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Drinking Context, Alcohol Use, and Subjective Responses During Binge-Drinking Episodes Measured by High-Resolution Ecological Momentary Assessment (HR-EMA)

Andrew M. Fischer[1], **Andrea C. King**[1], **Dingcai Cao**[2], **Daniel J. Fridberg**[1]

[1]Department of Psychiatry & Behavioral Neuroscience, The University of Chicago

[2]Department of Ophthalmology and Visual Sciences, University of Illinois at Chicago

Abstract

Objective: Subjective responses to alcohol play a key role in the development and maintenance of risky drinking and alcohol use disorder (AUD). The social and environmental context where drinking occurs may moderate alcohol's subjective effects, but ecologically valid studies of these associations are limited. The present study used high-resolution ecological momentary assessment (HR-EMA) targeting real-world binge drinking episodes to examine associations among drinking context, alcohol consumption, and subjective responses to alcohol.

Method: Young adult heavy drinkers (N = 61; 57% male) completed two smartphone-based, 3-hour HR-EMA of drinking context (social context and location), alcohol use, and subjective responses (alcohol stimulation, sedation, feeling, liking, and wanting more). Analyses examined the associations between drinking context and subjective alcohol responses, accounting for demographic characteristics and individual differences in alcohol consumption.

Results: Most (85%) participants reported binge drinking during real-world drinking events. Estimated blood alcohol concentration (eBAC) and alcohol stimulation and reward (liking, wanting) were greater when participants drank with others (versus alone) and in a bar/restaurant (versus other location). Sedation was higher when drinking alone versus with others.

Conclusions: The current study extends prior laboratory-based research and shows that subjective responses during naturalistic binge-drinking episodes may be influenced by drinking context. Drinking with others and in bars and restaurants may increase alcohol consumption, enhance alcohol's rewarding effects, and lead to more alcohol-related harm in at-risk drinkers.

Keywords

High-Resolution Ecological Momentary Assessment; Heavy Drinking; Brief Biphasic Alcohol Effects Scale; Drug Effects Questionnaire; Subjective Alcohol Response

In the United States, 41.6% of young adults ages 21–25 report past-month binge drinking, defined as consuming 5+ drinks for men/4+ drinks for women within two hours (SAMHSA,

Correspondence concerning this article should be addressed to Daniel J. Fridberg, Ph.D., Department of Psychiatry & Behavioral Neuroscience, The University of Chicago, Chicago, Illinois, USA 60637. dfridberg@bsd.uchicago.edu.

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2019). Heavy binge drinking increases the risk for acute alcohol-related consequences including injury and sexual assault (Mair et al., 2015; O'Brien et al., 2006). Furthermore, compared with their lighter drinking peers, young adult binge drinkers carry additional risk of increased alcohol use, alcohol use disorder, and alcohol-associated health problems later in life, including cancer and cardiovascular disease (Addolorato et al., 2018; Patrick et al., 2021; Zucker, 2008; Rehm, 2011; Bennett et al., 1999). Thus, to develop new interventions and enhance current treatments for heavy drinking in young adults, it is critical to identify factors that may contribute to increased drinking behaviors among members of this group.

Individual differences in subjective responses to alcohol are important risk factors in the development of alcohol use disorder (AUD). Alcohol has biphasic effects, with stimulant and rewarding effects predominating while blood alcohol concentration (BAC) is rising (i.e., during the ascending limb of the BAC curve), and sedative effects predominating as BAC falls after drinking stops (i.e., during the descending BAC limb; Newlin & Thompson, 1990). Most research examining subjective responses to alcohol has employed controlled, fixed-dose laboratory challenges, and critical studies in this field have shown that both lower sensitivity to alcohol's sedating effects (King et al., 2011; Schuckit, 1980, 1994) and greater sensitivity to its stimulating and rewarding effects (King et al., 2011; King et al., 2016; King et al., 2014; King et al., 2021, Venerable & Fairbairn, 2020) predict drinking exacerbations and development of AUD. The methodology used in these studies included participants drinking alone (Schuckit, 1980, 1994), in the presence of a research assistant (King et al., 2011; King et al., 2016; King et al., 2014; King et al., 2021), or in small groups (Venerable & Fairbairn, 2020). Additional laboratory research has shown that the social context and location in which alcohol is consumed may play an important role in moderating alcohol subjective responses. These studies have shown that the stimulating effects of alcohol are enhanced when participants drink with other participants versus drinking alone (Corbin et al., 2021; Kirkpatrick & de Wit, 2013). Further, "bar-lab" settings that include features intended to resemble a typical pub or bar (bar stools, signs, etc.) have been shown to augment alcohol's rewarding effects compared with traditional laboratory settings that include features like computers, filing cabinets, and desk chairs (Corbin et al., 2015).

