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Drinking Motives and Drinking Consequences across Days: Differences and Similarities between Moderate, Binge, and High-Intensity Drinking

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Abstract

Background: The current study examined the extent to which within-person variation in drinking motives differentiates moderate, binge, and high-intensity drinking; and independent associations of motives and drinking intensity with alcohol use consequences in a sample of young adult drinkers from across the U.S.

Methods: Participants were past 30-day drinkers in the U.S. nationally-representative Monitoring the Future 12th grade sample in 2018, who also reported alcohol use during a 14-day data collection burst one year later (N=484 people, mean age 19.3 [SD 0.40], 43% female; N=1,042 drinking days) as part of the Young Adult Daily Life Study in 2019. Weighted multi-level modeling estimated within- and between-person associations of drinking motives, drinking intensity (i.e., moderate [women 1–3, men 1–4 drinks], binge [women 4–7, men 5–9 drinks], and high-intensity drinking [women 8+, men 10+ drinks]), and number of positive and negative alcohol consequences.

Results: On days participants reported greater enhancement and social motives, they were more likely to engage in high-intensity (vs. binge) drinking, binge (vs. moderate) drinking, and experience more positive alcohol consequences. On days participants reported greater enhancement and coping motives, they experienced more negative alcohol consequences. Binge (vs. moderate) drinking on a given day was associated with more positive and negative alcohol consequences; high-intensity (vs. binge) drinking on a given day was associated with more negative alcohol consequences that day. Moderation analyses indicated social motives were associated with high-intensity (vs. binge) drinking only among college students.

Conclusions: Stronger drinking motives on a given day were associated with drinking intensity (enhancement and social motives) and negative consequences (enhancement and coping). High-intensity (vs. binge or moderate) drinking was associated with more negative consequences but not more positive consequences. Results underscore that high-intensity drinking and consequences vary across days and time-varying, occasion-specific risks such as current motivational context are appropriate targets for intervention.

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Keywords

high-intensity drinking; drinking motives; alcohol use consequences; multi-level modeling; young adult

Introduction

The public health consequences of alcohol misuse are a global concern (World Health Organization, 2002; 2005), and the likelihood of negative alcohol-related consequences increases with consumption level (Hingson & White, 2013). Binge drinking (defined as 4+ drinks for women/5+ drinks for men) is associated with increased risk of health and economic consequences (Centers for Disease Control and Prevention, 2019). High-intensity drinking (sometimes called extreme binge drinking; Patrick et al., 2013) has been defined as drinking at twice the level of a binge: 10+ drinks using a universal threshold, or sex-specific drink thresholds of 8+ for women and 10+ for men (Patrick, 2016). High-intensity drinking is most prevalent during young adulthood (Patrick et al., 2016b, 2017a; Patrick & Terry-McElrath, 2019; Schulenberg et al., 2020). Individuals who drink at high-intensity levels have greater likelihoods of reporting negative outcomes than either non-binge or binge drinkers (Patrick et al., in press; Read et al 2008; White et al., 2016). Such research emphasizes high-intensity drinkers as different people with potentially different average drinking motives and sociodemographic characteristics than those who drink less. However, high-intensity drinking also varies within-people, across days, and is associated with positive and negative alcohol use consequences on those days (Patrick et al., 2016a). For example, controlling for between-person differences, there was an almost three-fold increase in blackout likelihood during high-intensity versus binge drinking events among college students (Merrill et al., 2019). To the degree that high-intensity drinking is an event-specific behavior, the ability to identify event-level risk factors is a key challenge for building real-time interventions to reduce harm.

Drinking motives are one of the most proximal risk factors for alcohol use (Ham & Hope, 2003; Cooper, 1994). Cooper's (1994) model of drinking motives includes four dimensions: enhancement, social, coping, and conformity (Cooper, 1994; Cox & Klinger 1988; Merrill & Read, 2010). Social motives are most prevalent among young adult drinkers, followed by enhancement motives; fewer individuals endorsing coping motives (Kuntsche et al., 2005). Conformity motives are less relevant among young adults than adolescents (Hussong, 2003).

When examined as person-level characteristics, drinking motives are consistently related to alcohol consumption level and consequences (Ham & Hope, 2003; Kuntsche et al., 2005). That is, reasons individuals give for drinking—outcomes desired, needs and functions served—differentiate drinking patterns between people (Cooper 1994; Kuntsche et al., 2005). Between-person analyses have examined alcohol quantity/frequency associations for enhancement (Anthenien et al., 2017; Cooper, 1994; Hussong, 2003; Read et al., 2003), social (Bradizza et al, 1999; Cooper, 1994; Hussong, 2003), and coping motives (Cooper, 1994; Dyer et al., 2019; Hussong, 2003; Patrick et al., 2011, 2017a; Terry-McElrath et al., 2017; White et al., 2016). Enhancement motives are particularly associated with heavy

drinking (Hussong, 2003; Kuntsche et al., 2005; Laghi et al., 2019)—including high-intensity drinking (White et al., 2016)—and negative outcomes (Merrill & Read, 2010). Social motives were associated with high-intensity drinking among college students (White et al., 2016). Some studies have found direct associations for coping motives with increased risk of high-intensity drinking (e.g., Terry-McElrath et al., 2017; White et al., 2016); others indicate coping motives are associated with negative alcohol consequences but not consumption (Anthenien et al., 2017; Kuntsche et al., 2005; Laghi et al., 2019; Merrill & Read, 2010; Read et al., 2003). Several studies indicate no association between conformity motives and alcohol use among young adults (Laghi et al., 2019; Merrill & Read, 2010; Terry-McElrath et al., 2017; White et al., 2016).

