

**Descriptive norms for simultaneous cannabis and alcohol use predict simultaneous use  
patterns assessed via daily surveys**

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## **Abstract**

**Background:** Simultaneous cannabis and alcohol use is common, but few studies have examined normative perceptions of simultaneous use behavior. This study examined unique associations of baseline descriptive norms for simultaneous use (i.e., perceptions about others' simultaneous use) with simultaneous use behaviors assessed via daily surveys.

**Method:** Young adults reporting frequent simultaneous use ( $N=150$ ) completed baseline measures of descriptive norms for the frequency of simultaneous use and the amounts of cannabis and alcohol consumed during typical simultaneous use occasions. Further, participants completed measures of descriptive norms for the frequency and quantity of cannabis and alcohol use in general (i.e., not limited to simultaneous use). Norms were assessed referencing both peer and friend groups. Following the baseline assessment, participants completed 21 daily smartphone surveys assessing cannabis and alcohol use each day. Simultaneous use was operationalized as same-day use of cannabis and alcohol.

**Results:** Multilevel models revealed that, controlling for descriptive norms for cannabis and alcohol use in general, perceiving more frequent simultaneous use among friends (but not peers) was significantly associated with a greater tendency to engage in simultaneous use relative to cannabis-only use across days. Further, perceiving heavier cannabis and alcohol consumption during simultaneous use occasions among friends (but not peers) were significantly associated with greater quantities of cannabis and alcohol consumed, respectively, across simultaneous use days.

**Conclusions:** Descriptive norms for simultaneous use contribute uniquely to simultaneous use behavior, over and above descriptive norms for cannabis use and alcohol use in general. Findings may inform norms-based interventions for young adults who engage in simultaneous use.

**Keywords:** Co-use; simultaneous alcohol and marijuana (SAM) use; alcohol; marijuana; perceived descriptive norms; ecological momentary assessment.

### **Public Health Significance Statement**

This study found that perceptions of others' simultaneous alcohol and cannabis use behaviors predicted one's own simultaneous use behaviors above and beyond perceptions of others' broader alcohol and cannabis use behavior (i.e., not limited to simultaneous use). Specifically, perceptions of friends' (but not peers') frequency of simultaneous use and quantities of alcohol and cannabis consumed during simultaneous use occasions predicted one's own frequency of simultaneous use and quantities of each substance consumed simultaneously, respectively. Results suggest that normative perceptions that are specific to simultaneous use contribute uniquely to simultaneous use patterns and should be examined in future research as potential targets of harm reduction interventions for simultaneous use among young adults.

## Introduction

Young adulthood, typically considered to span ages 18 to 25, marks a period of high prevalence of simultaneous use of alcohol and cannabis (Lee et al., 2022; McCabe et al., 2021; Patrick et al., 2019), which has been defined as using both alcohol and cannabis at the same time or with overlapping effects (Lee et al., 2022; Sokolovsky et al., 2020). Mounting evidence suggests that simultaneous use, relative to using alcohol or cannabis alone, is associated with elevated risk for both acute and chronic substance-related harms (Lee et al., 2022; Subbaraman & Kerr, 2015; Yurasek et al., 2017). Although consequences associated with simultaneous use have been studied extensively (Lee et al., 2022), risk factors for simultaneous use patterns have received relatively less research attention, despite being critical for informing preventive and harm reduction interventions for simultaneous use. Accordingly, research is needed to examine the psychosocial risk factors that predict simultaneous use patterns among young adults.

Given the often-social nature of simultaneous use, individuals' perceptions about others' substance use patterns, known as perceived descriptive norms, may help to explain young adult simultaneous use. Social norms theory contends that individuals' behaviors are influenced by their perceptions of others' behaviors, including misperceptions (Perkins & Berkowitz, 1986). Consistent with social norms theory, empirical work shows that young adults' perceptions of others' substance use influence their own substance use patterns (Mbaba et al., 2022; Perkins, 2002). For example, perceiving more frequent alcohol use among friends prospectively predicts more frequent alcohol use (Brooks-Russell et al., 2014), and perceiving heavier peer alcohol consumption is associated with consuming more drinks per week (Larimer et al., 2020; Neighbors et al., 2007; Perkins, 2002). Similarly, several studies have observed associations between descriptive norms for cannabis use and young adults' cannabis use patterns (Mbaba et

al., 2022), with perceiving more frequent cannabis use among friends linked to using cannabis more frequently (Buckner, 2013; Neighbors et al., 2008) and perceiving heavier peer and friend cannabis consumption linked to using more cannabis flower on average per week (Montes et al., 2021). Further, consistent with social norms theory's assertion that perceptions of proximal (relative to distal) referent groups' behaviors should exert the greatest influence on one's own behavior, several studies have found that young adults' substance use patterns are most strongly associated with perceptions of the use patterns of friends relative to those of broader peer or general population referent groups (e.g., Buckner, 2013; Collins & Spelman, 2013; Lac & Donaldson, 2018; Montes et al., 2021).

Given contributions of descriptive norms to alcohol and cannabis use patterns, it is conceivable that descriptive norms may also contribute to simultaneous use patterns. Event-level data have shown that being in social settings (e.g., parties, friend's house) predicts an increased likelihood of reporting simultaneous use relative to single-substance use (Gunn et al., 2021; Linden-Carmichael et al., 2021). Accordingly, the tendency for simultaneous use to occur in social settings may render young adults' perceptions of others' simultaneous use (especially friends' simultaneous use) particularly important in determining their own simultaneous use. However, relatively few studies have examined associations between descriptive norms and simultaneous use patterns. Select studies have shown associations of greater descriptive norms for alcohol use with an elevated likelihood of engaging in simultaneous use (Linden-Carmichael et al., 2019; Litt et al., 2021; Pritschmann et al., 2022) and with more frequent simultaneous use (Linden-Carmichael et al., 2019); however, it is unclear from these studies whether descriptive norms that are specific to simultaneous use contribute to simultaneous use patterns, as these studies only assessed descriptive norms for alcohol use more generally and not descriptive norms

for simultaneous use, specifically. Only two studies to our knowledge have examined descriptive norms for simultaneous use. First, White et al. (2019) found that college students who estimated that a greater proportion of their friends and peers engaged in weekly simultaneous use were more likely to report past-year simultaneous use themselves and also reported more frequent past-month simultaneous use. Second, Boyle et al. (2023) administered daily surveys asking participants to estimate how many of their friends were likely to engage in simultaneous use each day and found that these estimates were higher on simultaneous use days compared to non-simultaneous-use days. Together, these studies suggest that among young adults, perceiving simultaneous use as more normative is associated with an increased likelihood of engaging in simultaneous use (Boyle et al., 2023; White et al., 2019).

Although prior studies preliminarily support a contribution of descriptive norms for simultaneous use to simultaneous use patterns, several knowledge gaps remain. First, as prior studies have not controlled for separate cannabis and alcohol use descriptive norms in the prediction of simultaneous use patterns, there is a need to establish whether descriptive norms for simultaneous use uniquely contribute to simultaneous use patterns, over and above the influence of normative perceptions of others' cannabis and alcohol use patterns *in general* (i.e., not limited to simultaneous use occasions). In addition, studies examining descriptive norms for simultaneous use have focused on prevalence norms, or young adults' estimates of the proportion of their peers or friends who engage in simultaneous use (Boyle et al., 2023; White et al., 2019). Thus, there remains a need to examine whether descriptive norms for frequency of simultaneous use and quantities of cannabis and alcohol consumed during simultaneous use occasions contribute to simultaneous use patterns. Relatedly, although prior studies have established associations of descriptive norms for simultaneous use with likelihood of reporting simultaneous

use and with frequency of simultaneous use (Boyle et al., 2023; White et al., 2019), further research examining more detailed simultaneous use patterns, such as the relative frequency of simultaneous use compared to single-substance use, and quantities of cannabis and alcohol consumed during simultaneous use days, is needed. Intensive longitudinal methods, including daily diary methods, may be ideal in assessing simultaneous use patterns as they reduce recall biases and facilitate a more reliable and detailed characterization of simultaneous use patterns. Intensive longitudinal methods also are well suited to examine whether individual differences in descriptive norms for simultaneous use are predictive of subsequent simultaneous use behavior.

### **The Current Study**

This study used daily surveys to examine associations of individual differences in descriptive norms for simultaneous use at baseline with simultaneous use patterns assessed over the next three weeks. The study focused on young adults (19 to 25 years of age) residing in Ontario, Canada, where both alcohol and cannabis are legal for individuals 19 years of age and older, and thus the use of both cannabis and alcohol may be perceived as relatively normative in this setting. Indeed, prior (albeit mixed) research shows trends toward more normative perceptions of cannabis use following cannabis legalization (Epstein et al., 2020; Gilson et al., 2023; Stone, 2020; Winfield-Ward & Hammond, 2024), making this an important context in which to examine descriptive norms for simultaneous use. We specifically examined the unique association of descriptive norms for simultaneous use frequency with the proportion of days involving simultaneous use (relative to no substance use, cannabis-only use, and alcohol-only use), controlling for separate descriptive norms for frequency of cannabis use and alcohol use in general (i.e., not limited to simultaneous use days). In addition, we examined whether descriptive norms for quantities of alcohol and cannabis consumed during simultaneous use occasions were

associated with average quantities of cannabis and alcohol consumed on days involving simultaneous use, controlling for descriptive norms for quantities of cannabis and alcohol consumed in general. Consistent with prior research (White et al., 2019), descriptive norms for simultaneous use were assessed with reference to both young adults' broader peer group and closer friend groups. We hypothesized that young adults perceiving more frequent simultaneous use among their peers and friends would report more frequent simultaneous use relative to cannabis-only use, alcohol-only use, and non-use (Hypothesis 1). Further, we hypothesized that perceiving heavier consumption of alcohol and cannabis among peers and friends during simultaneous use would be associated with greater consumption of alcohol and cannabis on simultaneous use days (Hypothesis 2).

## **Method**

### **Participants and Recruitment**

All study procedures were approved by the research ethics boards at York University and the Centre for Addiction and Mental Health. The current study used baseline questionnaire and ecological momentary assessment (EMA) data from a larger longitudinal EMA study of young adults who engage in simultaneous use (Wardell et al., 2024). We recruited young adults ( $M = 22.08$  years [ $SD = 2.10$ ]) from across Ontario, Canada using fliers posted on university campuses and in the community, online advertisements, and social media posts. Eligibility criteria were being between the ages of 19 and 25 years, residing in Ontario, Canada, using both alcohol and cannabis at least weekly on average in the past month, reporting simultaneous use at least twice in the past month, and owning a compatible iOS or Android phone. Exclusion criteria were severe mental illness (bipolar disorder, psychosis) or neurodevelopmental disorder, exclusive use

of cannabis for medical reasons, current treatment for or efforts to reduce cannabis or alcohol use, and monthly use of illegal drugs.

