.e., co-use). Finally, to test the hypothesis that drinking faster—particularly on co-use days—would be associated with increased likelihood of experiencing negative alcohol-related consequences, we tested the interaction between co-use and drinking rate on consequences (controlling for number of drinks).

MATERIALS AND METHODS

Procedures

Screening—Recruitment targeted U.S. undergraduate students from three state universities in states with different recreational cannabis-use laws: recreational cannabis use was criminalized in School A's state; illegal but decriminalized at School B's state; and legal (for adults age 21+) at School C's state at the time of data collection. Medical use of

cannabis was legal in all states. Online screening survey invitations were sent via e-mail to 8000 undergraduate students recruited from each university's registrar database (stratified by anticipated graduation year; total $N = 24,000$). Eligibility criteria included: (1) full-time enrollment at one of the universities; (2) age 18–24 years; (3) past-year alcohol use; (4) past-year cannabis use; and (5) verified e-mail address (see White et al., 2019 for details on recruitment and representativeness). Eligibility criteria did not specify if alcohol and cannabis use that occurred over the past-year was concurrent or simultaneous nor if past-year cannabis use was medicinal and recreational. Of 7000 screening responses, 2874 (41.1%) met eligibility criteria. Participants were entered into a lottery to win a $100 Amazon.com gift card (10 per campus) for completing the screener.

Baseline survey—Of the 2874 students that screened eligible, a sample of 2501 students oversampled for past-month alcohol and cannabis use were e-mailed invitations to participate in the baseline survey. Of those who consented and were enrolled ($N = 1610$), 1390 participants (86.3%) were retained in the final baseline sample (participants were excluded if they provided data inconsistent with eligibility criteria originally provided in screening or had technical issues). Participants were compensated with a $25 Amazon gift card (For greater detail on the baseline survey, see Jackson et al., 2021 Supplemental Material).

Daily surveys—Participants who reported past-month use of alcohol and cannabis "at the same time so their effects overlapped" (i.e., simultaneous use) at baseline were eligible to take part in the daily portion of the study ($N = 693$). To ensure heterogeneity in the sample, participants were stratified by frequency of simultaneous use, sex, and school. Stratification involved overenrolling frequent simultaneous users (i.e., three or more times in the past month) and male participants to ensure sufficient rates of simultaneous use and a roughly equal balance of participants by sex. Due to sampling section, only 596 students were invited to the daily phase of the study (see Figure S1 for details). After nonresponse to the invitation and quotas being met, 379 were given access to a smart phone application and 343 completed the daily surveys.

Participants completed a 28-day burst of intensive longitudinal experience sampling comprising five daily surveys delivered via a custom-developed smartphone application (see Jackson et al., 2021 Supplemental Material for greater detail on recruitment and participation rates). Data from the first 2 days were omitted due to technical issues resulting in the exclusion of two further participants who discontinued their participation during this period, resulting in a final sample of 341. A second 28-day burst was completed 3 months later by 316 participants (92.7% of the first burst). Participants were compensated $1 for each completed survey (up to $5 per day/$35 per week) with potential bonuses of $10 each week if they completed at least 85% of surveys for that week and $20 at the end of 4 weeks if they completed at least 90% of surveys, totaling $200 maximum (Amazon gift cards) per burst.

The five daily surveys were scheduled at the same time each day (9:00 AM; 2:00 PM; 5:00 PM; 8:00 PM; and 11:00 PM) and were active for 2 h (except for the 9:00 AM survey which was open for 5 h). Each survey asked about behavior that occurred since the time the last survey

was completed (including up to one missed survey). If two or more surveys were missed in a row, the current survey would use the scheduled time of the previous survey as a starting time anchor (for full details on missed surveys, see Supplemental Material in Stevens et al., 2020). Survey completion took approximately 1 to 2 min with an additional 2 to 3 min for the 9:00 AM survey which contained two parts: (1) a daily portion assessing prior-day substance use behavior between the time of the last completed survey and bedtime and (2) a morning portion which included items that cumulatively assessed yesterday's behavior from wake time through bedtime, including negative consequences. Completion of at least one daily survey was high (85.8%). For each of the five surveys, compliance was as follows: 9:00 AM (78%), 2:00 PM (59%), 5:00 PM (66%), 8:00 PM (65%), and 11:00 PM (56%). An average of 3.75 surveys per day (SD = 1.29; range 1–5) were completed by each participant in this study. All procedures were approved by the Institutional Review Board of Brown University and a Certificate of Confidentiality was obtained from NIDA.

Measures

Type of alcohol and/or co-use day—Participants were asked at each survey if they used alcohol, cannabis, both, or neither for each time interval: "What did you use between [time X] and [time Y]?" The timeframe for this question was anchored between the time the previous survey was submitted and the time the current survey was triggered. Type of use day was indexed as alcohol-only (n = 2076), cannabis-only (n = 3917), co-use (use of both alcohol and cannabis; n = 2024), or no alcohol or cannabis use (n = 7781) based on all surveys reported within a day. Alcohol-only and co-use days were selected for the current analysis and no use and cannabis only-days were excluded. Co-use was measured at the daily level given recent work from our group in this same sample, suggesting no difference in subjective intoxication or consequences when comparing different operationalizations of simultaneous use (i.e., based on timing of using each substance) ranging from 1 to 240 min within a day, as the large majority (94%) of co-use days included co-use occurring within 240 min (Sokolovsky et al., 2020). Furthermore, given consequences were assessed at the daily level, it made sense to assess type of use at the day level.

Substance use quantity—If alcohol and/or cannabis were endorsed, participants were presented with a timeline overlaid on a grid with time anchors (in minutes) and were instructed to tap on the screen at points corresponding to times when they had a drink or used cannabis. Instructions were as follows: ("Tap your finger in the blue box each time you had a drink/used marijuana at the corresponding time"). Screenshots of this assessment are available in Jackson et al., 2021. Day-level alcohol quantity was indexed as the sum of the number of drinks (taps) across all surveys in each day.