While laboratory-based studies indicate that social setting and location can influence alcohol use and associated subjective responses in young adult heavy drinkers, these studies may lack external validity to real-life drinking environments. Studies using retrospective measures have shown that young adults report drinking more often (Skryznski & Creswell, 2020) and consuming greater quantities of alcohol (Monk et al., 2020) when drinking in the presence of others versus alone. While retrospective studies may allow researchers to gain insight into drinkers' typical experiences outside of the laboratory, the data are not collected in real-time and may be prone to recall bias.

Ecological momentary assessment (HR-EMA; Fridberg et al., 2021; Piasecki, 2019) can overcome the limitations of laboratory-based and retrospective studies by examining real-time responses during natural environment heavy drinking events (i.e., those where blood alcohol concentration [BAC] exceeds 0.08 g/dL) for timeframes longer than is practical in the laboratory. A subset of EMA methods known as high resolution EMA (HR-EMA; Fridberg, 2019 Piasecki, 2019) allows researchers to oversample drinking behavior, context,

and alcohol-related subjective responses within a drinking episode. As opposed to random assessment or daily diary-type EMA (Piasecki et al., 2019), HR-EMA targets assessments to the specific behavior of interest (e.g., binge drinking), thereby capturing a wide array of participant experiences during the behavior and reducing overall participant burden (Piasecki et al., 2019; Fridberg et al., 2019).

Prior HR-EMA studies of naturalistic drinking events by Piasecki and colleagues (2011; 2012) showed that the pleasurable effects of alcohol (e.g., “buzzed” and “excited”) were stronger when drinking with others versus alone, and when drinking in a bar or restaurant versus other locations. However, most participants in those studies were smokers and engaged in cigarette smoking while consuming approximately 3–4 drinks; thus, it is unclear whether alcohol responses were affected by co-use of nicotine and if the observed effects during moderate drinking would also pertain to heavy drinking episodes. To our knowledge, no prior published studies have used HR-EMA to examine the associations among drinking context, alcohol consumption, and subjective effects of alcohol without the confound of nicotine or other psychoactive substances during a typical heavy (binge) drinking episode, i.e., when individuals are at greatest risk of alcohol-related harm.

To this end, the current study used HR-EMA to examine heavy drinkers’ alcohol consumption and subjective response to alcohol as a function of social context (drinking in the presence of others versus alone) and location (bars/restaurants versus other locations) during two separate heavy drinking episodes. In contrast to prior HR-EMA studies that collected data on all alcohol use over several weeks (e.g., Piasecki et al., 2012), we sought to examine drinkers’ experiences during the first three hours of two distinct heavy drinking episodes to 1) focus our analyses on those drinking episodes where individuals may experience the greatest number of consequences, 2) limit participant burden, and 3) allow us to examine the consistency of outcomes over distinct drinking events (Fridberg et al., 2021; Fridberg et al., 2019). Based on prior laboratory-based and naturalistic studies of alcohol consumption and subjective responses (Piasecki et al., 2011; Corbin et al., 2015; Monk et al., 2020) we predicted that participants would consume more alcohol when drinking with others versus alone, and when drinking in public drinking-related locations (i.e., bars and restaurants) versus all other locations. We also predicted that, after controlling for estimated blood alcohol concentration (eBAC), participants would report higher alcohol-related stimulation and rewarding effects, and lower sedative-type effects, when drinking with others (versus alone) and in public bars/restaurants (versus other locations).

Materials and Methods

Design

This study examined data from the Mobile Alcohol Response Study (MARS) at the University of Chicago. Participants were enrolled from April 2017 – June 2018 and all study procedures were approved by the University of Chicago Institutional Review Board. Participants in MARS completed smartphone-based HR-EMA of alcohol use, subjective responses, and related outcomes for “up to two” drinking episodes (see below) separated by at least 24 hours. A prior report described the feasibility, safety, and reliability of this HR-EMA method (Fridberg et al., 2019), and another report showed that alcohol responses

obtained using HR-EMA were correlated with those same measures reported during an oral, fixed-dose laboratory alcohol challenge (Fridberg et al., 2021). Note that participants from the larger study sample who participated early in the data collection process were encouraged (but not required) to complete HR-EMA of two drinking episodes. However, the study instructions were soon modified such that participants were required to complete both HR-EMA episodes to finish the study and receive full compensation. Thus, of the original, larger participant sample (N = 83; Fridberg et al., 2021; Fridberg et al., 2019), 61 participants (73%) completed two separate HR-EMA episodes and comprised the study sample for this report.

Participants

Study candidates were recruited via online advertisements and word-of-mouth referrals. Inclusion criteria were generally healthy 21–29-year-olds who reported heavy social drinking, i.e., consuming ≥14 drinks/week for males (≥7 drinks/week for females) with 1–4 heavy drinking episodes per week (defined as ≥5 drinks per occasion for males, ≥ 4 drinks per occasion for females) for at least the past year, in line with prior research (King et al., 2011).