An initial 177 young adults were enrolled in the study; however, some participants were withdrawn from the study during the baseline visit for reporting less than weekly alcohol or cannabis use ( $n = 2$ ), not providing a valid Ontario home address ( $n = 3$ ), or experiencing technical difficulties installing or using the EMA mobile application or connecting to the baseline videoconference ( $n = 4$ ). An additional  $n = 17$  completed less than 10% of the prompted EMA surveys and were subsequently withdrawn.<sup>1</sup> Of the  $N = 151$  who completed the study, one participant did not complete the descriptive norms measure, resulting in an analytic sample of  $N = 150$ . Sample characteristics are reported in Table 1.

## **Procedure and Measures**

### ***Baseline Assessment***

Following an online eligibility screening, participants attended a baseline visit with a research assistant, during which they provided informed consent. They also were oriented to the EMA protocol and mobile application (MetricWire Inc., Waterloo, ON), including training in accurately reporting quantities of cannabis flower consumed in grams and quantities of alcohol consumed in standard drinks using visual aids; visual aids included an infographic from the Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU; Cuttler & Spradlin, 2017) that depicted various quantities of cannabis flower in grams, alongside a dollar bill to provide scale, as well as a standard drink conversion chart. After the baseline visit,

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<sup>1</sup> We compared participants whose data were withdrawn from the study because they completed less than 10% of the prompted EMA surveys to those whose data remained in the study on baseline characteristics; one of the withdrawn participants completed the baseline questionnaire multiple times with discordant responses and thus their baseline data were excluded from these comparisons. Participants whose data were withdrawn ( $n=16$ ) were more likely to be male, had higher CUDIT-R and AUDIT total scores, and reported using more grams of cannabis flower in a typical day relative to participants in the analytic sample; no other statistically significant group differences on baseline demographic or substance-use-related characteristics were observed.

participants completed an online questionnaire that included measures of descriptive norms and cannabis and alcohol use and harms. Several other measures relevant to the larger study were included in the questionnaire, but only those pertinent to the current analyses are detailed here. Participants received a gift card worth \$40 CAD for participating in the baseline assessment.

### ***Baseline Measures***

**Descriptive Norms.** To assess descriptive norms for simultaneous use frequency, participants were asked, “*how often do you think a typical person with your gender and age uses cannabis and alcohol together (so that their effects overlap)?*” Similarly-worded items asked participants to estimate the frequency of cannabis use and alcohol use in general (i.e., not limited to simultaneous use occasions) for a typical person with their gender and age. Frequency items were rated on an ordinal scale from 1 = *never* to 12 = *everyday* (see Table 2 for complete response options). To assess descriptive norms for quantities consumed during simultaneous use, participants were asked, “*how many grams of cannabis, on average, do you think a typical person with your gender and age consumes on a given occasion when they are using cannabis and alcohol together?*” and “*how many drinks, on average, do you think a typical person with your gender and age consume on a given occasion when they are using cannabis and alcohol together?*” Similarly-worded versions of each of these items asked participants to estimate quantities of cannabis and alcohol consumed on typical cannabis use occasions and alcohol use occasions, respectively, among peers of the same gender and age. Response options were categorical and ranged from 0 grams to 28 or more grams (for cannabis), or 0 drinks to 25 or more drinks (for alcohol); these items were recoded as continuous (using midpoints for response options that presented ranges) for analyses, with 28 grams and 25 drinks as upper limits for cannabis and alcohol quantities, respectively. Consumption items were presented after

participants had been trained in reporting cannabis and alcohol quantities during the baseline visit. Subsequently, all items assessing frequency and quantity norms were re-administered with “*your friends of the same gender*” as the referent group, in place of “*a typical person with your gender and age*.” Descriptive statistics for each descriptive norm item are provided in Table 2, and zero-order correlations among all descriptive norm items are presented in Table 3. Complete descriptive norm items and response options are provided in the Supplementary Materials.

**Cannabis and Alcohol Use and Harms.** For descriptive purposes, selected items from the DFAQ-CU (Cuttler & Spradlin, 2017) were used to assess typical and past-month cannabis use frequency (with response options ranging from 1 = *not at all* to 13 = *more than once a day*) and grams of cannabis flower used per typical session, day, and week in our sample. We also administered selected items from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) Recommended Alcohol Screening Questions (NIAAA Task Force on Recommended Questions, 2003) to assess past-three-month alcohol use frequency and quantity. Participants also completed the eight-item Cannabis Use Disorder Identification Test – Revised (CUDIT-R) (Adamson et al., 2010) and the 10-item Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993) to respectively characterize hazardous cannabis use and alcohol use.

### ***EMA Protocol***

The day after the baseline assessment, participants began a 21-day EMA protocol that involved daily, randomly-timed, and event-contingent surveys. The current analysis used only the daily surveys as they most comprehensively assessed daily cannabis and alcohol use. Daily surveys were available from 7:00 AM to 1:00 PM, with reminder notifications sent at 10:00 AM, 11:00 AM, and 12:00 PM (or until survey completion). Using items adapted from the DFAQ-CU (Cuttler & Spradlin, 2017), daily surveys asked whether participants had used cannabis during

the previous day, and if so, their route(s) of cannabis administration (smoked, vaporized, ate/drank, other), form(s) of cannabis used (flower, concentrates, edibles/beverages, other), and grams of cannabis flower used (if applicable). Daily surveys also asked whether participants had used alcohol during the previous day, and if so, the number of standard drinks they consumed. Participants could view visual depictions of grams of cannabis flower and a standard drink conversion chart through the EMA application when completing relevant questions. Further, in each daily survey on which participants reported having used both cannabis and alcohol during the previous day, participants reported whether they had used both substances within the same two hours. Daily surveys included additional items that were part of the larger study that are not detailed here because they are beyond the scope of the current analyses. Participants received between \$45 and \$115 CAD (depending on completion rate for the prompted surveys) following their participation in the larger EMA protocol.

## **Data Analysis**

### ***Comparing Descriptive Norms for Simultaneous Use, Cannabis Use, and Alcohol Use***

For descriptive purposes, multilevel models with observations (level 1) nested within participants (level 2) were used to examine within-person differences in descriptive norms as a function of referent behavior (simultaneous use, cannabis use, alcohol use). One set of models included a set of dummy variables indicating the referent behavior (simultaneous use [referent category], alcohol use, cannabis use) as level 1 predictors of descriptive norms for frequency of use. Multilevel models were also used to examine differences in descriptive norms for quantities of cannabis flower and alcohol consumed as a function of referent behavior modelled at level 1 (simultaneous use [referent category] versus cannabis use and simultaneous use [referent category] versus alcohol use, respectively). All analyses were run separately for descriptive

norms with peer and friend referent groups. Level 1 predictors were not centered as they varied only within (and not between) persons. Dependent variables were modelled as linear outcomes using gaussian distributions and identity link functions. Models were fit with maximum likelihood estimation in the *glmmTMB* package for R (Brooks et al., 2017; R Core Team, 2022).

### ***Descriptive Norms for Simultaneous Use as Predictors of Simultaneous Use Patterns***

Multilevel multinomial logistic regression models with days (level 1) nested within participants (level 2) were used to examine associations of descriptive norms for simultaneous use frequency (level 2 predictor) with likelihood of engaging in simultaneous use (referent category) compared to non-use, cannabis-only use, and alcohol-only use, modelled as a level 1 (day-level) categorical outcome. Separate models were specified for descriptive norms with peer and friend referent groups. As descriptive norms for simultaneous use frequency vary only at the person level, associations reflect between-person (level 2) relations between norms and propensity to engage in simultaneous cannabis and alcohol use (versus to use no substance, use cannabis alone, and use alcohol alone) across days. At level 2, we controlled for each of descriptive norms for cannabis use frequency and alcohol use frequency in general, and for the proportion of each participants' daily surveys that represented weekend days (Friday–Sunday). Given that frequencies and quantities of both cannabis and alcohol use tend to vary by age (e.g., Grant et al., 2012; Mauro et al., 2018; Nicolai et al., 2012) and sex (e.g., Calakos et al., 2017; Hawke et al., 2018; Salvatore et al., 2017), age and sex were included as level 2 covariates. As our independent variable of interest varied only at level 2, no covariates were included at level 1.

We also used multilevel models to examine associations of descriptive norms for cannabis and alcohol quantities consumed during simultaneous use with each of cannabis consumption quantities and alcohol consumption quantities on simultaneous use days. We

limited these analyses to the 428 daily surveys in which simultaneous use was reported, and consequently, to the  $n=103$  participants who reported one or more simultaneous use days. Separate sets of models were specified for descriptive norms with peer and friend referent groups. In the models predicting cannabis quantities consumed, grams of cannabis flower used each day was modelled as a level 1 linear outcome using a gaussian distribution, and in the models predicting alcohol quantities, standard drinks used each day were modelled as a level 1 count outcome using a negative binomial distribution. Descriptive norms for quantities of the relevant substance (alcohol or cannabis) used during simultaneous use were specified as a level 2 independent variable in each model, and we controlled for the parallel descriptive norms variable for quantities consumed during typical cannabis or alcohol use occasions (in general) at level 2 in each model. At level 2, we also controlled for person-mean standard drinks consumed across simultaneous use days and the proportion of simultaneous use days that involved non-flower cannabis use in the models predicting cannabis quantities consumed, and person-mean grams of cannabis flower used across simultaneous use days in the models predicting alcohol quantities consumed. Further, age, sex, and the proportion of each participants' simultaneous use days that were weekend days were included in each model as level 2 covariates.

All models were fit using maximum likelihood estimation. In all models, continuous independent variables and covariates were grand-mean centered. Multinomial logistic regression models were estimated using Mplus version 8.8 (Muthén & Muthén, 2021), and all other models were estimated using the *glmmTMB* package in R (Brooks et al., 2017; R Core Team, 2022).<sup>2</sup>

## Transparency and Openness

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<sup>2</sup> One participant was excluded from multilevel models examining descriptive norms for simultaneous use as predictors of simultaneous use patterns due to missing data on sex.