Drinking rate—In order to measure how quickly alcohol was consumed throughout the day, we used two separate measures. The first, *daily rate*, was calculated by dividing the number of total drinks reported in a day by time spent drinking (hours between first drink and last drink) +1 (for single drink days). Second, *peak hour rate*, was used to accommodate anomalous drinking days of long duration and was calculated as number of drinks consumed in the peak hour of drinking (i.e., hour in the day in which the most drinks were consumed). This measure captures rate of drinking that is not attenuated by all-day drinking. For

example, if 2 days had the same rate of drinking in the evening, but on 1 day someone drank for more hours in the day (e.g., also had one drink in the morning), their rate for the day would be much lower than if they did not drink in the morning because the denominator (i.e., time spent drinking) in the rate calculation would be larger.

Consequences—On the morning survey following substance use days, participants indicated whether the following consequences occurred "because of yesterday's use of [alcohol, or alcohol and marijuana together]": hangover, nausea/vomiting, hurt self, drove car drunk/high, blackout, rude/aggressive, and unwanted sex. This selection of consequences was adapted from Read et al. (2006) consequence subscales, the Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ; Kahler et al., 2005), the Marijuana Consequence Scale (MACQ; Simons et al., 2012), the Rutgers Alcohol Problem Index (RAPI; White & LaBouvie, 1989), and the Rutgers Marijuana Problem Index (RMPI; Johnson & White, 1995), with a focus on selecting acute consequences that would be observed at the daily level. Given low rate of any consequence endorsement on a given day (24%), a binary measure (yes/no) was used to indicate whether any negative consequences occurred on a given day.

Covariates—All models controlled for the baseline demographic characteristics of sex (assigned at birth, ref: female), age (dichotomized as below age 21 [ref] or 21+ years old), school (ref: School C [recreational cannabis use legal]), race (White [ref] versus non-White), and ethnicity (non-Hispanic/Latinx [ref] versus Hispanic/Latinx). Models also controlled for day of the week (dichotomized as weekday [ref] or weekend [Friday or Saturday]), based on inspection of use patterns (Sokolovsky et al., 2020), any drug use other than cannabis or nicotine (dichotomized at the daily level, ref: no, 6% of days), any liquor that day (dichotomized, ref: no, added due to unique prediction of consequences; (Stevens et al., 2021)), and drinking start time (dichotomized as early/before 4:00 PM [ref] or later) due to the calculation of daily rate and peak hour rate at the daily level.[1] Because alcohol quantity has consistently been a robust predictor of consequences in co-use occasions (Gunn et al., 2021c; Lipperman-Kreda et al., 2017; Mallett et al., 2019), daily number of drinks was also controlled for in models with daily rate as the focal predictor. Number of drinks in excess of the peak hour (i.e., number of drinks consumed outside the hour of heaviest drinking) was likewise controlled for in models with peak hour rate as the focal predictor. Models examining the focal predictor of co-use on peak hour rate and daily rate also controlled for between-person number of drinks (per drinking day) and proportion of co-use days. Models examining focal predictors of peak hour rate and daily rate on consequences controlled for between-person mean of each. Finally, the models examining the interaction of peak hour rate and drinking rate by co-use on consequences controlled for the between-person mean of each and the between-person measure of percent co-use days.

[1]We chose 4:00 PM as the cutoff for this early drinking given recent evidence, suggesting that "day drinking" (before 4:00 PM) was a significant predictor of heavy episodic or high intensity drinking at the day level (Calhoun & Maggs, 2021).

Data analysis

Given the need to reliably calculate drinking rate within a day, we needed data that covered the entire day so that no drinking data were missing and not to miss any co-use. Therefore, we removed 989 total days without complete daily coverage (no more than two missed surveys). We also removed a single day where excess drinks (21) were reported in the peak hour of drinking, resulting in a total of 3110 drinking days and 318 participants for all analyses. There were no significant differences in demographic characteristics between those participants that had full coverage days and the final sample (Cohen's $h = 0.01–0.03$). See Figure S1 for depiction of sample selection. Data were structured so that each row represented 1 day for one participant.

In order to examine the associations between day-level co-use and daily rate/peak hour rate, two analyses using generalized linear mixed models (GLMMs; Hedeker, 2005) were conducted. In separate models, we regressed peak hour rate (model 1a) and daily rate (model 1b) onto the focal predictor of co-use and the set of covariates noted above. Models were fit using the lme4 (Bates et al., 2015) package in R (R Core Team, 2017).

To examine the association between daily rate/peak hour rate and experience of any daily consequences, two analyses were conducted using GLMMs, specifying a binomial distribution. These models were fit using the R package glmmTMB (Brooks et al., 2017). In separate models, we regressed the binary consequence variable onto focal predictors of peak hour rate (model 2a) and daily rate (model 2b) and the same set of covariates as noted above, in addition to controlling for co-use. To test the interaction between daily rate/peak hour rate and co-use on consequences, another set of GLMMs with these interaction terms (model 3a: peak hour rate × co-use, model 3b: daily rate × co-use) and the same outcome (binary consequence) was specified. Random intercept terms for subject were included in all models. This analysis was not preregistered and thus results should be considered exploratory.

RESULTS

Descriptive statistics for the subset of participants utilized for the present analyses are presented in Table 1. Across both assessment waves for the current sample of 318 participants and 3110 days, we observed 1530 alcohol-only days and 1580 co-use days. Mean daily rate was similar on alcohol-only days (M = 1.37, SD = 0.70) compared to co-use days (M = 1.39, SD = 0.75). Mean peak hour rate was slightly lower on alcohol-only days (M = 2.48, SD = 1.52) compared to co-use days (M = 2.65, SD = 1.71). Frequencies of peak hour rate by alcohol-only and co-use days are provided in Table 2 and distribution of daily rate across all drinking days is provided in Figure 1.

Co-use on peak hour rate/daily rate

Results from GLMMs predicting peak hour rate and daily rate from co-use (versus alcohol-only use) are presented in Table 3. The ICC for the peak hour and daily rate models were 0.04 and 0.10, respectively; suggesting that little variability on these outcomes was between-person. Co-use was positively associated with peak hour rate (model 1a) but not

daily rate of drinking (model 1b), suggesting that co-use was associated with a higher number of drinks at peak hour of drinking, compared to alcohol-only use. Covariate effects are presented in Table 3.