Candidates who met initial study criteria during a telephone screen were invited to an in-person screening to confirm eligibility via standard interviews and questionnaires, including the Timeline Follow-back (TLFB; Sobell & Sobell, 1995) and the Structured Clinical Interview for the DSM-5 (First et al., 2015). Screening excluded individuals meeting criteria for severe AUD, tobacco use disorder, or other major psychiatric disorders (e.g., bipolar disorder, schizophrenia). Current cannabis users were included if they reported using ≤3 times/week and agreed to abstain from using cannabis during their drinking episodes. Nondaily nicotine users were included if they agreed not to smoke or use tobacco products during the episodes. Study staff used a family history tree (King et al., 2014) to identify participants' first-degree biological relatives with current or past AUD, but this was not used as an inclusion/exclusion criterion.

Orientation

During study orientation, a research assistant helped the participant download the dedicated study app (Metricwire Inc.; Toronto, ON, Canada) on their smartphone and provided training on the use of the app to record alcohol use, subjective responses, and contextual information (e.g., social context, location). The research assistant referenced the participant's Timeline Follow-back data to help him/her identify days during the week when heavy drinking was likely to occur (e.g., Friday-Sunday) and to avoid atypical or special occasions for drinking (e.g., holidays, weddings, or times of increased stress). While the HR-EMA procedure was intended to target participants' typical heavy drinking episodes, for ethical and safety reasons, each participant was neither instructed nor required to consume a specific amount of alcohol during the HR-EMA periods and was informed they could stop drinking at any time during the episodes. To ensure that the baseline surveys captured participants' subjective experiences before they started drinking, instructions reminded participants to avoid drinking alcohol or using drugs on the day before they initiated the HR-EMA procedure.

HR-EMA Procedure

The HR-EMA episode was self-initiated by the participant with a baseline survey completed 30 minutes to 3 hours prior to when they planned to consume the first drink of the episode (M±SD = 70.2±88.2 minutes). This baseline survey assessed current subjective stimulation and sedation (see Dependent Measures below) and probed for any alcohol use that day (if endorsed, the HR-EMA episode was canceled, and the participant was asked to engage in another episode at least 24 hours later and reminded not to drink prior to initiating the episode). After the pre-drinking baseline survey, the participant consumed their first alcoholic drink. S/he then completed the post-first-drink survey after finishing the entire drink. All ensuing surveys were automatically prompted by notifications at 15, 30, 60, 90, 120, 150, and 180 minutes after the first drink survey. These surveys, as well as the post-first-drink survey, included questions about the type of alcohol, size and number of drinks consumed since the last survey, social context, location, and subjective alcohol effects (see Dependent Measures, below). We limited our assessments to the first 3 hours of the drinking episodes to minimize participant burden and because we expected that this time frame would be sufficient to capture alcohol use and associated subjective responses during ascending, peak, and early descending BAC for most participants (Fridberg et al., 2019).

Dependent Measures

Each survey asked participants to specify if he/she was alone or in the presence of others, as well as his/her current location (“home,” “bar/restaurant,” “friend’s home,” “outside,” “work/school,” “vehicle,” or “other”). Additional measures included subjective responses to alcohol measured via the Drug Effects Questionnaire (DEQ; Morean et al., 2013) to assess alcohol feeling, liking, and wanting more (each rated from 0 [Not at all] - 100 [Extremely]), and the 6-item Brief Biphasic Alcohol Effects Scale (B-BAES; Rueger et al., 2009). B-BAES items (rated 0 – 10) were summed to compute the stimulation (sum of “energized,” “excited,” and “up”) and sedation (sum of “sedated,” sluggish,” and “slow thoughts”) subscales. Internal consistencies (Cronbach’s alpha) for the B-BAES stimulation and sedation subscales were .92 and .88, respectively. To further reduce participant burden and the likelihood of errors in drink reporting, each survey asked participants to report only the serving size, type, and number of drinks consumed since the last completed survey. These data were then converted to standard drink units and used to calculate estimated blood alcohol concentration levels (eBAC) at each time point according to the equation of Matthews and Miller (1979): eBAC = [(number of standard drinks consumed during the episode / 2) × (GC/w)] – (.017g/dl per hour × time in hours since drinking started) where GC is a gender constant (9.0 for women and 7.5 for men). A small number (n = 25; 2.6%) of completed surveys were associated with calculated eBAC ≥ 0.30 g/dl, a level of intoxication associated with loss of consciousness or death. We assumed those responses reflected errors in reporting and opted to treat data from those surveys as missing, as in our previous work (Fridberg et al., 2021; Fridberg et al., 2019).