Although drinking motives show high rank-order stability over time (Windle & Windle, 2018), they vary meaningfully within individuals across age (Patrick et al., 2011; Patrick & Schulenberg, 2011) and drinking days (Patrick et al., 2019, 2020). Within-person drinking motive variability has been associated with differential young adult alcohol use. Among college students, greater enhancement (Stevenson et al., 2019), social (Hamilton et al., 2020) and coping (Dvorak et al., 2014; Hamilton et al., 2020) motives were associated with the number of drinks consumed on drinking days. In related research among college students, days characterized by greater positive and negative expectancies were associated with high-intensity drinking (vs. drinking at less than high-intensity levels), which was associated with more positive and negative drinking consequences (Patrick et al., 2016a). Among young adults in general, stronger enhancement motives have been associated with any drinking on particular days (O'Donnell et al., 2019), and stronger enhancement and social motives have been associated with number of drinks consumed across drinking days (Patrick et al., 2019). These studies have not examined if time-varying drinking motives differentiate the likelihood of binge versus high-intensity drinking and related consequences on a particular drinking day. To the degree that high-intensity drinking varies within persons, understanding drinking motives for high-intensity drinking on a given day may be particularly critical for informing real-time interventions.

Many studies of time-varying drinking and motives across days include only college students; less is known about young adults not in a 4-year college context, or regarding differences by sex. Four-year college environments are associated with more peer-centered socializing opportunities which may increase the relevance of enhancement and social motives, in particular. High-intensity drinking frequency increases after high school only among college attenders (Patrick et al., 2016b), and binge drinking is more prevalent among 4-year college attenders than other young adults (Patrick & Terry-McElrath, 2017; Schulenberg et al, 2020). Yet, young adults who are not attending 4-year colleges also engage in these behaviors: over one-fifth (22%) of young adults not attending 4-year colleges full-time report binge drinking (vs. 33% of full-time 4-year college students), and high-intensity drinking prevalence is similar (10% for full-time 4-year students vs. 12% for other young adults; Schulenberg et al, 2020). The current study examined college status as a predictor of high-intensity drinking and consequences, and a moderator of time-varying drinking motives. Furthermore, differences in associations by sex were examined. Although previous analyses have found few significant sex interactions in associations between motives and alcohol use (Bradizza et al., 1999; Dvorak et al., 2014; Patrick et al., 2019),

high-intensity drinking is more prevalent among men than women (Patrick et al., 2017b, 2017c; Patrick & Terry-McElrath, 2019; Terry-McElrath & Patrick, 2020).

Using data from U.S. young adult drinkers one year after high school, the current study examined (1) if drinking motives on a given day differentiated the likelihood of moderate, binge, or high-intensity drinking that day; (2) if drinking motives and drinking intensity on a given day were associated with the total number of positive and negative alcohol consequences that day; and (3) if these daily associations were moderated by college status or sex.

Materials and Methods

Participants

The current study used data collected in 2019 through the Young Adult Daily Life (YADL) Study following adolescent alcohol users across the transition to adulthood. YADL participants were drawn from the 14,502 U.S. nationally-representative 12th grade students who participated in the Monitoring the Future (MTF) study in Spring 2018 (for detailed methodology information on the 12th grade study, see Miech et al., 2019). To be eligible for YADL, participants had to report past 30-day alcohol use in 12th grade. Of the 4,240 MTF respondents who reported past 30-day drinking, 828 were excluded because they were randomly selected for participation in the MTF longitudinal study (for detailed longitudinal study methods, see Schulenberg et al., 2020), and 1,208 were excluded for not providing contact information necessary for follow-up, leaving 2,204 individuals eligible to participate in YADL.

In December 2018, all 2,204 eligible participants were sent a newsletter, followed by mail and email invitations to YADL in May 2019. Year 1 of YADL included a 30-minute annual survey and 14 consecutive 5–7 minute daily surveys all completed online; data were collected from the end of May through July 2019. Email, text message, mailed postcard, and phone call reminders were used. Respondents could receive up to $100 in Year 1. The study was approved by a University of Michigan Institutional Review Board. Out of the 2,204 individuals eligible to participate, 911 (41.3%) consented to participate in 2019; 16 respondents (0.7%) refused. Mean age at time of data collection was 19.3 years [SD 0.40].

Bivariate analyses examining high school characteristics associated with YADL participation showed that, of the 2,204 eligible individuals, participants were significantly more likely to be female (vs. male; $p<0.001$), report having two parents in the household (vs. fewer; $p<0.001$); reside in the Northeast (vs. other regions; $p=0.014$); have grades of B- or above (vs. C+ or below; $p=0.004$); definitely plan on graduating from a 4-year college (vs. not; $p<0.001$); report no binge drinking (vs. binge drinking; $p=0.030$); and have lower past 30-day drinking frequency ($p<0.001$) in 12th grade. No significant differences were found based on race/ethnicity (Black, White, Hispanic, other), average parental education, religiosity or truancy in 12th grade. This information was used to construct participation weights used in analyses (described below).

Most annual survey completers (769 out of 911; 84.4%) completed at least one daily survey. Among those with any daily surveys, over three-quarters (78.2%) completed at least 11 of 14 and the majority (60.1%) completed all 14. As the current research questions pertained to alcohol use days, participants reporting at least one alcohol use day (63.3%, n=487) were retained for analysis; 3 of these participants were excluded because of missing drinking motive data. The final analytic sample included 484 participants and 1,042 drinking days (mean drinking days per respondent = 2.15 [SD 1.64]; range 1–13).