Peak hour rate/daily rate on consequences

Results from GLMMs predicting experience of any consequence from peak hour rate (model 2a) and daily rate (model 2b), both controlling for co-use, covariates, and drinking quantity, are presented in Table 4. The ICC for these models was 0.24, suggesting that 24% of the variability on experiencing a consequence was between-person. Both peak hour and daily rate positively predicted the likelihood of experiencing a consequence, such that more drinks at the peak hour of drinking and faster daily rate of drinking were associated with increased likelihood of experiencing a negative consequence even with controls for the amount of alcohol consumed. Co-use was not a significant predictor of consequences; however, the alcohol quantity measure in each model was significant with higher consumption being related to a greater likelihood of experiencing a consequence.[2] Covariate effects are presented in Table 4.

Interaction between co-use and peak hour rate/daily rate on consequences

Results from GLMMs predicting consequences from the interactions of peak hour and daily rate by co-use are presented in Table 5. There were significant interactions of both peak hour rate (model 3a) and daily rate (model 3b) with co-use on likelihood of experiencing a consequence, suggesting that the association of peak hour rate and daily rate with experiencing a consequence was stronger on alcohol-only days compared to co-use days (see Figure 2). Covariate effects are presented in Table 5. Ad-hoc simple slopes analysis using recentered peak hour rate at discrete drink counts revealed that likelihood of experiencing a consequence was significantly greater on co-use days when peak hour rate was one or two, nonsignificant at three, and significantly lower at four or more drinks. Similarly, ad-hoc simple slopes analyses for daily rate at mean ± 1.5 SD revealed that likelihood of experiencing a consequence was significantly greater on co-use days when daily rate was low (−1.5 SD), nonsignificant at the mean daily rate, and significantly lower when daily rate was high (+1.5 SD). A further region of significance follow-up found that this effect was significant and positive at daily rates below 1.2 and significant and negative at daily rates above 2.0.

DISCUSSION

This study is the first to examine how rate of drinking is associated with co-use of alcohol and cannabis and extends prior work, suggesting that faster rate of drinking is associated with experiencing negative consequences. We further extended this prior work by examining a proxy measure of drinking rate, the number of drinks in the peak hour of drinking, which is more robust to daily diary studies where all-day drinking may occur. We also examined

[2]Sensitivity analyses were conducted without controlling for alcohol quantity. Primary effects of interest (peak hour rate and daily rate) remained significant predictors of consequences; however, co-use became a significant predictor of consequences in the daily rate model (OR = 1.29, $p = 0.03$), and age (ORs = 1.50–1.52, ps < 0.05), and other drug use became significant in both models (ORs = 1.96–1.86; ps < 0.01).

how rate of drinking and co-use interact to predict experience of a consequence to better understand how these patterns of drinking may lead to negative drinking-related outcomes in college students who also use cannabis.

First, we found that although co-use did not predict rate of drinking within a day, it did predict the drinking rate in the peak hour of drinking. The results suggest that alcohol may be consumed faster during peak drinking hours on days when cannabis is consumed compared to days when only alcohol is consumed. This effect was significant even when controlling for significant covariates, including day of week (weekends being associated with more peak hour drinks), liquor use, and between-subjects drinking quantity and co-use frequency. This finding also suggests that these two measures of drinking rate, rate computed across a day and number of drinks at the peak hour of drinking, are unique and both have value when considering patterns of drinking at the day level. This is the first study to examine how drinking rate is associated with co-use and contributes to previous literature, suggesting that riskier drinking patterns may occur when cannabis is also consumed, particularly in young adult and college student populations (Gunn et al., 2018b; Ito et al., 2021; Lee et al., 2020; Linden-Carmichael et al., 2020). However, additional research is needed, particularly to isolate the timing of cannabis use and subjective effects across the drinking day and their acute impact on drinking rate during the peak of consumption, and in turn, the consequences experienced.

Next, as hypothesized, we found a significant effect of both daily rate and peak hour rate on the experience of a negative consequence. This finding is consistent with Carpenter and Merrill (2020), suggesting that faster drinking is associated with a higher likelihood of experiencing a negative consequence. Also, consistent with Carpenter and Merrill, our work was significant when controlling for the effect of daily number of drinks (i.e., quantity). Building on this work, we also found that these effects were consistent when controlling for between-person levels of rate, as well as day-level cannabis use (i.e., co-use), suggesting a strong effect of rate predicting experience of a consequence at the daily level.

Finally, we found significant interactions for both daily rate and peak hour rate by co-use on the experience of a negative consequence. These interactions suggested that the strength of the association between faster drinking rate and likelihood of experiencing a negative consequence was stronger on alcohol-only days compared to co-use days. Importantly, as can be seen in Figure 2 and described in post-hoc simple slopes analyses, co-use days are associated with *higher* likelihood of a consequence at lower rates of drinking (See Figure 2), and as can be seen in Table 2 and Figure 1, the majority of drinking days in the sample occurred at these lower drinking rates. Therefore, it is critical to note that co-use still may be associated with increased risk of experiencing a consequence on certain drinking days (e.g., days with lower drinking rates). Further, this work should also be considered in the context of between-person studies that have found a strong association between co-use and consequences (Green et al., 2019; Midanik et al., 2007; Subbaraman & Kerr, 2015) and other within-person studies that have found that co-use is associated with more negative consequences compared to alcohol-only days while controlling for alcohol consumption (Mallett et al., 2017). Finally, as discussed in our prior work (Gunn et al., 2021c; Sokolovsky et al., 2020) and work by others (Lee et al., 2020; Lipperman-Kreda et al., 2017; Mallett et

al., 2019), when alcohol use is controlled for, the association between co-use and experience of a consequences is mitigated. This study found effects of both rate and number of drinks, which suggests both are unique indicators of risk for alcohol-related consequences. Future work with greater temporal resolution should examine whether amount of alcohol consumed accounts for (mediates) the association between co-use and consequences, as this body of work suggests.