Statistical Analyses

Separate generalized estimating equations (GEE; Hardin & Hilbe, 2002) were conducted for eBAC and subjective responses to alcohol (stimulation, sedation, feeling, liking, and

wanting more) and tested the effects of both social context (alone or with others) and location (dichotomized as bar/restaurant or other locations) at each time point during the 3-hour HR-EMA period. Location was dichotomized as “bar/restaurant” or “other” to compare private residences and all infrequently reported locations (i.e., “outside,” n = 68, 7.02%, “work/school,” n = 6, 0.62%, “vehicle,” n = 33, 3.41% or “other” n = 3, 0.31%) to the location of interest (bars/restaurants) where we expected higher levels of alcohol consumption and enhanced positive reward. All models controlled for sex, baseline (past month) heavy drinking frequency, drinking episode, and family history of AUD (first-degree biological relatives only). Models predicting alcohol subjective responses (alcohol feeling, stimulation, sedation, liking, and wanting more) also included eBAC to account for the effect of alcohol consumption at each survey time point. All valid HR-EMA data were included in the analyses regardless of whether the episode met criteria for a binge. The high number of repeated observations across the two HR-EMA episodes allowed for all GEE models to detect a small-to-medium effect size (0.10–0.25) as defined by Cohen (1992), with 80% power and a type-1 error rate of 0.05.

Results

Table 1 shows background demographic and drinking characteristics for the sample. Participants were approximately 25.5 years of age, 57% male, racially diverse, and most had a college education. They reported drinking alcohol on 47% of days in the month prior to enrollment and binge drinking on 22% of days, with a mean of 6.4 drinks consumed. The mean number of AUD symptoms met in the past year was 1.8±1.2 SD with nearly half the sample (n = 29; 47%) endorsing 0 or 1 AUD symptom, or meeting criteria for mild (2–3 symptoms; n = 26, 43%) or moderate AUD (4–5 symptoms; n = 6, 10%).

While participants were not required to drink a specified amount during the HR-EMA episodes, 104 (85%) of the 122 drinking episodes recorded by participants met or exceeded the definition of heavy (binge) drinking (i.e., ≥5/4 drinks consumed for men/women). The remaining 15% of episodes consisted of moderate (9%, M±SD = 3.6±0.5 drinks consumed) and light (6%, M±SD = 2.1±0.7 drinks consumed) drinking events. The proportion of participants reporting binge drinking was similar between the first (53/61, 87%) and second (51/61, 84%) episodes (p = .13) with 7.7±3.4 standard drinks consumed in episode 1 versus 6.8±3.1 in episode 2 (p =.06). Examined separately, eBAC at the end of each 3-hour monitoring period exceeded the threshold for intoxication for both episodes; episode 1 = 0.15±0.08 g/dL, episode 2 = 0.13±0.07 g/dL, p = .08.

Of the 971 survey prompts completed across both episodes, most (81%) were completed in the social context of with others versus alone. As noted in our prior report (Fridberg et al., 2021), participants completed more surveys with others during the first episode versus the second (84% versus 78%, respectively, p = 0.03). Twenty-nine percent of survey prompts (n = 284) were completed in a bar/restaurant, compared with 70.7% (n = 687) at other locations, with the majority of those (59%, n = 575) completed in private residences (i.e., the participant’s own home or a friend’s home). Most drinking episodes occurred within a single context, as 84% and 64% of participants reported stable social context in the first and second episodes, respectively, and 66% and 64% remained in the same location for the episodes,

respectively. In addition, participants rarely endorsed consummatory behaviors other than drinking alcohol during the episodes, such as eating (11.8% of surveys completed), smoking (1.7%), or other drug use (0.2%).

Table 2 shows the results of the main analyses examining associations among social context, drinking location, eBAC (calculated from reported drinks), and subjective alcohol responses. Consistent with our hypotheses, eBAC increased more rapidly over time when participants were with others versus alone (social context × time $p = .006$; Table 2, Figure 1A) and more rapidly when participants drank in bars/restaurants compared to all other locations (location × time $p = .04$; Table 2, Figure 2A).

Alcohol consumption and subjective responses differed significantly across social context. Interaction effects with time revealed that, even when controlling for eBAC, ratings of alcohol feeling, stimulation, liking and wanting more were significantly higher later in the episodes when participants drank with others versus alone (social context × time; ps < .05; see Table 2 and Figures 1B, 1C, 1E, 1F). There was also an interaction effect between social context and time for measures of sedation, such that those drinking alone reported feeling more sedated compared with those who drank with others ($p <$. 001; Figure 1D).

Regarding associations between drinking location and alcohol subjective responses, ratings of alcohol feeling, stimulation, and liking were significantly higher in bars/restaurants compared to all other locations (ps < .05; see Table 2 and Figures 2B, 2C, 2E). There was no significant main effect ($p = .05$) or interaction of location for sedation ($p = .71$; Figure 2D). Participants reported higher alcohol wanting in bars/restaurants versus other locations as the HR-EMA episodes progressed (location × time $p = .03$; Figure 2F).

Discussion

The present study found significant associations among drinking context, alcohol use, and subjective alcohol responses during real-world drinking episodes in young adult heavy drinkers. Participants drank more alcohol when drinking with others versus alone and when drinking in bars/restaurants versus other locations. Even after controlling for these differences in alcohol consumption, the stimulating and rewarding (liking, wanting) effects of alcohol were more pronounced, and sedative effects dampened, when participants were with others versus alone, especially from 60 minutes in the episodes onward (Figures 1, 2). Alcohol stimulation, liking, and wanting were also enhanced when consumption took place in bars/restaurants versus other locations. Last, drinking context remained mostly consistent throughout the episodes, unlike prior reports in college drinkers, and switching drinking context (or not) within the 3-hour episode was not associated with maximum eBAC.