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study, and we follow JARS (Kazak, 2018). Anonymized data, analysis code, and research materials are available upon request to the corresponding author, subject to any applicable ethics requirements. The study's design and its analysis were not pre-registered.

## Results

### Descriptive Statistics

Participants ( $N = 150$ ) completed a combined total of 2805 daily surveys (average 89.05% completion rate), of which 428 (15.26%) reported simultaneous use, 711 (25.35%) reported cannabis-only use, 241 (8.59%) reported alcohol-only use, and 1425 (50.80%) reported no cannabis or alcohol use. Participants indicated that they had used both cannabis and alcohol within the same two hours on 88.78% of simultaneous use days. Participants reported an average of 2.85 ( $SD = 3.36$ , range = 0–21) simultaneous use days, 4.74 ( $SD = 5.02$ , range = 0–21) cannabis-only days, 1.61 ( $SD = 2.32$ , range = 0–21) alcohol-only days, and 9.50 ( $SD = 6.30$ , range = 0–21) non-use days. Averaging across each participant's simultaneous use days, participants reported consuming an average of 0.46 ( $SD = 0.60$ ) grams of cannabis flower and 3.85 ( $SD = 2.39$ ) standard drinks per simultaneous use day, and they used flower and non-flower forms of cannabis on an average of 67.40% ( $SD = 41.15$ ) and 42.02% ( $SD = 43.10$ ) of their simultaneous use days, respectively.

Results of multilevel models examining within-person differences in descriptive norms as a function of referent behavior (simultaneous use, cannabis use, alcohol use) are shown in Table 4. Descriptive norms were significantly greater for both cannabis use frequency and alcohol use frequency, in general, relative to norms for simultaneous use frequency, specifically, with both peer and friend referent groups. In other words, participants perceived that their peers and same-

gender friends engaged more often in each of cannabis use and alcohol use in general (not limited to simultaneous use) than in simultaneous use. In addition, with both peer and friend referent groups, descriptive norms for number of drinks consumed during typical drinking occasions were significantly greater than descriptive norms for number of drinks consumed during simultaneous use occasions, indicating that participants perceived that their peers and same-gender friends were consuming more alcohol during drinking occasions in general relative to during simultaneous use occasions, specifically. Further, with friend (but not peer) referent groups, descriptive norms for grams of cannabis flower consumed during typical cannabis use occasions were significantly greater than descriptive norms for grams of cannabis flower consumed during simultaneous use occasions, indicating that participants perceived that their same-gender friends were consuming more cannabis flower during cannabis use occasions in general relative to during simultaneous use occasions, specifically.

### **Associations of Descriptive Norms for Simultaneous Use with Simultaneous Use Patterns**

#### ***Descriptive Norms for Simultaneous Use Frequency***

Results of the multinomial logistic regression models examining associations of descriptive norms for simultaneous use frequency with propensity for simultaneous use compared to non-use, cannabis-only use, and alcohol-only use are shown in Table 5. Although simultaneous use was the referent category in these models, herein we interpret the inverse of estimates of interest to align with our objective of examining associations of descriptive norms with propensity for simultaneous use. In the model with friend referent groups, descriptive norms for simultaneous use frequency were significantly, positively associated with propensity for simultaneous use relative to cannabis-only use (but not alcohol-only use or non-use), providing some support for Hypothesis 1. In other words, participants who perceived more frequent

simultaneous use among their same-gender friends were more likely to simultaneously use cannabis and alcohol versus use only cannabis across days. Further, descriptive norms for cannabis use frequency in general were significantly, negatively associated with propensity to engage in simultaneous use relative to cannabis-only use, but were significantly, positively associated with propensity to engage in simultaneous use relative to non-use; that is, participants who perceived more frequent cannabis use in general among their same-gender friends were less likely to engage in simultaneous use relative to cannabis-only use but were more likely to engage in simultaneous use relative to non-use.<sup>3</sup> By contrast, in the model with peer referent groups, there were no significant associations observed for any of the descriptive norms variables.

### ***Descriptive Norms for Consumption Quantities During Simultaneous Use***

Results of multilevel models examining associations of descriptive norms for quantities of each substance consumed on a typical simultaneous use occasion with participants' own consumption on simultaneous use days are reported in Table 6. In the model predicting quantities of cannabis flower consumed with peers as the normative referent group, the association of descriptive norms for cannabis quantities consumed during simultaneous use occasions with quantities of cannabis flower consumed on simultaneous use days was not statistically significant. Further, descriptive norms for quantities of cannabis used (in general) were significantly, positively associated with quantities of cannabis flower consumed on simultaneous use days, meaning that participants who perceived heavier cannabis consumption in general among their peers used more cannabis flower overall across their simultaneous use days.

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<sup>3</sup> As a sensitivity analysis, we re-ran all models excluding simultaneous use days on which cannabis and alcohol were not used within the same two hours ( $n = 48$ ); all significant associations between descriptive norms for frequency of simultaneous use and participants' own likelihood of engaging in simultaneous use remained statistically significant.

In the model predicting quantities of alcohol consumed with peers as the normative referent group, the association of descriptive norms for alcohol quantities consumed during simultaneous use occasions with quantities of alcohol consumed on simultaneous use days was not statistically significant, nor was the association of descriptive norms for quantities of alcohol consumed (in general) with quantities of alcohol consumed on simultaneous use days.

In the model with predicting quantities of cannabis flower consumed with friends as the normative referent group, consistent with Hypothesis 2, descriptive norms for cannabis quantities consumed during simultaneous use occasions were significantly, positively associated with quantities of cannabis flower consumed on simultaneous use days. In other words, perceiving that same-gender friends were using more cannabis flower during simultaneous use occasions was associated with consuming more cannabis flower across simultaneous use days. Descriptive norms for quantities of cannabis consumed by friends during cannabis use occasions in general were also significantly associated with consuming more cannabis flower overall across simultaneous use days.

In the model predicting quantities of alcohol consumed with friends as the normative referent group, descriptive norms for alcohol quantities consumed during simultaneous use occasions were significantly, positively associated with quantities of alcohol consumed across simultaneous use days, consistent with Hypothesis 2. In other words, perceiving that same-gender friends were consuming more alcohol during simultaneous use occasions was associated with consuming more alcohol across simultaneous use days. Descriptive norms for quantities of alcohol consumed by friends during alcohol occasions in general were not significantly associated with participants' own alcohol consumption across their simultaneous use days.<sup>4</sup>

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<sup>4</sup> As a sensitivity analysis, we re-ran all models examining associations of descriptive norms for quantities of each substance consumed on a typical simultaneous use occasion with participants' own consumption on simultaneous

## Discussion

Although descriptive norms predict patterns of cannabis use and alcohol use, individually (e.g., Larimer et al., 2020; Mbaba et al., 2022; Neighbors et al., 2007, 2008), limited research has examined their relation to patterns of simultaneous use. The current study examined the associations of descriptive norms for simultaneous use with simultaneous use patterns, over and above the effects of descriptive norms for cannabis use and alcohol use in general (i.e., not limited to simultaneous use). We found partial support for the hypothesis that young adults' perceptions of others' simultaneous use frequency would be associated with their own relative simultaneous use frequency. Specifically, participants who perceived more frequent simultaneous use among their same-gender friends reported engaging in simultaneous use on a greater proportion of days than they reported exclusively using cannabis. Also as hypothesized, we found that perceiving heavier cannabis consumption during simultaneous use among same-gender friends was associated with consuming more grams of cannabis flower across simultaneous use days, and perceiving heavier alcohol consumption during simultaneous use among same-gender friends was associated with greater overall alcohol consumption across simultaneous use days.

These results broadly converge with previous research linking perceptions of heavier peer alcohol and cannabis use with greater alcohol and cannabis consumption, respectively (Larimer et al., 2020; Montes et al., 2021; Neighbors et al., 2007), and are the first to link young adults' perceptions of the amounts of alcohol and cannabis typically consumed by others during simultaneous use, specifically, with their own typical quantities consumed during simultaneous

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use days, excluding simultaneous use days on which cannabis and alcohol were not used within the same two hours ( $n = 48$ ); all significant associations between descriptive norms for simultaneous use and participants' own consumption on simultaneous use days remained statistically significant.

use. Given that simultaneous use often occurs in social settings and with others (Gunn et al., 2021; Linden-Carmichael et al., 2021), perceptions of others' more frequent simultaneous use and heavier consumption during simultaneous use may reflect engaging in simultaneous use among friend groups wherein frequent and heavy simultaneous use is more normative, and thus young adults' simultaneous use behaviors may mirror those of their friends. Alternatively, young adults reporting greater simultaneous use may be overestimating their friends' frequency of, and level of consumption during, simultaneous use, as has been observed for alcohol and cannabis use more broadly (Borsari & Carey, 2001, 2003; Montes et al., 2021). Future research is needed to delineate the contributions of the social context of simultaneous use and potential self-other differences in perceptions of simultaneous use patterns.

Findings extend the limited past research linking greater descriptive norms for simultaneous use with simultaneous use behavior (White et al., 2019) by controlling for descriptive norms for cannabis and alcohol use *in general*, supporting the specific contribution of descriptive norms for simultaneous use to simultaneous use behavior. Our results suggest that the influence of descriptive norms for simultaneous use is more than an artefact of perceiving both cannabis use and alcohol use to be more normative, and in turn, engaging in more frequent and heavier use of each substance, thereby opportunistically increasing the likelihood they are used simultaneously. Instead, young adults may intentionally combine cannabis and alcohol, resulting in patterns of simultaneous use that may be distinct from their general patterns of alcohol and cannabis use. Indeed, specific motives for simultaneous use, such as “cross-fading” motives (i.e., to enhance the effects of cannabis or alcohol by using both substances simultaneously; Patrick et al., 2020), support the notion that simultaneous use may often be an intentional, rather than solely opportunistic, behavior, and thus is likely to be influenced by normative perceptions

specific to simultaneous use. This underscores the need to explicitly assess young adults' perceptions of others' simultaneous use in research examining normative influences on young adult simultaneous use. Further, findings preliminarily suggest that norms-based interventions for simultaneous use, such as normative re-education and personalized normative feedback interventions, may require content tailored to simultaneous use, rather than merely combining content from separate alcohol and cannabis interventions.