Implications

The current investigation adds to a limited but growing body of literature showing that faster rate of consumption is associated with negative alcohol-related consequences (Carpenter & Merrill, 2020; Kuntsche et al., 2015). Thus, there is an increased need to focus on drinking rate to understand harms associated with alcohol use and thus develop valuable points of harm reduction. Notably, we found that using cannabis was associated with an increased likelihood of experiencing a consequence on days with lower rates of drinking, which has important implications for harm reduction strategies in the context of co-use. For instance, this suggests that protective behavioral strategies aimed at reducing the rate of drinking such as alternating alcoholic drinks with water and tracking drinks, which are also valuable harm reduction strategies for reducing negative consequences associated with alcohol use (Borden et al., 2011; Martens et al., 2004), may not be as effective in the context of co-use. Future harm reduction work for co-use should focus on informing individuals of the risk associated with lower drinking rates. Understanding the consequences experienced on these co-use days with lower drinking rates is an important area for future work in order to develop more tailored harm reduction strategies. Further, we did not examine the role of context in this study, which we know differs between alcohol-only and co-use days (Gunn et al., 2021b), and may also interact with rate of drinking to predict consequences.

In a related study of young adults in the Netherlands, pace of drinking was found to increase over the course of an evening (Groefsema & Kuntsche, 2019). The researchers demonstrated that increase in drinking rate across the evening, coupled with knowledge that faster rate is associated with consequences, could have important policy implications. For instance, earlier closing times for bars and restaurants may reduce likelihood of alcohol-related consequences for populations of legal drinking age. However, for college samples such as the one studied here, many students are under the age of 21 and policy interventions such as this may not be as applicable to this age group. Rather, policies such as noise ordinances during evening hours may be more applicable for college student populations. The study of Groefsema and Kuntsche (2019) also found that the tendency to increase pace of drinking over an evening is more common among those with more harmful drinking habits (i.e., higher AUDIT scores), highlighting the importance of focusing on rate of drinking among those with alcohol-related problems. Further, given that we found a significant association between co-use and faster peak hour rate (controlling for between-person drinking), this may be an important mechanism to target for intervention and prevention efforts to reduce harms associated with alcohol and cannabis co-use. This may be especially important given alcohol subjective effects take longer to peak compared to cannabis (Hartman et al., 2016) and thus the interactive subjective effects may be delayed in some occasions, which may

result in increased use to reach desired effect. As noted above, additional work is needed to understand more how cannabis impacts drinking rate in the midst of a drinking event.

Strengths and limitations

The present study should be interpreted in the context of a few limitations. First, the sample comprised college students. Although we included a relatively large sample from several university campuses, additional work is needed to confirm these results in more diverse age groups and samples, including clinical populations. Second, we were unable to control for cannabis quantity consumed on co-use days because missing data were confounded with type of day (with no cannabis use on alcohol-only days, by definition). Examining the impact of cannabis quantity on drinking rate during co-use days is an important future direction. Third, given the low prevalence of negative consequences at the day level, we dichotomized the consequence measure in the present analyses. It is important for future studies to consider number of consequences and specific types of consequences as well in order to have a more nuanced understanding of the impact of drinking rate on consequences. Relatedly, given the daily repeated nature of the assessments, a shortened list of all possible consequences was administered to reduce participant burden. Future work should examine a wider range of consequences in order to better understand the risks associated with co-use and drinking rate.

Despite these limitations, the study had several strengths. We collected data five times a day from a large sample of college students from three different universities. We conducted within-person analyses that controlled for important within- and between-person covariates including daily alcohol consumption (i.e., number of drinks), which has been a consistent predictor of consequences in prior alcohol and cannabis co-use studies (Gunn et al., 2021c; Lee et al., 2020; Lipperman-Kreda et al., 2017; Mallett et al., 2019; Sokolovsky et al., 2020). We included two distinct measures of rate of consumption, which is a robust way to examine the impact of pace of drinking at the day level. Overall, this study found that daily drinking rate and number of drinks during the peak hour of drinking are both unique characteristics of drinking patterns. Further, both rate measures predict the experience of negative consequences, and do so differentially for co-use versus alcohol-only use days. Therefore, rate of consumption should be addressed in drinking interventions for college students.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

Bates D, Mächler M, Bolker BM & Walker SC (2015) Fitting linear mixed-effects models using lme4. Journal of Statistical Software, 67, 1–48.

Blanco C, Okuda M, Wright C, Hasin DS, Grant BF, Liu SM et al. (2008) Mental health of college students and their non-college-attending peers: results from the national epidemiologic study on alcohol and related conditions. Archives of General Psychiatry, 65, 1429–1437. [PubMed: 19047530]

Borden LA, Martens MP, McBride MA, Sheline KT, Bloch KK & Dude K (2011) The role of college students' use of protective behavioral strategies in the relation between binge drinking and alcohol-related problems. Psychology of Addictive Behaviors, 25, 346–351. [PubMed: 21443303]

Brière FN, Fallu JS, Descheneaux A & Janosz M (2011) Predictors and consequences of simultaneous alcohol and cannabis use in adolescents. Addictive Behaviors, 36, 785–788. [PubMed: 21429672]

Brooks ME, Kristensen K, van Benthem KJ, Magnusson A, Berg CW, Nielsen A et al. (2017) glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling. The R Journal, 9, 378–400.

Calhoun BH & Maggs JL (2021) Day drinking among college students and its association with risky substance use behaviors. Alcoholism, Clinical and Experimental Research, 45, 2546–2559. [PubMed: 34932227]

Carpenter RW & Merrill JE (2020) How much and how fast: alcohol consumption patterns, drinking-episode affect, and next-day consequences in the daily life of underage heavy drinkers. Drug and Alcohol Dependence, 218, 108407. [PubMed: 33257198]

Green KM, Reboussin BA, Pacek LR, Storr CL, Mojtabai R, Cullen BA et al. (2019) The effects of marijuana use on transitions through stages of alcohol involvement for men and women in the NESARC I and II. Substance Use & Misuse, 54, 2167–2176. [PubMed: 31299872]

Groefsema M & Kuntsche E (2019) Acceleration of drinking pace throughout the evening among frequently drinking young adults in The Netherlands. Addiction, 114, 1295–1302. [PubMed: 30807680]

Gunn RL, Jackson K, Borsari B & Metrik J (2018a) Negative urgency mediates the relationship between depression and marijuana problems. Borderline Personality Disorder and Emotion Dysregulation, 5, 10. [PubMed: 29796282]

Gunn RL, Norris AL, Sokolovsky A, Micalizzi L, Merrill JE & Barnett NP (2018b) Marijuana use is associated with alcohol use and consequences across the first 2years of college. Psychology of Addictive Behaviors, 32, 885–894. [PubMed: 30359046]

Gunn RL, Aston ER & Metrik J (2021a) Patterns of cannabis and alcohol co-use: substitution versus complementary effects. Alcohol Research: Current Reviews, 42, 4.