Our findings build upon prior laboratory-based, retrospective reports, and EMA studies of the associations between drinking context and subjective alcohol responses. Prior laboratory research manipulated drinking context to show that drinking with others (Corbin et al., 2021; Kirkpatrick & de Wit, 2013) and drinking in environments designed to mimic bars/restaurants (Corbin et al., 2015) were associated with enhanced subjective alcohol reward among young adults who consumed a fixed dose of alcohol (typically targeting 0.08 g/dL

BAC). The present results showed similar effects during real-world drinking events and found that differences in alcohol subjective responses across drinking contexts may increase as drinking continues past the typical threshold of intoxication.

One interesting finding in this study was that the associations among social context and location with alcohol responses were not driven solely by heavier drinking in those situations (i.e., GEE analyses controlled for amount of alcohol consumed). Social context amplified positive alcohol subjective effects during the latter portions of the drinking episode but not the earlier portions. Thus, the cumulative effects of alcohol felt later in excessive drinking episodes may be more sensitive to social context and location than the initial portions of such an episode due to alcohol metabolism effects, and/or disinhibition that results from progression of drinking during an episode. To our knowledge, the only other HR-EMA study examining contextual factors on alcohol responses (Piasecki et al., 2012) had similar findings of greater subjective alcohol “buzzed” and “excitement” when with others and when drinking in bars/restaurants compared to other venues even during more moderate episodes, albeit with concomitant cigarette smoking during the episode in many participants.

The present findings have potential clinical relevance and implications for future studies. Heavy drinking is maintained or increases over time in young adults who experience reduced negative affect or enhanced euphoric and pleasurable effects after consuming alcohol in the laboratory (King et al., 2011; King et al., 2021; Venerable & Fairbairn, 2020). In line with these studies, the current finding that drinking in the presence of others or in public locations is associated with alcohol’s positive effects suggests that regular drinking in those contexts could further increase heavy drinkers’ risk for future drinking exacerbations or AUD. Further, the current study findings showing that drinking alone (versus with others) is not associated with enhancement of alcohol’s pleasurable effects is consistent with prior work showing that solitary drinking may be motivated by a desire to reduce negative affect (Creswell et al., 2021; Corbin et al., 2020; Creswell et al., 2014; Christiansen et al., 2002; Kuntsche et al., 2005). As the current study did not assess negative emotional states, future HR-EMA of naturalistic drinking events should include items assessing negative affect to form a more complete picture of contextual effects on a wide range of alcohol responses. Finally, most heavy drinkers in the present study reported stable social context and location during the 3-hours comprising each HR-EMA monitoring period. While changes in drinking context were not a specific focus of the present study, future research examining the effects of social and environmental context stabilization versus fluctuations on drinking behavior and alcohol repsonses may help to identify subgroups of at-risk drinkers in adolescence and young adulthood.

There were several strengths of the study, including testing at-risk heavy drinkers with minimal smoking or other substance use, high compliance with the HR-EMA protocol with 87% of assessments completed, and use of well-validated scales to assess alcohol effects. The HR-EMA protocol was rated as feasible, acceptable, and reliable by participants as detailed previously (Fridberg et al., 2019). At the same time, the results should be interpreted considering some limitations. First, the 3-hour period of smartphone prompts may not have captured the entire drinking period or the declining eBAC limb (Fridberg et

al., 2019). This interval was chosen to capture binge drinking during rising-to-peak eBAC, but not so long that it would place undue burden or complacency on subjects. Future HR-EMA work will need to balance the benefit of data capture to extend the duration of monitoring (Piasecki et al., 2012) versus participant engagement and fatigue issues. Second, participants recorded two drinking episodes, in contrast to prior HR-EMA work which captured a larger number of drinking events (Piasecki et al., 2012). However, most episodes (85%) reported in this study met the definition of a heavy/binge episode, indicating that this approach is useful for capturing data during high-risk drinking events. Relatedly, as this study assessed primarily binge drinking events, the results may not generalize to non-binge drinking episodes. Third, our measures did not evaluate how well participants knew the other individuals with whom they were drinking. Prior research suggests that drinking in a novel social setting (i.e., drinking with strangers) may enhance alcohol reward relative to drinking with friends (Fairbairn, 2017), so future HR-EMA work could include additional questions to capture such factors.

In conclusion, both social context and location, i.e., drinking with others and public places, are associated with greater alcohol consumption, heightened alcohol stimulation, and rewarding effects, even after controlling for alcohol consumption among heavy social drinkers. The present data build upon previous laboratory and EMA-based studies indicating that context may play an important role in drinking behavior and related outcomes. These factors are particularly important for young adults who are heavy drinkers and/or with mild or moderate AUD and could help understand the factors and motivations that maintain excessive drinking or lead to exacerbations over time. Future research may help elucidate natural environment effects that are not possible in the controlled laboratory setting.