Measures

Annual survey.—*College status* was coded as attending full-time at a 4-year college versus other. (This dichotomy was used because 74.8% of unweighted drinking days were from full-time 4-year attenders [71.9% of the sample]; there was not enough variability to model drinking separately by 2-year, community college, or vocational-technical school attenders [17.1% of the sample; 16.3% of drinking days] and non-attenders [11.0% of the sample; 8.9% of drinking days.]) Biological *sex* at birth was coded as female or male. Separate items measured ethnicity (identification as Hispanic or Latino/a) and race (Asian or South Asian; Native Hawaiian or other Pacific Islander; Black or African American; American Indian or Alaska Native; White; Arab, Middle Eastern or North African; or Other). Due to limited sample sizes, *race/ethnicity* was recoded for analysis as a trichotomy indicating Hispanic, non-Hispanic White, or non-Hispanic Other (including multiracial).

Daily surveys.—If respondents reported any alcohol use on a given day, they were asked how many total drinks they had (response options of 1–25+ drinks). *Drinking intensity* on a given day was coded using sex-specific thresholds: moderate drinking (1–4 drinks for women/1–5 drinks for men), binge but not high-intensity drinking (4–7 drinks for women/5–9 drinks for men; hereafter referred to simply as binge drinking), or high-intensity drinking (8+ drinks for women/10+ drinks for men; Patrick, 2016).

Daily drinking motives were measured using 13 items answering the question “Why did you drink on [day]?” using response options of no (0), somewhat (1), or definitely (2) (as in Hamilton et al., 2020; O’Hara et al., 2015) adapted for daily use from the Drinking Motives Questionnaire (Cooper, 1994; Grant et al., 2007). Subscales were calculated as the mean for each day (see Table 1) and included *enhancement* (2 items, α=0.62, M=1.12 [SE=0.03]: because I liked the feeling; to have fun), *social* (2 items, α=0.86, M=0.64 [SE 0.04]: to improve a party/gathering; to make a party/gathering more fun), and *coping* (7 items, α=0.83, M=0.17 [SE 0.02]: to avoid dealing with my ongoing problems; to feel less depressed; to cheer up; to forget my ongoing problems/worries; to feel more confident/sure of myself; to feel less nervous; because I was angry). A fourth conformity scale was excluded because of very low endorsement in this sample of young adult drinkers (2 items, because my friends pressured me [M=0.07, SE 0.01]; to fit in with a group I like [M=0.11, SE 0.02]).

Drinking consequences were measured each day using 16 items answering the question, “Did any of the following things happen to you as a result of your drinking on [day]?” with yes/no response options. Thirteen items were obtained from the Daily Alcohol-Related

Consequences and Evaluations (DACE) Measure for Young Adults (Lee et al., 2017); three additional items were adapted for daily use from the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler et al., 2005, 2008). *Negative consequences* were coded as the sum of the following 10 consequences: I had a hangover, I became aggressive, I hurt or injured myself by accident, I couldn't remember what I did while drinking, I was rude or obnoxious, I did something that embarrassed me, I had a sexual experience I wish I hadn't, I felt nauseated or vomited, I passed out, I drank more than I planned to. *Positive consequences* were coded as the sum of the following 6 consequences: I felt relaxed, I was in a better mood, I got a buzz, I was able to express my feelings more easily, I felt more energetic, I was more sociable.

Two additional measures were coded at the daily level. *Weekend* was a dichotomy indicating if the day was a Thursday, Friday, or Saturday (vs. other days) (Del Boca et al 2004; Patrick et al., 2019). *Day number* was a continuous measure indicating day of survey, coded as 0–13.

Analyses

Using Mplus v.7.4 (Muthén and Muthén, 1998–2015), two-level regression models were used to model drinking days at Level 1 nested within persons at Level 2 to test for within-person associations between drinking motives and drinking intensity (RQ1), within-person associations between drinking motives, drinking intensity, and drinking consequences (RQ2), and moderation by college status and sex (RQ3).

For RQ1, multinomial logistic regression models examined associations between drinking motives and alcohol use; the dependent variable was the categorical drinking intensity (moderate, binge, or high-intensity drinking). Between-person (Level 2) predictors were person means of all three motive scales—enhancement, social, and coping motives—across days (grand-mean centered), college status, sex, and race/ethnicity. Drinking day (Level 1, within-person) predictors were the three motive scales (person-centered), weekend, and day number. Estimates from multinomial logistic regression models indicated the relative risk of being in separate categories of the outcome variable versus a pre-set base category/class. To model predictors of increasing and adjacent drinking intensity levels (i.e., the risk of binge vs. moderate, and the risk of high-intensity vs. binge), two separate models were used to specify the appropriate referent class. First, moderate drinking was set as the referent class in order to obtain estimates comparing the likelihood of binge versus moderate (estimates comparing high-intensity vs. moderate were obtained but not tabled). Second, binge drinking was set as the referent class to obtain estimates comparing the likelihood of high-intensity versus binge (estimates comparing moderate vs. binge were obtained but not tabled because they were the inverse of those reported in the first model).

For RQ2, negative binomial regression models examined associations between drinking motives, drinking intensity, and drinking consequences; in these models, the dependent variable was the count of positive or negative consequences. The focus of these models was to examine if motives on a given day had direct associations with consequences (with and without accounting for drinking intensity) and indirect associations through drinking intensity. Analyses were fit in three steps. In Model 1, analyses focused on motive and

consequence associations; between-person (Level 2) and drinking day (Level 1) predictors were the same as those for RQ1. In Model 2, motives were removed and replaced with person means of drinking intensity (grand-mean centered) at Level 2 and drinking intensity that day (person-centered) at Level 1. Model 3 included all measures in Models 1 and 2 (i.e., both motives and drinking intensity). Estimates indicated the degree to which one-unit increases in each independent variable were associated with one-unit increases in the number of reported positive or negative consequences. In Models 2 and 3, two separate sub-models were specified to describe associations with increasing drinking risk: (a) moderate drinking was used as the referent class to obtain estimates comparing binge vs. moderate and high-intensity vs. moderate (as shown in Tables 4 and 5); then (b) binge drinking was used as the referent class to obtain estimates comparing high-intensity vs. binge (estimates of interest are presented in the text).