In addition, although not hypothesized, we observed independent contributions of descriptive norms for cannabis use and alcohol use in general (i.e., not limited to simultaneous use) in differentiating propensity for simultaneous use relative to single-substance use. For example, perceiving others' cannabis use (but not alcohol use) as more frequent was significantly associated with more frequent simultaneous use relative to non-use (when same-gender friends were the referent group). This finding may be interpreted in light of evidence supporting alcohol as a complement to cannabis (i.e., greater likelihood of using alcohol or using larger quantities of alcohol on days when cannabis is used or when larger quantities of cannabis are used; e.g., Coelho et al., 2023; Daros et al., 2022; Ito et al., 2021; Metrik et al., 2018); that is, descriptive norms for cannabis use frequency may be sufficient to increase the likelihood of simultaneous use by invoking more cannabis use, and in turn, complementary alcohol use. However, this interpretation is speculative, and further research is needed to delineate potential mechanisms of asymmetric associations of descriptive norms for cannabis use versus alcohol use with simultaneous use patterns.

Notably, associations of young adults' perceptions of others' simultaneous use with their own simultaneous use behaviors were more consistently observed when referencing their friends of the same gender, rather than a typical person of the same age and gender. This aligns with

prior research on descriptive norms for cannabis use and alcohol use, individually, wherein young adults' perceptions of more proximal (versus more distal) referent groups' use exert greater influence on their own use (e.g., Buckner, 2013; Collins & Spelman, 2013; Lac & Donaldson, 2018; Montes et al., 2021). Perhaps young adults are more likely to conform to the simultaneous use norms of their closer friend group, or they may have a greater sense of shared identity with their friend group than with their broader same-age peer group. Although these interpretations are speculative, our findings nonetheless underscore the importance of assessing participants' perceptions of simultaneous use among multiple referent groups in research examining descriptive norms for simultaneous use as predictors of simultaneous use outcomes. Further, findings suggest that norms-based interventions for simultaneous use among young adults may benefit from content emphasizing normative substance use among individuals' close friends, as this content may be most personally salient and likely to influence young adults' simultaneous use behaviors.

In descriptive analyses, we found that across both peer and friend referent groups, young adults perceived simultaneous use as less frequent than both cannabis use and alcohol use in general—an unsurprising finding given that simultaneous use is subsumed under cannabis use and alcohol use, and thus should be equally or less frequent than each. Young adults also perceived peers' and friends' alcohol consumption to be lighter during simultaneous use occasions, specifically, relative to during drinking occasions in general, and friends' cannabis consumption to be lighter during simultaneous use occasions, specifically, relative to cannabis occasions in general. Studies comparing alcohol consumption between simultaneous use and alcohol-only use at the day and event levels have generally found that young adults consume more alcohol during simultaneous use occasions relative to alcohol-only use occasions (Ito et al.,

2021; Lee et al., 2020), although select studies have observed the opposite pattern or no significant differences (Linden-Carmichael et al., 2020; Waddell et al., 2021). Only one study to our knowledge has compared cannabis consumption between simultaneous use and cannabis-only use occasions, observing no significant differences (Linden-Carmichael et al., 2020), although findings may have been influenced by imprecise units used to quantify cannabis consumption (i.e., hits). Thus, future research should clarify whether young adults' perceptions of their friends' lighter drinking during simultaneous use, specifically, relative to alcohol use in general, represent misperceptions or reflect their friends' true drinking patterns.

### **Strengths and Limitations**

This study had several strengths, including a prospective design that permitted an examination of temporal associations of descriptive norms for simultaneous use with simultaneous use patterns. In addition, assessing descriptive norms for both frequency of simultaneous use and consumption quantities during simultaneous use, and assessing detailed simultaneous use outcomes via daily surveys, permitted a detailed characterization of the relations between descriptive norms for simultaneous use and simultaneous use patterns. Further, the Canadian context of our study provides a novel contribution to the literature on descriptive norms for simultaneous use given that these norms may be influenced by both cannabis and alcohol being fully legal (Epstein et al., 2020; Gilson et al., 2023; Stone, 2020; Winfield-Ward & Hammond, 2024).

We also acknowledge that our study had several limitations. As descriptive norms were assessed only at baseline, associations were examined only at the person level, and not at the day or event level. Building on one previous study that observed within-person variability in descriptive norms for simultaneous use (Boyle et al., 2023), future research examining unique

day-level associations of descriptive norms for simultaneous use with simultaneous use behaviors is needed. In addition, although participants were trained to report only cannabis flower (and not other forms of flower) in grams, and thus it was implied that items on the descriptive norms measure assessing quantities of cannabis in grams applied only to cannabis flower, these items did not explicitly instruct participants to restrict reporting to cannabis flower. Relatedly, we did not explicitly assess descriptive norms for quantities of non-flower forms of cannabis, and thus did not examine associations of such norms with quantities of non-flower forms of cannabis used across simultaneous use days, representing an important direction for future research. Further, we did not assess descriptive norms for cannabis-only use and alcohol-only use, instead assessing only descriptive norms for each of cannabis use and alcohol use in general; future research assessing these norms should consider comparing young adults' perceptions of the frequency of—and cannabis and alcohol quantities consumed during—simultaneous use relative to cannabis-only use and alcohol-only use. Moreover, due to a lack of correspondence in the assessment approaches for descriptive norms for simultaneous use and simultaneous use behaviors (e.g., differently-worded items, baseline assessment of trait-like norms versus daily assessment of use behavior), we did not examine whether participants' perceptions of others' patterns of simultaneous use were discrepant with their own simultaneous use patterns. Establishing the extent of self-other differences in perceptions of simultaneous use patterns is an important direction for future research.

Some limitations related to our EMA protocol should also be considered in the interpretation of results. First, although retrospective biases were mitigated using daily diary methods, self-report biases cannot be ruled out. In addition, our study broadly defined simultaneous use as same-day cannabis-alcohol co-use, which deviates from more standard

definitions of using cannabis and alcohol within a narrow time period or such that their effects overlap (see Sokolovsky et al., 2020; Lee et al., 2022). Notably, 89% of same-day co-use days in our data involved use of both substances within the same two hours, such that same-day co-use largely reflected more stringent operationalizations of simultaneous use. Further, results did not change in sensitivity analyses that excluded same-day co-use days on which alcohol and cannabis were not both used within the same two hours. Still, future research replicating analyses with simultaneous use defined as use of both substances with overlapping effects is needed.

Furthermore, our sample had limited racial diversity, and small cell sizes for several race categories precluded a comprehensive examination of the role of race in the associations examined. Relatedly, results may not generalize to young adults who are not White. Thus, replications of our findings in larger samples with greater racial diversity are needed. In addition, young adults who completed less than 10% of the prompted EMA surveys were excluded from the analytic sample, potentially limiting the generalizability of findings given that these individuals differed from the analytic sample on select demographic and substance-use-related characteristics. Moreover, due to our study's eligibility criteria, findings may not generalize to young adults who use cannabis and alcohol more or less frequently, use other drugs frequently, are seeking treatment, or reside in jurisdictions where non-medical cannabis is illegal.

## **Conclusions**

This study extends prior research on risk factors for young adult simultaneous use by examining associations of descriptive norms for simultaneous use with patterns of simultaneous use. Findings suggest that descriptive norms for simultaneous use frequency and for consumption quantities during simultaneous use contribute to the relative frequency of simultaneous use and to typical consumption quantities on simultaneous use days, respectively,

over and above the effects of descriptive norms for cannabis use and alcohol use more generally. Future research should examine normative perceptions of friends' simultaneous use behaviors as potential targets of intervention for young adult simultaneous-use-related risk.

## References

- Adamson, S. J., Kay-Lambkin, F. J., Baker, A. L., Lewin, T. J., Thornton, L., Kelly, B. J., & Sellman, J. D. (2010). An improved brief measure of cannabis misuse: The Cannabis Use Disorders Identification Test-Revised (CUDIT-R). *Drug and Alcohol Dependence*, 110(1–2), 137–143. <https://doi.org/10.1016/j.drugalcdep.2010.02.017>
- Borsari, B., & Carey, K. B. (2001). Peer influences on college drinking: A review of the research. *Journal of Substance Abuse*, 13(4), 391–424. [https://doi.org/10.1016/s0899-3289\(01\)00098-0](https://doi.org/10.1016/s0899-3289(01)00098-0)
- Borsari, B., & Carey, K. B. (2003). Descriptive and injunctive norms in college drinking: A meta-analytic integration. *Journal of Studies on Alcohol*, 64(3), 331–341. <https://doi.org/10.15288/jsa.2003.64.331>
- Boyle, H. K., Carey, K. B., Jackson, K. M., & Merrill, J. E. (2023). Applying the prototype willingness model to day-level simultaneous alcohol and cannabis use. *Psychology of Addictive Behaviors*, 37(4), 626–638. <https://doi.org/10.1037/adb0000920>
- Brooks, M. E., Kristensen, K., Benthem, K. J. van, Magnusson, A., Berg, C. W., Nielsen, A., Skaug, H. J., Mächler, M., & Bolker, B. M. (2017). glmmTMB Balances Speed and Flexibility Among Packages for Zero-inflated Generalized Linear Mixed Modeling. *The R Journal*, 9(2), 378–400.
- Brooks-Russell, A., Simons-Morton, B., Haynie, D., Farhat, T., & Wang, J. (2014). Longitudinal Relationship Between Drinking with Peers, Descriptive Norms, and Adolescent Alcohol Use. *Prevention Science*, 15(4), 497–505. <https://doi.org/10.1007/s11121-013-0391-9>
- Buckner, J. D. (2013). College Cannabis Use: The Unique Roles of Social Norms, Motives, and Expectancies. *Journal of Studies on Alcohol and Drugs*, 74(5), 720–726. <https://doi.org/10.15288/jsad.2013.74.720>