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Public health significance:

Binge drinking is associated with progression to alcohol use disorder (AUD) and alcohol-related harms. Among heavy-drinking young adults, individual differences in alcohol subjective responses, i.e., reduced negative affect or enhanced pleasurable effects after consuming alcohol, are risk factors for continued binge drinking and related consequences. This study of young adults' experiences during real-world heavy drinking events found that drinking in the presence of others or in public locations is associated with alcohol's positive effects, suggesting that frequent drinking in those contexts could further increase risk for future drinking exacerbations and AUD in that group.

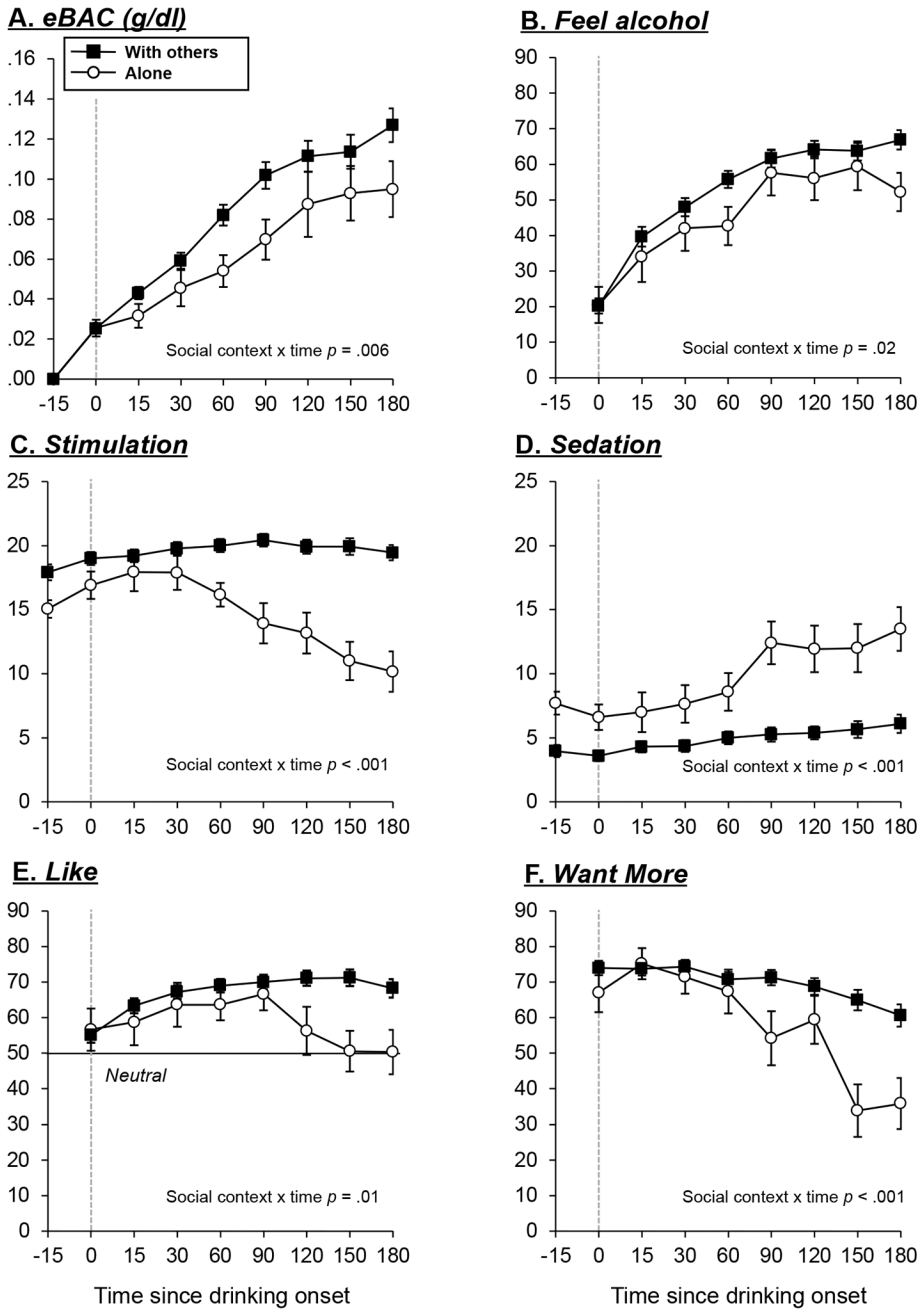

Figure 1.

Estimated blood alcohol concentration (eBAC) and subjective responses to alcohol when participants drank with others (square markers) or alone (circle markers).

Note. Values shown are mean ± SEM. The vertical dashed line in each panel indicates when participants completed their post–first-drink survey. Alcohol feel, like, and want more were measured using the Drug Effects Questionnaire; alcohol stimulation and sedation were assessed using the Brief Biphasic Alcohol Effects Scale. eBAC, estimated blood alcohol concentration.