For RQ3, moderation was examined with the cross-level interaction of college status or sex with motive scales or drinking intensity in multivariable models. In these interaction models, all covariates (including all motive scales) were included simultaneously as in RQs 1 and 2, but cross-level interactions with motives were limited to one college×motive term (or one sex×motive term) per model.

Descriptive analyses were conducted using SAS v.9.4; estimates at the drinking day level were clustered within persons using survey commands. Thus, day-level descriptive measure variance is reported using standard errors; person-level descriptive measure variance is reported using standard deviations. Analyses in Mplus were specified as twolevel random using Montecarlo integration and the MLR estimator to obtain robust standard errors. All analyses were weighted to adjust for sampling and nonresponse (based on extensive information available from MTF 12th grade measures including sex, race/ethnicity, region, number of parents in the household, average parental education, religious commitment, average high school grades, truancy, college plans, and substance use).

Results

Person-level sample characteristics

In this sample of drinkers, 64.5% attended a 4-year college full-time; 57.0% were men (see Table 2). The majority (67.6%) identified as non-Hispanic White, 20.3% identified as Hispanic, and 12.1% as another racial/ethnic category. As analyses were restricted to those reporting drinking during the 14 days, most (79.1%) reported moderate at least once; 36.4% reported 1+ days of binge (but not high-intensity) drinking, and 16.8% reported 1+ days of high-intensity drinking. Further analyses (not tabled) indicated that among those reporting binge only, the mean number of binge days was 1.47 [SD=0.69]. Among those reporting any high-intensity drinking, the mean number of binge-only days was 1.74 [SD=1.04], and the additional mean number of high-intensity days was 1.34 [SD=0.73], for a total average of 2.24 [SD=1.32] days with either binge or high-intensity drinking. At the person level, average motive scale endorsements across drinking days were 1.09 [SD=0.57] (“somewhat”) for enhancement, 0.58 [SD=0.61] (between “no” and “somewhat”) for social, and 0.17 [SD=0.30] (slightly over “no”) for coping. Approximately half (53.0%) of individuals reported weekday drinking; most (81.2%) reported weekend drinking.

Associations between drinking motives and drinking intensity on a given day

The intraclass correlation (ICC) for drinking intensity on a given day (modeled as an ordinal variable following Raykov & Marcoulides, 2015) was 0.405; the majority (59.5%) of variance occurred at the day level (within-person). ICCs are not available for nominal outcomes (Muthén, 2020). Thus, estimating the degree of within-person variance for the thresholds of interest was conducted by fitting simple multilevel multinomial models to estimate between-person variances for the relevant random intercepts (i.e., the threshold between moderate [referent class] and binge, and the threshold between binge [referent class] and high-intensity) with no other parameters in the model. The resulting between-person variance estimate for the moderate/binge threshold was 1.447 [SE=0.412], $p<0.001$, indicating significant between-person variance. The estimate for the binge/high-intensity threshold was 1.183 [0.978], $p=0.226$, indicating no significant between-person variance. Thus, variance in high-intensity drinking was almost entirely within-person; between-person predictors would not be expected to significantly differentiate high-intensity versus binge drinking. Table 3 presents models of associations between drinking motives and drinking intensity on a given day.

Between-persons (Level 2).—Between-persons, greater person means for enhancement and social (but not coping) motives were associated with binge (vs. moderate) drinking. Also, the likelihood of binge (vs. moderate) drinking was significantly greater for those attending a 4-year college full-time than other respondents, and significantly lower for other (including multiracial) versus non-Hispanic White respondents. The likelihood of high-intensity (vs. binge) drinking was not associated with between-person differences in motives, college status, or race/ethnicity. Sex did not differentiate drinking intensity.

Within-person (Level 1).—Within-person, greater enhancement and social motives were associated with greater drinking intensity. Specifically, if a respondent's daily enhancement motive scale value was one unit higher than their own average, their likelihood of binge (vs. moderate) drinking was 3 times higher (ARR 3.00), and their likelihood of high-intensity (vs. binge) drinking was over 4 times higher (ARR 4.20). A one-unit increase above their personal average of daily social motives was associated with roughly doubling the likelihood of both binge (vs. moderate) and high-intensity (vs. binge) drinking (ARRs 2.05 and 1.92, respectively). Within-person associations between coping motives and drinking intensity were not significant. Weekends (vs. weekdays) were associated with higher drinking intensity.

Associations between drinking motives, alcohol use, and drinking consequences on a given day

ICCs were 0.311 for number of positive consequences and 0.082 for number of negative consequences, indicating that the majority of variance was at the drinking-day (within-person) level, particularly for negative consequences. Model results are shown in Tables 4 and 5 for positive and negative consequences, respectively.

Between-persons (Level 2).—There were no between-person differences in number of consequences by college status, sex, or race/ethnicity. Person-mean drinking motives were

associated with consequences. Greater average enhancement, social, and coping motives were each associated with a greater number of positive consequences; estimate size remained relatively unchanged after controlling for drinking intensity. Average enhancement motives were not associated with negative consequences, but greater average social and coping motives were associated with more negative consequences (before and after controlling for drinking intensity). After controlling for drinking intensity, estimate strength decreased for social motives but increased for coping motives.