- Calakos, K. C., Bhatt, S., Foster, D. W., & Cosgrove, K. P. (2017). Mechanisms Underlying Sex Differences in Cannabis Use. *Current Addiction Reports*, 4(4), 439–453.  
<https://doi.org/10.1007/s40429-017-0174-7>
- Coelho, S. G., Hendershot, C. S., Rueda, S., & Wardell, J. D. (2023). Daily associations between cannabis use and alcohol use among people who use cannabis for both medicinal and nonmedicinal reasons: Substitution or complementarity? *Psychology of Addictive Behaviors*. <https://doi.org/10.1037/adb0000930>
- Collins, S. E., & Spelman, P. J. (2013). Associations of descriptive and reflective injunctive norms with risky college drinking. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors*, 27(4), 1175–1181.  
<https://doi.org/10.1037/a0032828>
- Cuttler, C., & Spradlin, A. (2017). Measuring cannabis consumption: Psychometric properties of the Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU). *PloS One*, 12(5), e0178194. <https://doi.org/10.1371/journal.pone.0178194>
- Daros, A. R., Pereira, B. J., Khan, D., Ruocco, A. C., Quilty, L. C., & Wardell, J. D. (2022). Daily associations between cannabis use and alcohol use in young adults: The moderating role of self-report and behavioral measures of impulsivity. *Addiction Research & Theory*, 30(2), 79–88. <https://doi.org/10.1080/16066359.2021.1939314>
- Epstein, M., Bailey, J. A., Kosterman, R., Furlong, M., & Hill, K. G. (2020). Evaluating the effect of retail marijuana legalization on parent marijuana use frequency and norms in U.S. States with retail marijuana legalization. *Addictive Behaviors*, 111, 106564.  
<https://doi.org/10.1016/j.addbeh.2020.106564>
- Gilson, M. S., Kilmer, J. R., Fleming, C. B., Rhew, I. C., Calhoun, B. H., & Guttmanova, K. (2023). Substance-Specific Risk Factors for Cannabis and Alcohol Use Among Young

- Adults Following Implementation of Nonmedical Cannabis Legalization. *Prevention Science*, 24(6), 1047–1057. <https://doi.org/10.1007/s11121-022-01435-8>
- Grant, J. D., Vergés, A., Jackson, K. M., Trull, T. J., Sher, K. J., & Bucholz, K. K. (2012). Age and ethnic differences in the onset, persistence and recurrence of alcohol use disorder. *Addiction*, 107(4), 756–765. <https://doi.org/10.1111/j.1360-0443.2011.03721.x>
- Gunn, R. L., Sokolovsky, A., Stevens, A. K., Hayes, K., Fitzpatrick, S., White, H. R., & Jackson, K. M. (2021). Contextual influences on simultaneous alcohol and cannabis use in a predominately white sample of college students. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors*, 35(6), 691–697. <https://doi.org/10.1037/adb0000739>
- Hawke, L. D., Koyama, E., & Henderson, J. (2018). Cannabis use, other substance use, and co-occurring mental health concerns among youth presenting for substance use treatment services: Sex and age differences. *Journal of Substance Abuse Treatment*, 91, 12–19. <https://doi.org/10.1016/j.jsat.2018.05.001>
- Ito, T. A., Cordova, K. A., Skrzynski, C. J., & Bryan, A. (2021). Complementarity in daily marijuana and alcohol among emerging adults. *Psychology of Addictive Behaviors*, 35, 723–736. <https://doi.org/10.1037/adb0000771>
- Lac, A., & Donaldson, C. D. (2018). Testing competing models of injunctive and descriptive norms for proximal and distal reference groups on alcohol attitudes and behavior. *Addictive Behaviors*, 78, 153–159. <https://doi.org/10.1016/j.addbeh.2017.11.024>
- Larimer, M. E., Parker, M., Lostutter, T., Rhew, I., Eakins, D., Lynch, A., Walter, T., Egashira, L., Kipp, B. J., & Duran, B. (2020). Perceived descriptive norms for alcohol use among tribal college students: Relation to self-reported alcohol use, consequences, and risk for

- alcohol use disorder. *Addictive Behaviors*, 102, 106158.  
<https://doi.org/10.1016/j.addbeh.2019.106158>
- Lee, C. M., Calhoun, B. H., Abdallah, D. A., Blayney, J. A., Schultz, N. R., Brunner, M., & Patrick, M. E. (2022). Simultaneous Alcohol and Marijuana Use Among Young Adults: A Scoping Review of Prevalence, Patterns, Psychosocial Correlates, and Consequences. *Alcohol Research: Current Reviews*, 42(1), 08. <https://doi.org/10.35946/arcr.v42.1.08>
- Lee, C. M., Patrick, M. E., Fleming, C. B., Cadigan, J. M., Abdallah, D. A., Fairlie, A. M., & Larimer, M. E. (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. <https://doi.org/10.1111/acer.14279>
- Linden-Carmichael, A. N., Allen, H. K., & Lanza, S. T. (2021). The socio-environmental context of simultaneous alcohol and marijuana use among young adults: Examining day-level associations. *Drug and Alcohol Review*, 40(4), 647–657.  
<https://doi.org/10.1111/dar.13213>
- Linden-Carmichael, A. N., Stamates, A. L., & Lau-Barraco, C. (2019). Simultaneous Use of Alcohol and Marijuana: Patterns and Individual Differences. *Substance Use & Misuse*, 54(13), 2156–2166. <https://doi.org/10.1080/10826084.2019.1638407>
- Linden-Carmichael, A. N., Van Doren, N., Masters, L. D., & Lanza, S. T. (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(3), 447–453. <https://doi.org/10.1037/adb0000556>
- Litt, D. M., Lowery, A., LoParco, C., & Lewis, M. A. (2021). Alcohol-related cognitions: Implications for concurrent alcohol and marijuana use and concurrent alcohol and

- prescription stimulant misuse among young adults. *Addictive Behaviors*, 119, 106946.  
<https://doi.org/10.1016/j.addbeh.2021.106946>
- Mauro, P. M., Carliner, H., Brown, Q. L., Hasin, D. S., Shmulewitz, D., Rahim-Juwel, R., Sarvet, A. L., Wall, M. M., & Martins, S. S. (2018). Age Differences in Daily and Nondaily Cannabis Use in the United States, 2002–2014. *Journal of Studies on Alcohol and Drugs*, 79(3), 423–431. <https://doi.org/10.15288/jsad.2018.79.423>
- Mbaba, M., AuBuchon, K. E., & Dodge, T. (2022). The Influence of Descriptive and Injunctive Norms on U.S. Adolescent Marijuana Use: A Systematic Review of the Literature. *Journal of Studies on Alcohol and Drugs*, 83(3), 312–322.  
<https://doi.org/10.15288/jsad.2022.83.312>
- McCabe, S. E., Arterberry, B. J., Dickinson, K., Evans-Polce, R. J., Ford, J. A., Ryan, J. E., & Schepis, T. S. (2021). Assessment of Changes in Alcohol and Marijuana Abstinence, Co-Use, and Use Disorders Among US Young Adults From 2002 to 2018. *JAMA Pediatrics*, 175(1), 64–72. <https://doi.org/10.1001/jamapediatrics.2020.3352>
- Metrik, J., Gunn, R. L., Jackson, K. M., Sokolovsky, A. W., & 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(6), 1096–1104.  
<https://doi.org/10.1111/acer.13639>
- Montes, K. S., Richards, D. K., & Pearson, M. R. (2021). A novel approach to assess descriptive and injunctive norms for college student marijuana use. *Addictive Behaviors*, 117, 106755. <https://doi.org/10.1016/j.addbeh.2020.106755>
- Muthén, L. K., & Muthén, B. O. (2021). *Mplus: Statistical Analysis with Latent Variables: User's Guide (Version 8.8)* (Version 8.8) [Computer software].

- Neighbors, C., Geisner, I. M., & Lee, C. M. (2008). Perceived marijuana norms and social expectancies among entering college student marijuana users. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors*, 22(3), 433–438. <https://doi.org/10.1037/0893-164X.22.3.433>
- Neighbors, C., Lee, C. M., Lewis, M. A., Fossos, N., & Larimer, M. E. (2007). Are Social Norms the Best Predictor of Outcomes Among Heavy-Drinking College Students? *Journal of Studies on Alcohol and Drugs*, 68(4), 556–565.
- Nicolai, J., Moshagen, M., & Demmel, R. (2012). Patterns of alcohol expectancies and alcohol use across age and gender. *Drug and Alcohol Dependence*, 126(3), 347–353. <https://doi.org/10.1016/j.drugalcdep.2012.05.040>
- Patrick, M. E., Fleming, C. B., Fairlie, A. M., & Lee, C. M. (2020). Cross-fading motives for simultaneous alcohol and marijuana use: Associations with young adults' use and consequences across days. *Drug and Alcohol Dependence*, 213, 108077. <https://doi.org/10.1016/j.drugalcdep.2020.108077>
- Patrick, M. E., Terry-McElrath, Y. M., Lee, C. M., & Schulenberg, J. E. (2019). Simultaneous Alcohol and Marijuana Use among Underage Young Adults in the United States. *Addictive Behaviors*, 88, 77–81. <https://doi.org/10.1016/j.addbeh.2018.08.015>
- Perkins, H. W. (2002). Social norms and the prevention of alcohol misuse in collegiate contexts. *Journal of Studies on Alcohol. Supplement*, 14, 164–172. <https://doi.org/10.15288/jsas.2002.s14.164>
- Perkins, H. W., & Berkowitz, A. D. (1986). Perceiving the Community Norms of Alcohol Use among Students: Some Research Implications for Campus Alcohol Education Programming. *International Journal of the Addictions*, 21(9–10), 961–976. <https://doi.org/10.3109/10826088609077249>

- Pritschmann, R. K., Gebru, N. M., Litt, D. M., Zhou, Z., & Lewis, M. A. (2022). Are Drinking Cognitions Associated with Marijuana and Concurrent Alcohol and Marijuana Use among Adolescents and Young Adults? *Cannabis*, 5(1), Article 1.
- R Core Team. (2022). *R: A language and environment for statistical computing* [Computer software]. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Salvatore, J. E., Cho, S. B., & Dick, D. M. (2017). Genes, Environments, and Sex Differences in Alcohol Research. *Journal of Studies on Alcohol and Drugs*, 78(4), 494–501. <https://doi.org/10.15288/jsad.2017.78.494>
- Saunders, J. B., Aasland, O. G., Babor, T. F., de la Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption-II. *Addiction (Abingdon, England)*, 88(6), 791–804. <https://doi.org/10.1111/j.1360-0443.1993.tb02093.x>
- Sokolovsky, A. W., Gunn, R. L., Micalizzi, L., White, H. R., & Jackson, K. M. (2020). Alcohol and marijuana co-use: Consequences, subjective intoxication, and the operationalization of simultaneous use. *Drug and Alcohol Dependence*, 212, 107986. <https://doi.org/10.1016/j.drugalcdep.2020.107986>
- Stone, A. L. (2020). Adolescent Cannabis Use and Perceived Social Norm Trends Pre- and Post-Implementation of Washington State's Liberalized Recreational Cannabis Policy: Healthy Youth Survey, 2008–2018. *Prevention Science*, 21(6), 772–783. <https://doi.org/10.1007/s11121-020-01136-0>
- Subbaraman, M. S., & Kerr, W. C. (2015). Simultaneous Versus Concurrent Use of Alcohol and Cannabis in the National Alcohol Survey. *Alcoholism: Clinical and Experimental Research*, 39(5), 872–879. <https://doi.org/10.1111/acer.12698>