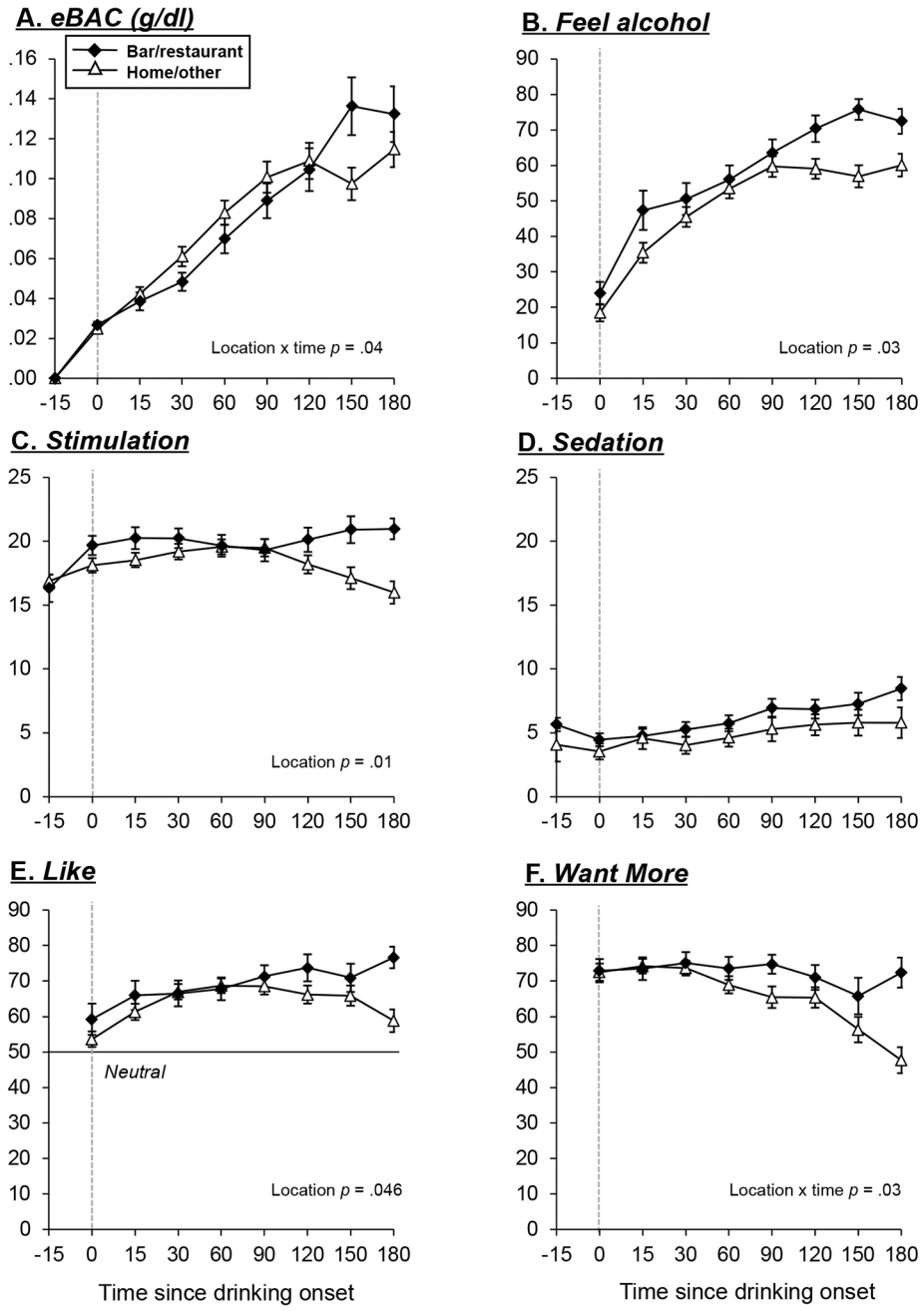

Figure 2.

Estimated blood alcohol concentration (eBAC) and subjective responses to alcohol when participants drank in a bar/restaurant (diamond markers) or other location (triangle markers). Note. Values shown are mean ± SEM. The vertical dashed line in each panel indicates when participants completed their post–first-drink survey. Alcohol feel, like, and want more were measured using the Drug Effects Questionnaire; alcohol stimulation and sedation were assessed using the Brief Biphasic Alcohol Effects Scale. eBAC, estimated blood alcohol concentration.