For drinking intensity, individuals reporting more binge (vs. moderate) days reported more positive and negative consequences prior to controlling for motives. After controlling for motives, the association became non-significant for positive consequences but remained for negative consequences. Individuals reporting more high-intensity (vs. moderate) drinking days had more positive and negative consequences both before and after controlling for motives (although association strength decreased when motives were included). Sub-models specifying binge drinking as the referent category found that more high-intensity (vs. binge) drinking days were associated with more positive consequences (both before and after controlling for motives), but were not associated with negative consequences.

Within-person (Level 1).—Stronger enhancement and social motives on a given day were associated with more positive consequences that day; effect sizes remained generally similar both before and after controlling for drinking intensity. Coping motives on a given day were not associated with positive consequences (either before or after controlling for drinking intensity). For negative consequences, having stronger enhancement, social, or coping motives on a given day was associated with more negative consequences that day before controlling for drinking intensity; after controlling for drinking intensity, the pattern was inconsistent. Associations became non-significant for social motives, decreased in strength for enhancement motives, and remained comparable for coping motives.

Greater drinking intensity on a given day was associated with more positive and negative consequences. Binge (vs. moderate) drinking and high-intensity (vs. moderate) drinking on a given day were associated with more positive and negative consequences before and after controlling for motives (although estimate strength decreased after controlling for motives in the positive consequence model). Sub-models specifying binge drinking as the referent category found that high-intensity drinking on a given day was associated with more negative consequences both before and after controlling for motives, but was not significantly associated with the number of positive consequences either before or after controlling for motives. Weekends (vs. weekdays) were associated with more negative (but not positive) consequences.

College status and sex interactions—To test RQ3, college×motives and sex×motives interactions were added to the models. Little evidence of interactions predicting drinking intensity or consequences was observed. The single exception was that the college×social motives interaction was significantly associated with high-intensity (vs. binge) drinking (Est 1.477, SE 0.71, p=0.037). Among full-time 4-year college students, reporting stronger social motives on a given day was associated with high-intensity (vs. binge) drinking that day (ARR 2.54 [1.21, 5.32], p=0.013). However, for young adults not attending a 4-year college

full-time, day-level variation in social motives was not significantly associated with high-intensity (vs. binge) drinking (ARR 0.60 [95% CI 0.21, 1.74], p=0.346). An additional supplemental multilevel linear model regressing social motives on college status (controlling only for race/ethnicity and sex) found that social motives were higher among those attending a 4-year college full-time (M=0.701, SE=0.042) than other (M=0.501, SE 0.065) young adults (Est. 0.197, SE=0.082, p=0.017).

Discussion

In this sample of young adult drinkers from across the U.S., the majority of variance in drinking intensity and consequences was within individuals from day to day. This was particularly true for high-intensity drinking, with nearly all of the variability occurring within persons across days. Therefore, predictors of high-intensity drinking occasions and acute alcohol consequences should be time-varying and contextual, such as drinking motives on a given day. It is important for interventions to consider characteristics of a specific drinking day or occasion in addition to considering characteristics of a person. In this study, motives for drinking on a given day were associated with drinking intensity that day. In particular, on days with greater-than-usual enhancement and social motives, participants were more likely report binge (vs. moderate) and high-intensity (vs. binge) drinking, and to experience more positive consequences. On days with greater enhancement and coping motives, participants experienced more negative consequences. Further, on days with greater social motives, participants reported higher drinking intensity, which in turn was associated with more negative consequences.

Results indicate that drinking motives have direct associations with drinking intensity, and direct and indirect associations with consequences. These findings extend previous within-person research, mostly among college students, that has found occasions with higher enhancement (Cook et al., 2019; O'Donnell et al., 2019; Patrick et al., 2019; Stevenson et al., 2019) and social (Patrick et al., 2019) motives usually are associated with higher alcohol consumption and related consequences. Our findings regarding coping motives add to a mixed literature which has found either no drinking occasion-level associations between coping motives and alcohol outcomes (Cook et al., 2019; Stevenson et al., 2019) or associations with higher alcohol consumption (Dvorak et al., 2014). The current study suggests that greater coping motives and high-intensity drinking are associated with more negative consequences on particular drinking occasions. New multilevel research is needed examining ways in which drinking motives, contexts, and other time-varying constructs (e.g., stress, affect) act as proximal, situational predictors of high-intensity drinking and consequences. Future efforts should build on existing research utilizing these predictors among young adults (e.g., Cook et al., 2019; Dvorak et al., 2014; Stevenson et al., 2019) but also specifically focus on high-intensity drinking and acute alcohol consequences among young adults outside of 4-year college contexts.

This is one of the first studies to compare high-intensity and binge drinking days. Results show that, between individuals, reporting more high-intensity days was associated with a greater number of positive but not negative consequences overall. In contrast, within individuals on any given day, high-intensity (vs. binge) drinking resulted in more negative

(but not positive) consequences. This “oppositional” finding illustrates the importance of separating between- and within-person associations. Individuals whose typical drinking reflects high-intensity (vs. binge) drinking perceive more overall positive consequences from their drinking. However, respondents reported more negative consequences on high-intensity drinking days than on binge drinking days, controlling for their average drinking intensity. This is consistent with existing intervention messages about biphasic alcohol effects and a point of diminishing returns where negative consequences begin to outweigh positive consequences (e.g., Miller et al., 2001), and supports clinician assessment and discussion of daily alcohol use motives with patients who exhibit problem alcohol use (Cook et al., 2019).