Gunn RL, Sokolovsky A, Stevens AK, Hayes K, Fitzpatrick S, White HR et al. (2021b) Contextual influences on simultaneous alcohol and cannabis use in a predominately White sample of college students. Psychology of Addictive Behaviors, 35, 691–697. [PubMed: 34014687]

Gunn RL, Sokolovsky AW, Stevens AK, Metrik J, White HR & Jackson KM (2021c) Ordering in alcohol and cannabis co-use: impact on daily consumption and consequences. Drug and Alcohol Dependence, 218, 108339. [PubMed: 33092910]

Hartman RL, Brown TL, Milavetz G, Spurgin A, Gorelick DA, Gaffney G et al. (2016) Controlled vaporized cannabis, with and without alcohol: subjective effects and oral fluid-blood cannabinoid relationships. Drug Testing and Analysis, 8, 690–701. [PubMed: 26257143]

Hedeker D (2005) Generalized linear mixed models. In: Encyclopedia of statistics in behavioral science. Hoboken, NJ: John Wiley & Sons, Ltd.

Ito TA, Cordova KA, Skrzynski CJ & Bryan A (2021) Complementarity in daily marijuana and alcohol among emerging adults. Psychology of Addictive Behaviors, 35, 723–736. [PubMed: 34291956]

Jackson KM, Sokolovsky AW, Gunn RL & White HR (2020) Consequences of alcohol and marijuana use among college students: prevalence rates and attributions to substance-specific versus simultaneous use. Psychology of Addictive Behaviors, 34, 370–381. [PubMed: 31944787]

Jackson KM, Stevens AK, Sokolovsky AW, Hayes KL & White HR (2021) Real-world simultaneous alcohol and cannabis use: an ecological study of situational motives and social and physical contexts. Psychology of Addictive Behaviors, 35, 698–711. [PubMed: 34472880]

Johnson V & White HR (1995) The relationship between work-specific and generalized stress and alcohol and marijuana use among recent entrants to the labor force. Journal of Drug Issues, 25, 237–251.

Kahler CW, Strong DR & Read JP (2005) Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: the brief young adult alcohol consequences questionnaire. Alcoholism, Clinical and Experimental Research, 29, 1180–1189. [PubMed: 16046873]

Kuntsche E, Otten R & Labhart F (2015) Identifying risky drinking patterns over the course of Saturday evenings: an event-level study. Psychology of Addictive Behaviors, 29, 744–752. [PubMed: 25844829]

Lee CM, Patrick ME, Fleming CB, Cadigan JM, Abdallah DA, Fairlie AM et al. (2020) A daily study comparing alcohol-related positive and negative consequences for days with only alcohol use versus days with simultaneous alcohol and marijuana use in a community sample of young adults. Alcoholism, Clinical and Experimental Research, 44, 689–696. [PubMed: 32022945]

Linden-Carmichael AN & Lanza ST (2018) Drinking patterns of college- and non-college-attending young adults: is high-intensity drinking only a college phenomenon? Substance Use & Misuse, 53, 2157–2164. [PubMed: 29671683]

Linden-Carmichael AN, Van Doren N, Masters LD & Lanza ST (2020) Simultaneous alcohol and marijuana use in daily life: implications for level of use, subjective intoxication, and positive and negative consequences. Psychology of Addictive Behaviors, 34, 447–453. [PubMed: 31971426]

Lipperman-Kreda S, Gruenewald PJ, Grube JW & Bersamin M (2017) Adolescents, alcohol, and marijuana: context characteristics and problems associated with simultaneous use. Drug and Alcohol Dependence, 179, 55–60. [PubMed: 28755540]

Mallett KA, Turrisi R, Hultgren BA, Sell N, Reavy R & Cleveland M (2017) When alcohol is only part of the problem: an event-level analysis of negative consequences related to alcohol and other substance use. Psychology of Addictive Behaviors, 31, 307–314. [PubMed: 28182448]

Mallett KA, Turrisi R, Trager BM, Sell N & Linden-Carmichael AN (2019) An examination of consequences among college student drinkers on occasions involving alcohol-only, marijuana-only, or combined alcohol and marijuana use. Psychology of Addictive Behaviors, 33, 331–336. [PubMed: 30869919]

Martens MP, Taylor KK, Damann KM, Page JC, Mowry ES & Cimini MD (2004) Protective behavioral strategies when drinking alcohol and their relationship to negative alcohol-related consequences in college students. Psychology of Addictive Behaviors, 18, 390–393. [PubMed: 15631613]

Metrik J, Gunn RL, Jackson KM, Sokolovsky AW & Borsari B (2018) Daily patterns of marijuana and alcohol co-use among individuals with alcohol and cannabis use disorders. Alcoholism, Clinical and Experimental Research, 42, 1096–1104. [PubMed: 29656401]

Midanik LT, Tam TW & Weisner C (2007) Concurrent and simultaneous drug and alcohol use: results of the 2000 National Alcohol Survey. Drug and Alcohol Dependence, 90, 72–80. [PubMed: 17446013]

Patrick ME, Kloska DD, Terry-McElrath YM, Lee CM, O'Malley PM & Johnston LD (2017) Patterns of simultaneous and concurrent alcohol and marijuana use among adolescents. The American Journal of Drug and Alcohol Abuse, 44, 441–451. [PubMed: 29261344]

R Core Team. (2017) R: a language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.