Table 1

Demographic and Drinking Characteristics for the Study Sample (N = 61)

Sample Characteristic	*M* (*SD*) or %	Range
Demographics		
Age (yrs)	25.5 (2.6)	21–30
Sex (male)	57%	-
Education (yrs)	16.0 (1.9)	12–20
Race		
% White	66%	-
% Black	10%	-
% More than one race	15%	-
% Other	9%	-
Family history		
% Family history of alcohol use disorder[a]	30%	-
Alcohol use background		
% Drinking days (past mo)	47.0%	18–100%
% Binge drinking days (past mo)	22.1%	4–50%
Drinks/light drinking day (past mo)	2.4 (0.7)	1–4
Drinks/binge drinking day (past mo)	6.4 (1.4)	4–10
AUDIT total	11.2 (4.6)	3–27
DSM-5 AUD symptoms	1.8 (1.2)	0–4

Note. Baseline drinking outcomes (% drinking/binge days, drinks/day) were measured via a past-month alcohol timeline follow-back interview.

[a]Positive family history of alcohol use disorder was established by a family history tree interview and deemed positive if at least one biological parent or sibling with known or suspected alcohol use disorder (AUD). AUDIT = Alcohol Use Disorders Identification Test (Babor et al., 2002).

Table 2

Results of the GEE Analyses Predicting Estimated BAC (eBAC) and Alcohol Subjective Responses

	eBAC			*Feel*			*Stimulation*			*Sedation*			*Like*			*Want More*		
	***b* (SE)**	**z**	***p***	***b* (SE)**	**z**	***p***	***b* (SE)**	**z**	***p***	***b* (SE)**	**z**	***p***	***b* (SE)**	**z**	***p***	***b* (SE)**	**z**	***p***
Time	0.02 (0.003)	6.57	<.001	9.10 (1.58)	5.77	<.001	−2.12 (0.36)	−5.81	<.001	1.80 (0.35)	5.14	<.001	−2.26 (1.54)	−1.47	.14	−9.90 (1.59)	−6.24	<.001
Social context	0.002 (0.007)	0.26	.80	−2.29 (2.94)	−0.78	.44	1.35 (0.68)	1.98	.05	−2.87 (0.65)	−4.39	<.001	1.38 (2.85)	0.48	.63	7.19 (2.93)	2.45	.01
Social context × Time	0.01 (0.004)	2.74	.006	3.80 (1.65)	2.30	.02	1.98 (0.38)	5.20	<.001	−1.12 (0 .37)	−3.07	<.001	4.52 (1.60)	2.82	.01	6.30 (1.65)	3.81	<.001
Location	−0.001 (0.001)	−0.13	.90	5.15 (2.32)	2.22	.03	1.40 (0.54)	2.61	.01	−1.00 (0.52)	−1.94	.05	4.49 (2.25)	2.00	.046	1.13 (2.31)	0.49	.62
Location × Time	0.006 (.003)	2.06	.04	−0.32 (1.33)	−0.24	.81	0.25 (0.31)	0.81	.42	0.11 (0.29)	0.37	.71	0.11 (1.29)	0.08	.93	2.84 (1.32)	2.15	.03
Episode	−0.008 (0.003)	−2.86	.004	3.64 (1.18)	3.08	<.001	−0.28 (0.27)	−1.02	.31	−0.40 (0.26)	−1.52	.13	0.28 (1.15)	0.25	.81	−3.82 (1.18)	−3.24	<.001
eBAC	-	-	-	405.81 (25.87)	15.69	<.001	36.63 (5.97)	6.13	<.001	9.18 (5.76)	1.59	.11	170.65 (25.09)	6.80	<.001	80.83 (25.79)	3.13	<.001
eBAC × Time	-	-	-	−100.16 (11.38)	−8.80	<.001	−9.20 (2.63)	−3.50	<.001	−0.42 (2.52)	−0.17	.87	−37.49 (11.07)	−3.39	<.001	−40.13 (11.35)	−3.54	<.001
Sex	−0.007 (0.009)	−0.73	.46	−3.01 (3.85)	−0.78	.44	1.37 (0.90)	1.53	.13	−0.05 (0.96)	−0.05	.96	4.99 (3.38)	1.48	.14	7.59 (3.77)	2.01	.04
FH	0.029 (0.10)	2.90	.004	−7.79 (4.21)	−1.85	.06	−1.51 (0.98)	−1.54	.12	0.08 (1.05)	0.08	.94	−7.14 (3.69)	−1.93	.05	−6.12 (4.12)	−1.49	.14
Past-month binge drinking	0.002 (0.002)	0.94	.35	0.75 (0.74)	1.01	.31	−0.12 (0.17)	−0.68	.50	0.30 (0.19)	1.63	.10	0.59 (0.65)	0.90	.37	1.14 (0.73)	1.56	.12

Note: N = 61. All models predicting alcohol subjective responses (alcohol feeling, stimulation, sedation, liking, and wanting more) covaried for BrAC/eBAC, time, background characteristics and drinking, and HR-EMA episode (i.e., first or second completed). For the models, social context was coded as 0 = “alone and” 1 = “with others,” and current location was coded as 0 = “private residence/other” and 1 = “bar/restaurant.” Time was entered as hours since drinking started. HR-EMA = high-resolution ecological momentary assessment; eBAC = estimated blood alcohol concentration; FH = family history of problematic drinking in first-degree relatives.