In this sample of young adult drinkers, we found few college status differences in associations between drinking motives, intensity, and consequences. Only one significant interaction indicated different associations for 4-year college students. Social motives on a given day were associated with high-intensity (vs. binge) drinking only among those attending a 4-year college full-time. In addition, 4-year attenders reported higher average levels of social motives than other young adults. College campus environments are associated with several factors that increase exposure to peers and opportunities for socializing which may increase social motive relevance. College campuses tend to have high alcohol outlet density and public drunkenness (Wechsler et al., 2002). Greek systems (i.e., fraternities/sororities) are primarily associated with 4-year institutions, and both alcohol use selection and socialization effects are associated with heavier drinking in these groups (McCabe et al. 2005). There is a significant and justified focus on how to address harmful and underage alcohol use among college students (College AIM, 2020). However, results showed that although attending a 4-year college full-time was associated with higher binge (vs. moderate) drinking, college status was not associated with the likelihood of high-intensity versus binge drinking. Young adults not enrolled in 4-year colleges are at risk for high-intensity drinking. However, fewer programs exist to reach this non-college population. Research studies and interventions for young adults that include students in community colleges and outside of educational settings clearly are needed.

This study used sex-specific definitions of binge and high-intensity drinking to adjust for typical differences in body size and alcohol metabolism for women and men; using these measures, there was little evidence of sex differences or moderation effects in associations between drinking motives, intensity, and consequences at mean age 19. Historically, young adult men have reported more high-risk drinking than women, but sex differences in alcohol use among early young adults have been diminishing (Keyes et al., 2019; Schulenberg et al., 2020; White, 2020). The current study focused only on association differences on drinking days (vs. attempting to examine sex or other covariate differences between non-drinking and drinking days). The lack of sex-based differences in drinking day associations indicates women and men are equally at risk for the likelihood of binge (vs. moderate) and high-intensity (vs. binge) drinking and consequences based on their drinking motives. Interventions with young adult drinkers may not need to tailor drinking motive content by sex. Whether this would be applicable for other age groups is unknown. Further, the current study examined number of consequences versus consequence type. Women tend to be more likely than men to report (a) regretting behavior that occurred while drinking, and (b) negative emotional/physical consequences (Patrick et al., 2020). Such differences in

consequence type are an area for future research and may help inform any prevention and intervention message tailoring by sex.

Limitations and future directions

It is important to consider these results within their limitations. The sample is based on individuals who reported past 30-day alcohol use as 12th grade students. Adolescents who drop out of high school were not in the sample but are at greater risk for alcohol use (Tice et al, 2017). Due to the focus on those with recent alcohol use while in 12th grade, individuals who identified as White were overrepresented (Johnston et al., 2020), thus limiting detailed examination of racial/ethnic differences. Young adults who began current alcohol use after high school also were not represented; however, both binge and high-intensity drinking are significantly less likely during young adulthood among those who initiate alcohol use after high school than before or during (Terry-McElrath & Patrick, 2016). A history of binge drinking was related to study attrition, thus the analytic sample may have underrepresented young adult heavy drinkers, although weights were used to adjust for this. All daily data were obtained retrospectively (i.e., respondents were asked about the previous day's drinking motives, behaviors, and consequences). It is possible that respondents may have conflated why they drank with what actually occurred when they did. Also, the enhancement motives scale had a relatively low reliability and only two items. Such limitations notwithstanding, the current study examined both between- and within-person associations between drinking motives, intensity, and consequences across days in a sample of early young adults both attending and not attending 4-year colleges. Future data collection efforts should strive to obtain adequate sample sizes to allow more detailed investigation of motive, drinking intensity, and consequence associations by college status (particularly differences between those not attending and attending at 2-year colleges or vocational/technical schools compared to those attending 4-year schools) and specific racial/ethnic groups. In addition, the extent to which concurrent and/or simultaneous polysubstance use may be associated with use motives, high-intensity drinking, and associated consequences are important areas for future research.

Conclusion

This study highlighted within-person variability in drinking motives, drinking intensity, and positive and negative consequences using repeated daily measures. High-intensity drinking and negative consequences on a given day were associated with greater drinking motives that day. In particular, enhancement and social motives were associated with drinking intensity; enhancement and coping motives were associated with negative consequences. Results underscore that high-intensity drinking varies across days and therefore time-varying, occasion-specific risks such as current motivational context may be appropriate targets for intervention.

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Table 1.

Descriptive Statistics and Reliabilities for Daily Drinking Motive Scales

Scale/Item	Mean (SE)	Reliability (α)
Enhancement scale	1.12 (0.03)	0.62
Because I liked the feeling	0.99 (0.03)	
To have fun	1.25 (0.03)	
Social scale	0.64 (0.04)	0.86
To improve a party/gathering	0.64 (0.04)	
To make a party/gathering more fun	0.63 (0.04)	
Coping scale	0.17 (0.02)	0.83
To avoid dealing with my ongoing problems	0.15 (0.02)	
To feel less depressed	0.15 (0.02)	
To cheer up	0.23 (0.02)	
To forget my ongoing problems/worries	0.16 (0.02)	
To feel more confident/sure of myself	0.28 (0.03)	
To feel less nervous	0.18 (0.02)	
Because I was angry	0.04 (0.01)	

Notes. Item response options: 0 (no), 1 (somewhat), 2 (definitely). Items were averaged together to create scale composites. Reliability coefficients (α's) calculated across drinking days.

Table 2.