Read JP, Kahler CW, Strong DR & Colder CR (2006) Development and preliminary validation of the young adult alcohol consequences questionnaire. Journal of Studies on Alcohol, 67, 169–177. [PubMed: 16536141]

Simons JS, Dvorak RD, Merrill JE & Read JP (2012) Dimensions and severity of marijuana consequences: development and validation of the marijuana consequences questionnaire (MACQ). Addictive Behaviors, 37, 613–621. [PubMed: 22305645]

Slutske WS (2005) Alcohol use disorders among US college students and their non-college-attending peers. Archives of General Psychiatry, 62, 321–327. [PubMed: 15753245]

Slutske WS, Hunt-Carter EE, Nabors-Oberg RE, Sher KJ, Bucholz KK, Madden PAF et al. (2004) Do college students drink more than their non-college-attending peers? Evidence from a population-based longitudinal female twin study. Journal of Abnormal Psychology, 113, 530–540. [PubMed: 15535786]

Sokolovsky AW, Gunn RL, Micalizzi L, White HR & Jackson KM (2020) Alcohol and marijuana co-use: consequences, subjective intoxication, and the operationalization of simultaneous use. Drug and Alcohol Dependence, 212, 107986. [PubMed: 32417362]

Stevens AK, Sokolovsky AW, Treloar Padovano H, White HR & Jackson KM (2020) Heaviness of alcohol use, alcohol problems, and subjective intoxication predict discrepant drinking reports in daily life. Alcoholism, Clinical and Experimental Research, 44, 1468–1478. [PubMed: 32530512]

Stevens AK, Aston ER, Gunn RL, Sokolovsky AW, Treloar Padovano H, White HR et al. (2021) Does the combination matter? Examining the influence of alcohol and cannabis product combinations on simultaneous use and consequences in daily life. Alcoholism, Clinical and Experimental Research, 45, 181–193. [PubMed: 33242220]

Subbaraman MS & Kerr WC (2015) Simultaneous vs. concurrent use of alcohol and cannabis in the National Alcohol Survey. Alcoholism, Clinical and Experimental Research, 39, 872–879. [PubMed: 25872596]

Terry-McElrath YM & Patrick ME (2018) Simultaneous alcohol and marijuana use among young adult drinkers: age-specific changes in prevalence from 1977 to 2016. Alcoholism, Clinical and Experimental Research, 42, 2224–2233. [PubMed: 30277588]

White HR & LaBouvie EW (1989) Towards the assessment of adolescent problem drinking. Journal of Studies on Alcohol, 50, 30–37. [PubMed: 2927120]

White HR, Kilmer JR, Fossos-Wong N, Hayes K, Sokolovsky AW & Jackson KM (2019) Simultaneous alcohol and marijuana use among college students: patterns, correlates, consequences, and norms. Alcoholism, Clinical and Experimental Research, 43, 1545–1555. [PubMed: 31135972]

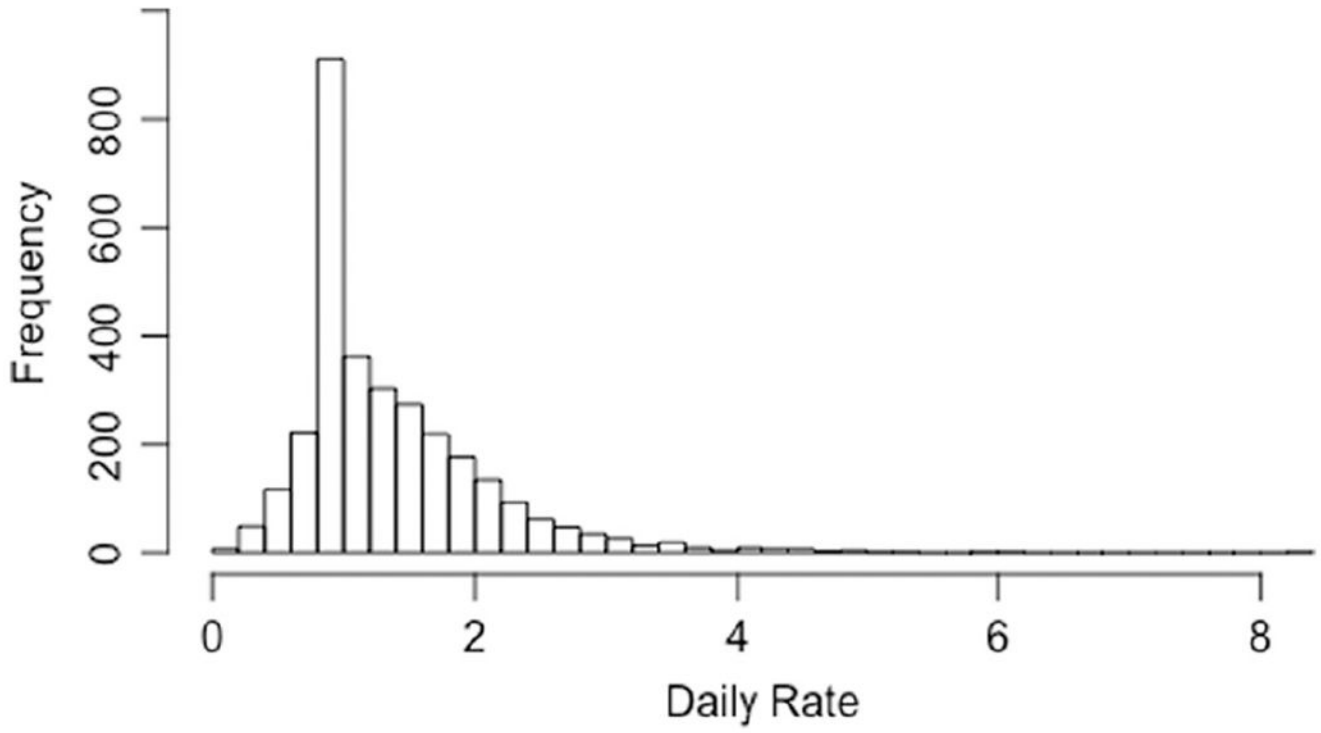

FIGURE 1.

Daily rate was calculated by dividing the number of total drinks reported in a day by time spent drinking (hours between first drink and last drink) + 1 (for single drink days).