- Waddell, J. T., Gunn, R. L., Corbin, W. R., Borsari, B., & Metrik, J. (2021). Drinking less on cannabis use days: The moderating role of UPPS-P impulsive personality traits. *Psychology of Addictive Behaviors*, 35(6), 737–748. <https://doi.org/10.1037/adb0000727>
- Wardell, J. D., Coelho, S. G., Farrelly, K. N., Fox, N., Cunningham, J. A., O'Connor, R. M., & Hendershot, C. S. (2024). Interactive effects of alcohol and cannabis quantities in the prediction of same-day negative consequences among young adults. *Alcohol, Clinical & Experimental Research*. <https://doi.org/10.1111/acer.15309>
- White, H. R., Kilmer, J. R., Fossos-Wong, N., Hayes, K., Sokolovsky, A. W., & Jackson, K. M. (2019). Simultaneous Alcohol and Marijuana Use Among College Students: Patterns, Correlates, Norms, and Consequences. *Alcoholism, Clinical and Experimental Research*, 43(7), 1545–1555. <https://doi.org/10.1111/acer.14072>
- Winfield-Ward, L., & Hammond, D. (2024). Social Norms for Cannabis Use After Nonmedical Legalization in Canada. *American Journal of Preventive Medicine*, 66(5), 809–818. <https://doi.org/10.1016/j.amepre.2023.12.013>
- Yurasek, A. M., Aston, E. R., & Metrik, J. (2017). Co-use of Alcohol and Cannabis: A Review. *Current Addiction Reports*, 4(2), 184–193. <https://doi.org/10.1007/s40429-017-0149-8>

**Table 1. Sample characteristics (N = 150)**

| Characteristic                                                                                             | <i>n</i> (%)  |
|------------------------------------------------------------------------------------------------------------|---------------|
| Sex <sup>a</sup>                                                                                           |               |
| Male                                                                                                       | 54 (36.00)    |
| Female                                                                                                     | 95 (63.33)    |
| Gender <sup>b</sup>                                                                                        |               |
| Man                                                                                                        | 57 (38.00)    |
| Woman                                                                                                      | 89 (59.33)    |
| Transgender                                                                                                | 2 (1.33)      |
| Nonbinary                                                                                                  | 5 (3.33)      |
| Race/ethnicity <sup>b</sup>                                                                                |               |
| White/Caucasian                                                                                            | 94 (62.67)    |
| Black/African Descent/African                                                                              | 13 (8.67)     |
| Asian                                                                                                      | 24 (16.00)    |
| Pacific Islander                                                                                           | 2 (1.33)      |
| Indigenous/Native North American                                                                           | 1 (0.67)      |
| East Indian                                                                                                | 15 (10.00)    |
| Middle Eastern                                                                                             | 5 (3.33)      |
| Hispanic/Latinx                                                                                            | 7 (4.67)      |
| Other <sup>c</sup>                                                                                         | 6 (4.00)      |
| Prefer not to respond                                                                                      | 2 (1.33)      |
| Annual household income <sup>d</sup>                                                                       |               |
| \$0–\$19,999                                                                                               | 31 (20.67)    |
| \$20,000–\$49,999                                                                                          | 48 (32.00)    |
| \$50,000–\$99,999                                                                                          | 35 (23.33)    |
| \$100,000–\$159,999                                                                                        | 14 (9.33)     |
| \$160,000+                                                                                                 | 20 (13.33)    |
| Highest level of education                                                                                 |               |
| Less than high school, GED, or high school diploma                                                         | 52 (34.67)    |
| Some college, technical certification, or associates degree                                                | 41 (27.33)    |
| Bachelors degree                                                                                           | 54 (36.00)    |
| Masters or doctoral degree                                                                                 | 3 (2.00)      |
| DFAQ-CU current cannabis use frequency <sup>e</sup>                                                        |               |
| 2–3 times a month                                                                                          | 7 (4.67)      |
| Once a week                                                                                                | 21 (14.00)    |
| Twice a week                                                                                               | 33 (22.00)    |
| 3–4 times a week                                                                                           | 34 (22.67)    |
| 5–6 times a week                                                                                           | 14 (9.33)     |
| Once a day                                                                                                 | 28 (18.67)    |
| More than once a day                                                                                       | 13 (8.67)     |
|                                                                                                            | <i>M (SD)</i> |
| Age                                                                                                        | 22.08 (2.10)  |
| CUDIT-R total score                                                                                        | 10.05 (5.38)  |
| AUDIT total score                                                                                          | 8.06 (4.65)   |
| DFAQ-CU grams of cannabis flower used in a typical session                                                 | 0.36 (0.34)   |
| DFAQ-CU grams of cannabis flower used in a typical day                                                     | 0.48 (0.61)   |
| DFAQ-CU grams of cannabis flower used in a typical week                                                    | 2.36 (3.98)   |
| DFAQ-CU number of cannabis use days in the past month                                                      | 15.43 (9.44)  |
| NIAAA number of alcohol use days per month in the past three months                                        | 9.50 (6.02)   |
| NIAAA number of standard drinks per day on a typical alcohol use day in the past three months <sup>a</sup> | 2.79 (1.23)   |

*Note.* CUDIT-R = Cannabis Use Disorder Identification Test; AUDIT = Alcohol Use Disorder Identification Test; DFAQ-CU = Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory; NIAAA = National Institute on Alcohol Abuse and Alcoholism Alcohol Screening Questions; MPT = Marijuana Purchase Task; APT = Alcohol Purchase Task. <sup>a</sup>One participant was missing data; <sup>b</sup>Participants could select more than one option; <sup>c</sup>Participants who selected “other” were subsequently given the option to indicate their race/ethnicity via text entry, however no participants chose to specify their race/ethnicity; <sup>d</sup>Two participants were missing data; <sup>e</sup>No participants reported using cannabis less than 2–3 times a month, and thus lower frequency categories are not included in the table.

**Table 2. Descriptive statistics for items assessing descriptive norms for simultaneous use, cannabis use, and alcohol use**

| Item                                                                                | Peer referent          | Friend referent        |
|-------------------------------------------------------------------------------------|------------------------|------------------------|
|                                                                                     | group<br><i>n</i> (%)  | group<br><i>n</i> (%)  |
| Descriptive norms for simultaneous use frequency                                    |                        |                        |
| Never                                                                               | 2 (1.33)               | 5 (3.33)               |
| Less than once per month                                                            | 20 (13.33)             | 16 (10.67)             |
| Once a month                                                                        | 29 (19.33)             | 20 (13.33)             |
| Two times a month                                                                   | 30 (20.00)             | 30 (20.00)             |
| Three times a month                                                                 | 22 (14.67)             | 29 (19.33)             |
| Once a week                                                                         | 24 (16.00)             | 19 (12.67)             |
| Two times a week                                                                    | 14 (9.33)              | 21 (14.00)             |
| Three times a week                                                                  | 4 (2.67)               | 3 (2.00)               |
| Four times a week                                                                   | 3 (2.00)               | 3 (2.00)               |
| Five times a week                                                                   | 2 (1.33)               | 4 (2.67)               |
| Six times a week                                                                    | 0 (0.00)               | 0 (0.00)               |
| Everyday                                                                            | 0 (0.00)               | 0 (0.00)               |
| Descriptive norms for cannabis use frequency                                        |                        |                        |
| Never                                                                               | 1 (0.67)               | 0 (0.00)               |
| Less than once per month                                                            | 8 (5.33)               | 5 (3.33)               |
| Once a month                                                                        | 9 (6.00)               | 7 (4.67)               |
| Two times a month                                                                   | 12 (8.00)              | 11 (7.33)              |
| Three times a month                                                                 | 17 (11.33)             | 11 (7.33)              |
| Once a week                                                                         | 27 (18.00)             | 21 (14.00)             |
| Two times a week                                                                    | 29 (19.33)             | 25 (16.67)             |
| Three times a week                                                                  | 25 (16.67)             | 19 (12.67)             |
| Four times a week                                                                   | 8 (5.33)               | 15 (10.00)             |
| Five times a week                                                                   | 8 (5.33)               | 13 (8.67)              |
| Six times a week                                                                    | 1 (0.67)               | 0 (0.00)               |
| Everyday                                                                            | 5 (3.33)               | 23 (15.33)             |
| Descriptive norms for alcohol use frequency                                         |                        |                        |
| Never                                                                               | 0 (0.00)               | 0 (0.00)               |
| Less than once per month                                                            | 0 (0.00)               | 2 (1.33)               |
| Once a month                                                                        | 0 (0.00)               | 0 (0.00)               |
| Two times a month                                                                   | 3 (2.00)               | 3 (2.00)               |
| Three times a month                                                                 | 13 (8.67)              | 15 (10.00)             |
| Once a week                                                                         | 30 (2.00)              | 30 (20.00)             |
| Two times a week                                                                    | 59 (39.33)             | 52 (34.67)             |
| Three times a week                                                                  | 31 (20.67)             | 30 (20.00)             |
| Four times a week                                                                   | 7 (4.67)               | 14 (9.33)              |
| Five times a week                                                                   | 4 (2.67)               | 3 (2.00)               |
| Six times a week                                                                    | 0 (0.00)               | 0 (0.00)               |
| Everyday                                                                            | 3 (2.00)               | 1 (0.67)               |
|                                                                                     | <i>M</i> ( <i>SD</i> ) | <i>M</i> ( <i>SD</i> ) |
| Descriptive norms for cannabis consumption during simultaneous use (grams)          | 0.52 (0.61)            | 0.56 (0.62)            |
| Descriptive norms for cannabis consumption in general (grams)                       | 0.58 (0.53)            | 0.68 (0.69)            |
| Descriptive norms for alcohol consumption during simultaneous use (standard drinks) | 3.49 (1.54)            | 3.81 (1.99)            |
| Descriptive norms for alcohol consumption in general (standard drinks)              | 3.93 (1.93)            | 4.31 (2.28)            |

*Note.* *M* = mean; *SD* = standard deviation. Descriptive norms for alcohol use and cannabis use frequency represent normative perceptions of the use of each substance in general, not limited to simultaneous use days.