Descriptive Statistics

	Days			Individuals		
	%/Mean	(SE)	Range	%/Mean	(SD)	Range
Consequences (mean)						
Positive consequences	2.9	0.09	0-6	2.8	(1.70)	0-6
Negative consequences	0.5	0.04	0-9	0.5	(0.83)	0-6
Day-level drinking intensity[a] (%)			1-3			
Moderate drinking (<4+/<5+)	63.8	(1.85)		79.1	(40.6)	0,1
Binge drinking (4-7/5-9)	25.8	(1.62)		36.4	(48.1)	0,1
High-intensity drinking (8+/10+)	10.4	(1.29)		16.8	(37.3)	0,1
Motive scales						
Enhancement (mean)	1.12	(0.02)	0.0-2.0	1.09	(0.57)	0.0-2.0
Social (mean)	0.64	(0.03)	0.0-2.0	0.58	(0.61)	0.0-2.0
Cope (mean)	0.17	(0.01)	0.0-1.9	0.17	(0.30)	0.0-1.71
Covariates: Level 1 (day)						
Weekend (Thurs/Fri/Sat) (%)			0,1			
No	37.6	(1.88)		53.0	(50.0)	0,1
Yes	62.4	(1.88)		81.2	(39.1)	0,1
Burst day number (0-13) (mean)	5.8	(0.15)	0-13	[b]		
Covariates: Level 2 (person)						
College status (%)			0,1			0,1
Full-time at 4-year college	68.3	(1.94)		64.5	(47.9)	
Other	31.7	(1.94)		35.5	(47.9)	
Sex (%)			0,1			0,1
Female	41.0	(1.75)		43.0	(49.5)	
Male	59.0	(1.75)		57.0	(49.5)	
Race/ethnicity (%)			1-3			1-3
Hispanic	16.4	(1.60)		20.3	(40.2)	
Non-Hispanic White	72.2	(1.81)		67.6	(46.8)	
Other (including multiracial)	11.4	(1.19)		12.1	(32.6)	

Notes: For consequences, data include 1,033 drinking days from 483 individuals. For all other measures, data include 1,048 drinking days from 484 individuals.

[a]Daily drinking intensity levels defined using gender-specific thresholds. For example, moderate drinking per occasion defined as less than 4 drinks for women and less than 5 drinks for men.

[b]The percentage of individuals reporting drinking on a particular day ranged from a low of 10.0% on Day 13 to a high of 23.1% on Day 3.

Table 3.

Associations Between Daily Drinking Motives and Daily Drinking Intensity Among U.S. Young Adults in 2019: Enhancement, Social and Coping Motives

	Binge (vs Moderate) ARR (95% CI) p	HID (vs Binge) ARR (95% CI) p
Level 1: Day		
Motives that day[a]		
Enhancement motives	**3.00 (1.29, 6.98) 0.011**	**4.20 (1.56, 11.32) 0.005**
Social motives	**2.05 (1.23, 3.43) 0.006**	**1.92 (1.01, 3.64) 0.046**
Coping motives	2.80 (0.98, 7.98) 0.054	0.58 (0.13, 2.47) 0.458
Weekend[b] (vs. weekday)	**1.52 (1.04, 2.20) 0.029**	**2.63 (1.29, 5.36) 0.008**
Burst day[c]	1.03 (0.98, 1.08) 0.216	1.02 (0.95, 1.10) 0.542
Level 2: Person		
Average motives across days[d]		
Enhancement motives	**2.61 (1.55, 4.38) 0.000**	1.04 (0.36, 2.96) 0.947
Social motives	**3.27 (2.01, 5.34) 0.000**	1.63 (0.77, 3.49) 0.200
Coping motives	0.61 (0.22, 1.72) 0.355	0.60 (0.19, 1.84) 0.370
College[e] (vs. other)	**2.04 (1.02, 4.12) 0.045**	1.15 (0.54, 2.48) 0.718
Male (vs. female)	0.70 (0.45, 1.09) 0.117	1.23 (0.67, 2.24) 0.503
Race/ethnicity (referent=White)		
Hispanic	0.99 (0.40, 2.44) 0.985	1.13 (0.45, 2.83) 0.802
Other	**0.45 (0.25, 0.81) 0.008**	0.71 (0.22, 2.33) 0.570

Notes: Ns(unwtd.)=1,042 days from 484 individuals. ARR = adjusted relative risk ratio; CI=confidence interval. Drinking intensity coded using biological sex-specific thresholds: moderate drinking = <4 drinks for women and <5 drinks for men; binge drinking = 4-7 drinks for women and 5-9 drinks for men; high-intensity drinking = 8+ drinks for women and 10+ drinks for men. Bold font indicates associations with p<.05. All measures entered simultaneously.

[a]Person-centered as daily motive value minus personal motive mean.

[b]Weekend defined as Thursday, Friday, or Saturday.

[c]Burst day numbered continuously from 0-13.

[d]Grand mean centered as person motive mean minus grand motive mean.

[e]College defined as attending full-time at a 4-year college.

Table 4.

Associations Between Daily Drinking Motives, Daily Drinking Intensity, and Positive Daily Drinking Consequences Among U.S. Young Adults in 2019