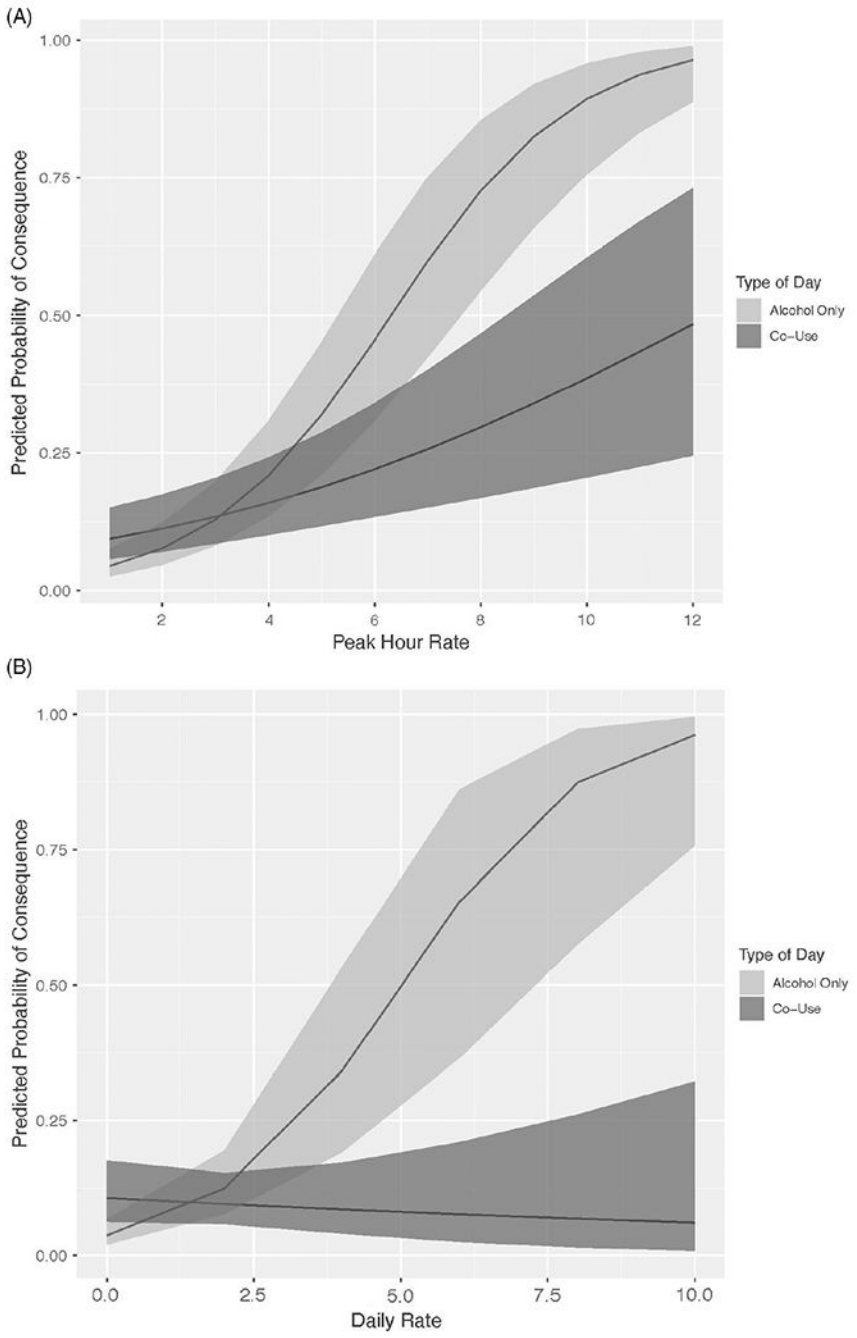

FIGURE 2.

The predicted probability of experiencing a consequence based on daily rate (number of drinks divided by number of hours spent drinking per day) and peak hour rate (maximum number of drinks consumed in a single hour) by alcohol and co-use days.

TABLE 1

Sample characteristics

Variable	M (SD) or %
Sex (female)	47%
Age	19.8 (1.3)
Race/Ethnicity	
Non-Hispanic White	76%
Non-Hispanic Black	3%
Asian	10%
Other	2%
Multiracial	8%
Ethnicity	
Hispanic/Latinx	11%
School	
A (recreational cannabis illegal)	31%
B (recreational cannabis decriminalized)	35%
C (recreational cannabis legal)	34%
Class	
Freshmen	19%
Sophomore	27%
Junior	25%
Senior	25%
≥5-year senior	4%
Drinks per day	5.1 (2.8)
Cannabis uses per day	2.6 (4.7)
Consequences per day	0.33 (0.64)

Note: $n = 318$; Drinks and cannabis uses per day were aggregated to the subject level.

TABLE 2

Frequency of peak hour rate by alcohol and co-use days

Peak hour rate (# drinks)	Alcohol-only days *n* (valid/cumulative %) (Total *n* = 1530)	Co-use days *n* (valid/cumulative %) (Total *n* = 1580)
1	499 (32.6% / 32.6%)	419 (26.5% / 26.5%)
2	408 (26.7% / 59.3%)	483 (30.6% / 57.1%)
3	296 (19.3% / 78.6%)	322 (20.4% / 77.5%)
4	163 (10.6% / 89.3%)	159 (10% / 87.5%)
5	92 (6.1% / 95.3%)	94 (6% / 93.5%)
6+	72 (4.7% / 100%)	103 (6.5% / 100%)

TABLE 3

Effect of co-use on rate

	Model 1a: Peak hour rate			Model 1b: Daily rate		
Predictors	**ß**	**CI**	***p***	**ß**	**CI**	***p***
Co-use	**0.14**	**0.01 – 0.27**	**0.038**	−0.02	−0.08 – 0.04	0.553
School (A)[a]	0.06	−0.08 – 0.21	0.398	0.06	−0.02 – 0.14	0.140
School (B)[a]	−0.09	−0.23 – 0.06	0.229	−0.04	−0.12 – 0.04	0.344
Male[a]	0.04	−0.07 – 0.16	0.455	0.01	−0.06 – 0.08	0.745
Age 21[a]	**−0.26**	**−0.38 – −0.14**	**<0.001**	**−0.19**	**−0.26 – −0.12**	**<0.001**
Non-white[a]	0.04	−0.11 – 0.18	0.626	0.03	−0.06 – 0.11	0.542
Hispanic/Latinx[a]	0.12	−0.09 – 0.33	0.272	0.05	−0.07 – 0.17	0.393
Weekend	**0.33**	**0.23 – 0.42**	**<0.001**	0.04	−0.00 – 0.08	0.070
Other drug use	−0.01	−0.21 – 0.19	0.895	−0.06	−0.16 – 0.03	0.198
After 4:00 PM drink start time	0.07	−0.05 – 0.19	0.255	**0.20**	**0.14 – 0.25**	**<0.001**
Liquor	**0.74**	**0.65 – 0.84**	**<0.001**	**0.24**	**0.20 – 0.29**	**<0.001**
# Drinks[a]	**0.29**	**0.27 – 0.32**	**<0.001**	**0.11**	**0.10 – 0.13**	**<0.001**
Proportion of co-use days[a]	−0.08	−0.28 – 0.13	0.478	0.04	−0.07 – 0.15	0.507

Note: N = 318 participants, 3110 daily observations. Statistically significant effects ($p < 0.05$) are in bold typeface.