**Table 3. Zero-order correlations among descriptive norms variables**

|                                                | 1.      | 2.      | 3.      | 4.      | 5.      | 6.      | 7.      | 8.      | 9.      | 10.     | 11.     | 12.  | 13.     | 14. |
|------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|---------|-----|
| 1. DN for SU frequency (P)                     |         |         |         |         |         |         |         |         |         |         |         |      |         |     |
| 2. DN for cannabis frequency (P)               | 0.54*** |         |         |         |         |         |         |         |         |         |         |      |         |     |
| 3. DN for alcohol frequency (P)                | 0.28*** | 0.16    |         |         |         |         |         |         |         |         |         |      |         |     |
| 4. DN for cannabis consumption during SU (P)   | 0.24**  | 0.31*** | -0.03   |         |         |         |         |         |         |         |         |      |         |     |
| 5. DN for cannabis consumption in general (P)  | 0.37*** | 0.49*** | 0.17*   | 0.60*** |         |         |         |         |         |         |         |      |         |     |
| 6. DN for alcohol consumption during SU (P)    | 0.02    | 0.14    | -0.11   | 0.26**  | 0.06    |         |         |         |         |         |         |      |         |     |
| 7. DN for alcohol consumption in general (P)   | 0.05    | 0.13    | 0.09    | 0.18*   | 0.16*   | 0.60*** |         |         |         |         |         |      |         |     |
| 8. DN for SU frequency (F)                     | 0.58*** | 0.33*** | 0.24**  | 0.26**  | 0.24**  | 0.09    | 0.13    |         |         |         |         |      |         |     |
| 9. DN for cannabis frequency (F)               | 0.23**  | 0.44*** | 0.16    | 0.18*   | 0.22**  | 0.17*   | 0.35*** | 0.46*** |         |         |         |      |         |     |
| 10. DN for alcohol frequency (F)               | 0.11    | 0.2*    | 0.41*** | -0.05   | 0.13    | -0.08   | -0.05   | 0.29*** | 0.13    |         |         |      |         |     |
| 11. DN for cannabis consumption during SU (F)  | 0.23**  | 0.27**  | -0.01   | 0.82*** | 0.51*** | 0.24**  | 0.21**  | 0.33*** | 0.35*** | 0.08    |         |      |         |     |
| 12. DN for cannabis consumption in general (F) | 0.34*** | 0.24**  | 0.20*   | 0.44*** | 0.56*** | 0.04    | 0.16*   | 0.35*** | 0.36*** | 0.30*** | 0.54*** |      |         |     |
| 13. DN for alcohol consumption during SU (F)   | 0.00    | 0.08    | -0.04   | 0.13    | -0.03   | 0.66*** | 0.62*** | 0.23*   | 0.30*** | 0.03    | 0.23**  | 0.05 |         |     |
| 14. DN for alcohol consumption in general (F)  | -0.01   | 0.14    | 0.00    | 0.29*** | 0.15    | 0.49*** | 0.84*** | 0.14    | 0.33*** | -0.01   | 0.34*** | 0.16 | 0.66*** |     |

*Note.* SU = simultaneous use of alcohol and cannabis; DN = descriptive norms; P = peer (typical person of the same age and gender) as the referent group; F = friends (of the same gender) as the referent group.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 4. Within-person differences in descriptive norms for frequency of use and quantities consumed as a function of simultaneous use relative to cannabis use and alcohol use**

|                                                         | Peer referent group |             |                 | Friend referent group |             |                 |
|---------------------------------------------------------|---------------------|-------------|-----------------|-----------------------|-------------|-----------------|
|                                                         | Estimate            | SE          | p               | Estimate              | SE          | p               |
| DV: Descriptive norms for frequency of use <sup>a</sup> |                     |             |                 |                       |             |                 |
| Cannabis use vs. simultaneous use [ref.]                | <b>1.90</b>         | <b>0.18</b> | <b>&lt;.001</b> | <b>2.73</b>           | <b>0.21</b> | <b>&lt;.001</b> |
| Alcohol use vs. simultaneous use [ref.]                 | <b>2.51</b>         | <b>0.18</b> | <b>&lt;.001</b> | <b>2.19</b>           | <b>0.21</b> | <b>&lt;.001</b> |
| DV: Descriptive norms for cannabis flower consumption   |                     |             |                 |                       |             |                 |
| Cannabis use vs. simultaneous use [ref.]                | 0.05                | 0.04        | .192            | <b>0.13</b>           | <b>0.05</b> | <b>.014</b>     |
| DV: Descriptive norms for alcohol consumption           |                     |             |                 |                       |             |                 |
| Alcohol use vs. simultaneous use [ref.]                 | <b>0.44</b>         | <b>0.13</b> | <b>.001</b>     | <b>0.49</b>           | <b>0.15</b> | <b>.001</b>     |

*Note.* SE = standard error; ref. = referent category; DV = dependent variable. Descriptive norms for alcohol use and cannabis use occasions represent normative perceptions of the use of each substance in general, not limited to simultaneous use. Bolding indicates statistical significance at  $\alpha = 0.05$ .

<sup>a</sup>Frequency of use coded as 1 = *never*, 2 = *less than once per month*, 3 = *once a month*, 4 = *two times a month*, 5 = *three times a month*, 6 = *once a week*, 7 = *two times a week*, 8 = *three times a week*, 9 = *four times a week*, 10 = *five times a week*, 11 = *six times a week*, 12 = *everyday*. Bolding indicates statistical significance at  $\alpha = 0.05$ .

**Table 5. Associations of descriptive norms for simultaneous use frequency with propensity for simultaneous use days compared to non-use days, cannabis-only use days, and alcohol-only use days**

|                                                  | Peer referent group |          |      |          | Friend referent group |              |             |              |
|--------------------------------------------------|---------------------|----------|------|----------|-----------------------|--------------|-------------|--------------|
|                                                  | OR                  | Estimate | SE   | <i>p</i> | OR                    | Estimate     | SE          | <i>p</i>     |
| Non-use vs. simultaneous use [ref.]              |                     |          |      |          |                       |              |             |              |
| Descriptive norms for simultaneous use frequency | 0.93                | -0.07    | 0.12 | 0.546    | 0.94                  | -0.07        | 0.11        | 0.542        |
| Descriptive norms for cannabis use frequency     | 0.98                | -0.02    | 0.09 | 0.829    | <b>0.85</b>           | <b>-0.17</b> | <b>0.08</b> | <b>0.029</b> |
| Descriptive norms for alcohol use frequency      | 0.80                | -0.22    | 0.16 | 0.164    | 0.81                  | -0.21        | 0.14        | 0.114        |
| Proportion weekend days                          | 1.98                | 0.68     | 4.54 | 0.880    | 3.21                  | 1.17         | 4.49        | 0.795        |
| Age                                              | 0.97                | -0.03    | 0.09 | 0.728    | 0.95                  | -0.05        | 0.09        | 0.564        |
| Sex (0 = male, 1 = female)                       | 1.25                | 0.22     | 0.40 | 0.575    | 1.11                  | 0.11         | 0.37        | 0.777        |
| Alcohol-only use vs. simultaneous use [ref.]     |                     |          |      |          |                       |              |             |              |
| Descriptive norms for simultaneous use frequency | 0.96                | -0.05    | 0.11 | 0.689    | 0.95                  | -0.05        | 0.10        | 0.572        |
| Descriptive norms for cannabis use frequency     | 0.95                | -0.05    | 0.08 | 0.530    | 0.88                  | -0.12        | 0.07        | 0.085        |
| Descriptive norms for alcohol use frequency      | 1.08                | 0.08     | 0.16 | 0.628    | 1.19                  | 0.18         | 0.15        | 0.251        |
| Proportion weekend days                          | 2.76                | 1.02     | 4.75 | 0.830    | 2.38                  | 0.87         | 4.75        | 0.855        |
| Age                                              | 1.07                | 0.07     | 0.09 | 0.425    | 1.04                  | 0.04         | 0.09        | 0.683        |
| Sex (0 = male, 1 = female)                       | 1.78                | 0.58     | 0.41 | 0.156    | 1.68                  | 0.52         | 0.38        | 0.171        |
| Cannabis-only use vs. simultaneous use [ref.]    |                     |          |      |          |                       |              |             |              |
| Descriptive norms for simultaneous use frequency | 0.87                | -0.14    | 0.10 | 0.144    | <b>0.78</b>           | <b>-0.25</b> | <b>0.08</b> | <b>0.002</b> |
| Descriptive norms for cannabis use frequency     | 1.05                | 0.05     | 0.07 | 0.426    | <b>1.15</b>           | <b>0.14</b>  | <b>0.06</b> | <b>0.022</b> |
| Descriptive norms for alcohol use frequency      | 0.96                | -0.04    | 0.13 | 0.773    | 0.83                  | -0.19        | 0.10        | 0.062        |
| Proportion weekend days                          | 0.07                | -2.70    | 3.85 | 0.484    | 0.21                  | -1.58        | 3.56        | 0.656        |
| Age                                              | 0.92                | -0.08    | 0.07 | 0.278    | 0.94                  | -0.06        | 0.07        | 0.375        |
| Sex (0 = male, 1 = female)                       | 1.55                | 0.44     | 0.33 | 0.182    | 1.20                  | 0.19         | 0.28        | 0.512        |

*Note.* OR = odds ratio; *SE* = standard error; ref. = referent category. Descriptive norms for alcohol use and cannabis use frequency represent normative perceptions of the use of each substance in general, not limited to simultaneous use days. The outcome in this model was a categorical variable with four categories: non-use day, alcohol-only use day, cannabis-only use day, and simultaneous use day (referent category). All continuous independent variables were grand-mean centered. One participant was excluded from the model due to missing data on sex. Bolding indicates statistical significance at  $\alpha = 0.05$ .