	Model 1: Motives but not drinking intensity	**Model 2: Drinking intensity but not motives**	**Model 3: Both drinking intensity and motives**
	Est (SE) p	**Est (SE) p**	**EST (SE) p**
Level 1: Day			
Drinking intensity[a]			
Moderate	--	(ref)	(ref)
Binge	--	**0.529 (0.069) <0.001**	**0.289 (0.066) <0.001**
HID	--	**0.671 (0.103) <0.001**	**0.225 (0.083) 0.006**
Motives[b]			
Enhancement motives	**0.542 (0.064) <0.001**	--	**0.479 (0.067) <0.001**
Social motives	**0.194 (0.056) 0.001**	--	**0.154 (0.054) 0.004**
Coping motives	0.072 (0.152) 0.633	--	0.025 (0.153) 0.872
Weekend[c] (vs. weekday)	-0.037 (0.043) 0.381	-0.019 (0.049) 0.704	-0.053 (0.041) 0.203
Burst day[d]	-0.003 (0.005) 0.539	0.002 (0.006) 0.689	-0.005 (0.005) 0.337
Level 2: Person			
Drinking intensity[e]			
Moderate	--	(ref)	(ref)
Binge	--	**0.411 (0.085) <0.001**	-0.003 (0.075) 0.966
HID	--	**0.651 (0.082) <0.001**	**0.220 (0.078) 0.005**
Motives[e]			
Enhancement motives	**0.444 (0.062) <0.001**	--	**0.437 (0.067) <0.001**
Social motives	**0.249 (0.039) <0.001**	--	**0.227 (0.039) <0.001**
Coping motives	**0.274 (0.106) 0.010**	--	**0.293 (0.108) 0.007**
College[f] (vs. other)	-0.105 (0.076) 0.164	-0.135 (0.073) 0.065	-0.128 (0.073) 0.078
Male (vs. female)	-0.092 (0.049) 0.061	-0.105 (0.055) 0.055	-0.099 (0.052) 0.056
Race/ethnicity (referent=White)			
Hispanic	-0.012 (0.074) 0.868	-0.065 (0.093) 0.484	-0.024 (0.071) 0.737

	Model 1: Motives but not drinking intensity Est (SE) p	Model 2: Drinking intensity but not motives Est (SE) p	Model 3: Both drinking intensity and motives EST (SE) p
Other	0.085 (0.095) 0.370	0.090 (0.101) 0.373	0.093 (0.093) 0.320

Notes: Ns(unwtd.)= 1,033 days from 483 individuals. Est. = regression estimate from multivariable negative binomial regression; SE=standard error. Bold font indicates associations with p<.05. All measures entered simultaneously.

[a]Drinking intensity use coded using biological sex-specific thresholds: moderate drinking = <4 drinks for women and <5 drinks for men; binge drinking = 4-7 drinks for women and 5-9 drinks for men; high-intensity drinking = 8+ drinks for women and 10+ drinks for men. Person-centered as daily value minus personal mean.

[b]Person-centered as daily value minus personal mean.

[c]Weekend defined as Thursday, Friday, or Saturday.

[d]Burst day numbered continuously from 0-13.

[e]Grand mean centered as person mean minus grand mean.

[f]College defined as attending full-time at a 4-year college.

Table 5.

Associations Between Daily Drinking Motives, Daily Drinking Intensity, and Negative Daily Drinking Consequences Among U.S. Young Adults in 2019

	Model 1: Motives but not drinking intensity Est (SE) p	Model 2: Drinking intensity but not motives Est (SE) p	Model 3: Drinking intensity and motives Est (SE) p
Level 1: Day			
Drinking intensity[a]			
Moderate	--	(ref)	(ref)
Binge	--	**2.217 (0.285) <0.001**	**2.039 (0.262) <0.001**
HID	--	**3.013 (0.413) <0.001**	**2.626 (0.370) <0.001**
Motives[b]			
Enhancement motives	**1.049 (0.261) <0.001**	--	**0.472 (0.239) 0.048**
Social motives	**0.461 (0.197) 0.019**	--	-0.020 (0.181) 0.913
Coping motives	**1.119 (0.344) 0.001**	--	**1.007 (0.331) 0.002**
Weekend[c] (vs. weekday)	**0.537 (0.173) 0.002**	0.355 (0.202) 0.080	**0.341 (0.172) 0.048**
Burst day[d]	0.027 (0.021) 0.195	0.024 (0.021) 0.248	0.017 (0.019) 0.378
Level 2: Person			
Drinking intensity[e]			
Moderate	--	(ref)	(ref)
Binge	--	**2.018 (0.265) <0.001**	**1.759 (0.248) <0.001**
HID	--	**1.855 (0.348) <0.001**	**1.588 (0.349) <0.001**
Motives[e]			
Enhancement motives	0.329 (0.240) 0.171	--	-0.031 (0.209) 0.882
Social motives	**0.637 (0.170) <0.001**	--	**0.327 (0.148) 0.027**
Coping motives	**0.770 (0.315) 0.014**	--	**1.033 (0.267) <0.001**
College[f] (vs. other)	0.332 (0.256) 0.195	0.258 (0.699) 0.712	0.215 (0.230) 0.350
Male (vs. female)	0.005 (0.160) 0.974	0.086 (0.333) 0.796	0.090 (0.153) 0.553
Race/ethnicity (referent=White)			
Hispanic	-0.375 (0.335) 0.263	-0.120 (0.697) 0.864	-0.210 (0.328) 0.521

	Model 1: Motives but not drinking intensity Est (SE) p	Model 2: Drinking intensity but not motives Est (SE) p	Model 3: Drinking intensity and motives Est (SE) p
Other	-0.273 (0.270) 0.313	0.037 (0.350) 0.915	0.062 (0.281) 0.824

Notes: Ns(unwtd.)= 1,033 days from 483 individuals. Est. = regression estimate from multivariable negative binomial regression; SE=standard error. Bold font indicates associations with p<.05. All measures entered simultaneously.

[a]Drinking intensity use coded using biological sex-specific thresholds: moderate drinking = <4 drinks for women and <5 drinks for men; binge drinking = 4-7 drinks for women and 5-9 drinks for men; high-intensity drinking = 8+ drinks for women and 10+ drinks for men. Person-centered as daily value minus personal mean.

[b]Person-centered as daily value minus personal mean.

[c]Weekend defined as Thursday, Friday, or Saturday.

[d]Burst day numbered continuously from 0-13.

[e]Grand mean centered as person mean minus grand mean.

[f]College defined as attending full-time at a 4-year college.