[a]Between-person variable. Peak hour rate = number of drinks consumed in the peak hour of drinking; Daily rate = total number of drinks consumed in a day divided by hours spent drinking; # Drinks = average total number of drinks per drinking day.

TABLE 4

Effect of rate on experiencing a consequence

	Any consequence					
	Model 2a			Model 2b		
Predictors	**OR**	**CI**	***p***	**OR**	**CI**	***p***
Peak hour rate (2a) | Daily rate (2b)	**1.43**	**1.31 – 1.56**	**<0.001**	**1.33**	**1.11 – 1.58**	**0.001**
Excess drinks (2a) | # drinks (2b)	**1.18**	**1.13 – 1.22**	**<0.001**	**1.21**	**1.17 – 1.25**	**<0.001**
Co-use	1.16	0.91 – 1.48	0.222	1.17	0.92 – 1.49	0.204
School (A)[a]	0.89	0.59 – 1.35	0.579	0.89	0.59 – 1.35	0.574
School (B)[a]	1.25	0.83 – 1.88	0.277	1.24	0.82 – 1.86	0.301
Male[a]	0.79	0.56 – 1.10	0.162	0.78	0.56 – 1.09	0.146
Age 21[a]	1.30	0.90 – 1.87	0.165	1.30	0.90 – 1.88	0.164
Non-white[a]	0.87	0.58 – 1.33	0.530	0.89	0.59 – 1.36	0.600
Hispanic/Latinx[a]	0.87	0.48 – 1.59	0.657	0.86	0.47 – 1.58	0.636
Weekend	**1.55**	**1.26 – 1.91**	**<0.001**	**1.58**	**1.28 – 1.95**	**<0.001**
Other drug use	1.47	0.98 – 2.21	0.062	1.42	0.95 – 2.13	0.090
Drink start time (ref: before 4:00 PM)	1.32	1.00 – 1.75	0.053	1.29	0.97 – 1.71	0.083
Liquor	**2.19**	**1.73 – 2.78**	**<0.001**	**2.21**	**1.75 – 2.80**	**<0.001**
Between-person: Peak hour rate[a] (2a) | Daily rate[a] (2b)	0.87	0.72 – 1.06	0.159	0.80	0.51 – 1.24	0.313

Note: $N = 318$ participants, 3110 daily observations. Statistically significant effects ($p < 0.05$) are in bold typeface.

[a]Between-person variable. Peak hour rate = number of drinks consumed in the peak hour of drinking, Daily rate = total number of drinks consumed in a day divided by hours spent drinking, # Drinks = total number of drinks, Excess drinks = number of drinks consumed in excess of the number consumed in the peak hour.

TABLE 5

Interaction between co-use and rate on consequences

	Any consequence					
	Model 3a			Model 3b		
Predictors	**OR**	**CI**	***p***	**OR**	**CI**	***p***
Co-use × Peak hour rate (3a) | Daily rate (3b)	**0.69**	**0.60 – 0.79**	**<0.001**	**0.49**	**0.37 – 0.66**	**<0.001**
Peak hour rate (3a) | Daily rate (3b)	**1.78**	**1.58 – 2.01**	**<0.001**	**1.91**	**1.50 – 2.42**	**<0.001**
Co-use	**3.25**	**1.96 – 5.36**	**<0.001**	**3.07**	**1.82 – 5.16**	**<0.001**
Excess drinks (3a) | # drinks (3b)	**1.18**	**1.14 – 1.22**	**<0.001**	**1.22**	**1.18 – 1.25**	**<0.001**
School (A)[a]	0.87	0.57 – 1.31	0.498	0.88	0.58 – 1.33	0.538
School (B)[a]	1.22	0.81 – 1.84	0.330	1.22	0.81 – 1.84	0.332
Male[a]	0.74	0.53 – 1.03	0.074	0.73	0.52 – 1.02	0.067
Age 21[a]	1.30	0.90 – 1.88	0.155	1.30	0.90 – 1.89	0.159
Non-white[a]	0.90	0.59 – 1.37	0.613	0.90	0.59 – 1.36	0.611
Hispanic/Latinx[a]	0.95	0.52 – 1.73	0.861	0.93	0.51 – 1.70	0.822
Weekend	**1.55**	**1.25 – 1.91**	**<0.001**	**1.58**	**1.28 – 1.95**	**<0.001**
Other drug use	1.45	0.97 – 2.17	0.071	1.41	0.94 – 2.11	0.099
Drink start time (ref: before 4:00 PM)	**1.36**	**1.03 – 1.81**	**0.032**	**1.36**	**1.02 – 1.81**	**0.039**
Liquor	**2.20**	**1.74 – 2.80**	**<0.001**	**2.22**	**1.75 – 2.81**	**<0.001**
% Co-use days[a]	1.52	0.88 – 2.62	0.136	1.51	0.88 – 2.60	0.137
Between-person: Peak hour rate[a] (3a) | Daily rate[a] (3b)	0.86	0.71 – 1.04	0.125	0.80	0.51 – 1.24	0.317

Note: N = 318 participants, 3110 daily observations. Statistically significant effects ($p < 0.05$) are in bold typeface.

[a]Between-person variable. Peak hour rate = number of drinks consumed in the peak hour of drinking, Daily rate = total number of drinks consumed in a day divided by hours spent drinking, # Drinks = total number of drinks, Excess drinks = number of drinks consumed in excess of the number consumed in the peak hour.