**Table 6. Associations of descriptive norms for consumption during simultaneous use with consumption on simultaneous use days**

|                                                                           | Peer referent group |              |             |                 | Friend referent group |              |             |                 |
|---------------------------------------------------------------------------|---------------------|--------------|-------------|-----------------|-----------------------|--------------|-------------|-----------------|
|                                                                           | RR                  | Estimate     | SE          | p               | RR                    | Estimate     | SE          | p               |
| DV: Grams of cannabis flower consumed on simultaneous use days            |                     |              |             |                 |                       |              |             |                 |
| Descriptive norms for grams of cannabis consumed during simultaneous use  | —                   | 0.19         | 0.11        | .075            | —                     | <b>0.31</b>  | <b>0.10</b> | <b>.002</b>     |
| Descriptive norms for grams of cannabis consumed in general               | —                   | <b>0.49</b>  | <b>0.11</b> | <b>&lt;.001</b> | —                     | <b>0.18</b>  | <b>0.09</b> | <b>.049</b>     |
| Person-mean standard drinks consumed on simultaneous use days             | —                   | <b>0.05</b>  | <b>0.02</b> | <b>.032</b>     | —                     | <b>0.05</b>  | <b>0.02</b> | <b>.038</b>     |
| Proportion of simultaneous use days that involved non-flower cannabis use | —                   | <b>-0.35</b> | <b>0.12</b> | <b>.004</b>     | —                     | <b>-0.50</b> | <b>0.13</b> | <b>&lt;.001</b> |
| Proportion of simultaneous use days that were weekend days                | —                   | -0.13        | 0.16        | .427            | —                     | -0.09        | 0.17        | .601            |
| Age                                                                       | —                   | 0.03         | 0.02        | .184            | —                     | 0.02         | 0.03        | .505            |
| Sex (0 = male, 1 = female)                                                | —                   | -0.07        | 0.11        | .528            | —                     | -0.06        | 0.12        | .620            |
| DV: Number of standard drinks consumed on simultaneous use days           |                     |              |             |                 |                       |              |             |                 |
| Descriptive norms for standard drinks consumed during simultaneous use    | 1.07                | 0.06         | 0.04        | .108            | <b>1.08</b>           | <b>0.08</b>  | <b>0.03</b> | <b>.014</b>     |
| Descriptive norms for standard drinks consumed in general                 | 1.01                | 0.01         | 0.03        | .837            | 1.01                  | 0.01         | 0.03        | .781            |
| Person-mean grams of cannabis flower used on simultaneous use days        | <b>1.28</b>         | <b>0.24</b>  | <b>0.08</b> | <b>.003</b>     | <b>1.28</b>           | <b>0.24</b>  | <b>0.08</b> | <b>.001</b>     |
| Proportion of simultaneous use days that were weekend days                | 1.30                | 0.27         | 0.17        | .127            | 1.31                  | 0.27         | 0.17        | .110            |
| Age                                                                       | <b>0.94</b>         | <b>-0.06</b> | <b>0.03</b> | <b>.016</b>     | <b>0.94</b>           | <b>-0.06</b> | <b>0.02</b> | <b>.014</b>     |
| Sex (0 = male, 1 = female)                                                | 0.87                | -0.14        | 0.11        | .220            | 0.92                  | -0.08        | 0.11        | .470            |

*Note.* RR = rate ratio; SE = standard error; DV = dependent variable. All continuous independent variables were grand-mean centered. The model included the 428 daily surveys in which co-use was reported, and consequently, the  $n = 103$  participants who reported one or more co-use days. Models further excluded one participant who was missing data on sex. Bolding indicates statistical significance at  $\alpha = 0.05$ .

## SUPPLEMENTARY MATERIALS

### Descriptive Norms Questions

#### Descriptive Norms for Alcohol Use (Peer Referent Group)

How often do you think a typical person with your gender and age consumes alcohol?

- Never
- Less than once per month
- Once a month
- Two times a month
- Three times a month
- Once a week
- Two times a week
- Three times a week
- Four times a week
- Five times a week
- Six times a week
- Everyday

How many drinks on average do you think a typical person with your gender and age consumes on a given occasion?

- 0 drinks
- 1 drink
- 2 drinks
- 3 drinks
- 4 drinks
- 5 drinks
- 6 drinks
- 7 drinks
- 8 drinks
- 9 drinks
- 10 drinks
- 11 drinks
- 12 drinks
- 13 drinks
- 14 drinks
- 15 drinks
- 16 drinks
- 17 drinks
- 18 drinks
- 19 drinks
- 20 drinks
- 21 drinks
- 22 drinks
- 23 drinks
- 24 drinks

- 25 or more drinks

### **Descriptive Norms for Alcohol Use (Friend Referent Group)**

How often do you think your friends of the same gender consume alcohol?

- Never
- Less than once per month
- Once a month
- Two times a month
- Three times a month
- Once a week
- Two times a week
- Three times a week
- Four times a week
- Five times a week
- Six times a week
- Everyday

How many drinks on average do you think your friends of the same gender consume on a given occasion?

- 0 drinks
- 1 drink
- 2 drinks
- 3 drinks
- 4 drinks
- 5 drinks
- 6 drinks
- 7 drinks
- 8 drinks
- 9 drinks
- 10 drinks
- 11 drinks
- 12 drinks
- 13 drinks
- 14 drinks
- 15 drinks
- 16 drinks
- 17 drinks
- 18 drinks
- 19 drinks
- 20 drinks
- 21 drinks
- 22 drinks
- 23 drinks
- 24 drinks
- 25 or more drinks

### **Descriptive Norms for Cannabis Use (Peer Referent Group)**

How often do you think a typical person with your gender and age uses cannabis?

- Never
- Less than once per month
- Once a month
- Two times a month
- Three times a month
- Once a week
- Two times a week
- Three times a week
- Four times a week
- Five times a week
- Six times a week
- Everyday

How many grams of cannabis, on average, do you think a typical person with your gender and age consumes on a given occasion?

- None/no marijuana use
- Less than 1/8 of a gram (0.125 g) - e.g., one or two hits
- 1/8 of a gram (0.125 g)
- 1/4 of a gram (0.25 g)
- 1/2 of a gram (0.5 g)
- 3/4 of a gram (0.75)
- 1 gram
- 1.25 grams
- 1.5 grams
- 1.75 grams
- 2 grams
- 2.1 grams to 3.5 grams (1/8 ounce)
- 3.6 grams to 7 grams (1/4 ounce)
- 7.1 grams to 14 grams (1/2 ounce)
- 14.1 grams to 21 grams (3/4 ounce)
- 21.1 grams to 28 grams (1 ounce)
- More than 28 grams (more than 1 ounce)

### **Descriptive Norms for Cannabis Use (Friend Referent Group)**

How often do you think your friends of the same gender use cannabis?

- Never
- Less than once per month
- Once a month
- Two times a month
- Three times a month
- Once a week
- Two times a week
- Three times a week
- Four times a week

- Five times a week
- Six times a week
- Everyday

How many grams of cannabis, on average, do you think your friends of the same gender consume on a given occasion?

- None/no marijuana use
- Less than 1/8 of a gram (0.125 g) - e.g., one or two hits
- 1/8 of a gram (0.125 g)
- 1/4 of a gram (0.25 g)
- 1/2 of a gram (0.5 g)
- 3/4 of a gram (0.75)
- 1 gram
- 1.25 grams
- 1.5 grams
- 1.75 grams
- 2 grams
- 2.1 grams to 3.5 grams (1/8 ounce)
- 3.6 grams to 7 grams (1/4 ounce)
- 7.1 grams to 14 grams (1/2 ounce)
- 14.1 grams to 21 grams (3/4 ounce)
- 21.1 grams to 28 grams (1 ounce)
- More than 28 grams (more than 1 ounce)

### **Descriptive Norms for Simultaneous use of Alcohol and Cannabis (Peer Referent Group)**

How often do you think a typical person with your gender and age uses cannabis and alcohol together (so that their effects overlap)?

- Never
- Less than once per month
- Once a month
- Two times a month
- Three times a month
- Once a week
- Two times a week
- Three times a week
- Four times a week
- Five times a week
- Six times a week
- Everyday

How many drinks on average do you think a typical person with your gender and age consumes on a given occasion when they are using cannabis and alcohol together?

- 0 drinks
- 1 drink
- 2 drinks
- 3 drinks

- 4 drinks
- 5 drinks
- 6 drinks
- 7 drinks
- 8 drinks
- 9 drinks
- 10 drinks
- 11 drinks
- 12 drinks
- 13 drinks
- 14 drinks
- 15 drinks
- 16 drinks
- 17 drinks
- 18 drinks
- 19 drinks
- 20 drinks
- 21 drinks
- 22 drinks
- 23 drinks
- 24 drinks
- 25 or more drinks

How many grams of cannabis, on average, do you think a typical person with your gender and age consumes on a given occasion when they are using cannabis and alcohol together?

- None/no marijuana use
- Less than 1/8 of a gram (0.125 g) - e.g., one or two hits
- 1/8 of a gram (0.125 g)
- 1/4 of a gram (0.25 g)
- 1/2 of a gram (0.5 g)
- 3/4 of a gram (0.75)
- 1 gram
- 1.25 grams
- 1.5 grams
- 1.75 grams
- 2 grams
- 2.1 grams to 3.5 grams (1/8 ounce)
- 3.6 grams to 7 grams (1/4 ounce)
- 7.1 grams to 14 grams (1/2 ounce)
- 14.1 grams to 21 grams (3/4 ounce)
- 21.1 grams to 28 grams (1 ounce)
- More than 28 grams (more than 1 ounce)

### **Descriptive Norms for Simultaneous use of Alcohol and Cannabis (Friend Referent Group)**

How often do you think your friends of the same gender use cannabis and alcohol together (so that their effects overlap)?

- Never
- Less than once per month
- Once a month
- Two times a month
- Three times a month
- Once a week
- Two times a week
- Three times a week
- Four times a week
- Five times a week
- Six times a week
- Everyday

How many drinks on average to you think your friends of the same gender consume on a given occasion when they are using cannabis and alcohol together?

- 0 drinks
- 1 drink
- 2 drinks
- 3 drinks
- 4 drinks
- 5 drinks
- 6 drinks
- 7 drinks
- 8 drinks
- 9 drinks
- 10 drinks
- 11 drinks
- 12 drinks
- 13 drinks
- 14 drinks
- 15 drinks
- 16 drinks
- 17 drinks
- 18 drinks
- 19 drinks
- 20 drinks
- 21 drinks
- 22 drinks
- 23 drinks
- 24 drinks
- 25 or more drinks

How many grams of cannabis, on average, do you think your friends of the same gender consume on a given occasion when they are using cannabis and alcohol together?

- None/no marijuana use
- Less than 1/8 of a gram (0.125 g) - e.g., one or two hits
- 1/8 of a gram (0.125 g)

- 1/4 of a gram (0.25 g)
- 1/2 of a gram (0.5 g)
- 3/4 of a gram (0.75)
- 1 gram
- 1.25 grams
- 1.5 grams
- 1.75 grams
- 2 grams
- 2.1 grams to 3.5 grams (1/8 ounce)
- 3.6 grams to 7 grams (1/4 ounce)
- 7.1 grams to 14 grams (1/2 ounce)
- 14.1 grams to 21 grams (3/4 ounce)
- 21.1 grams to 28 grams (1 ounce)
- More than 28