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Context and Craving Among Individuals With Alcohol Use Disorder Attempting to Moderate Their Drinking

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Many individuals with alcohol use disorder (AUD) prefer a goal of moderation, because they do not see their drinking as causing severe enough consequences to merit abstinence. Given that individuals attempting to moderate will continue to put themselves in contexts where drinking occurs, understanding how distinct external alcohol cues prompt craving is important for implementing the optimal treatments for individuals with AUD. Using data from a randomized controlled trial of stepped care brief interventions for AUD, this study explored the relationship between drinking contexts and craving in individuals attempting to moderate their drinking using ecological momentary assessment (EMA). At baseline, participants were asked to prospectively identify drinking contexts that were particularly likely to elicit intense craving and heavy drinking, called highly valued drinking contexts (HVCs). During EMA, participants were asked to report three times a day (morning, afternoon, evening) on their non–mutually exclusive contexts and their level of craving. Using multilevel modeling, all drinking contexts were tested as concurrent predictors of craving across the 84 days of the study. Next, AUD severity was tested as a moderator of HVC on craving. Results demonstrated that being in an HVC corresponded to greater reports of any craving and intensity of craving, over and above the influences of several other contextual factors (e.g., negative affect and already drinking). AUD severity significantly moderated HVC's impact on any craving, such that greater AUD severity potentiated HVC's already high odds of any craving. Implications for treatments for individuals with AUD are discussed.

Public Health Significance
Alcohol use disorder (AUD) is a highly prevalent disorder, experienced around the globe. Craving, one of the hallmarks of AUD, is highly associated with continued use and/or relapse to use. This study provides important information about context eliciting craving that is useful to both those suffering with and treating AUD, so as to provide greater opportunities for reduction of harm and successful recovery.

Keywords: alcohol craving, alcohol use disorder, drinking context, drinking cues

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Alcohol use disorder (AUD) is a costly, heterogeneous disorder that is widespread across the globe (Rehm et al., 2009). Individuals with AUD present with a continuum of symptoms, with some demonstrating greater severity than others. Among those individuals with AUD, a subset are characterized by having mild to moderate levels of AUD severity, low rates of co-occurring disorders, and higher psychosocial functioning than those with severe AUD (Hester, 1995; Morgenstern et al., 2007, 2012, 2017; Rosenberg, 1993). These individuals, historically referred to as problem drinkers, may endorse symptoms of AUD but do not report a history of withdrawal or extreme personal or social consequences from drinking in their lives. Given their tendency for higher functioning and a symptom profile that is relatively less severe, this subset often does not identify consequences from drinking as being severe enough to require abstinence, thus preferring a goal of moderation, and rarely seek specialized treatment. These individuals are estimated to make up about half of all individuals with AUD (Moss, Chen, & Yi, 2007). Engaging with individuals with AUD around a goal of moderation can lead to harm reduction, health improvement, and prevention of worsening AUD.

The Unique Situation of Craving in the Context of Moderation as a Drinking Goal

For individuals with AUD, achieving moderate drinking (i.e., drinking within the healthy/low-risk guidelines set out by the National Institute for Alcohol Abuse and Alcoholism (NIAAA); National Institute on Alcohol Abuse and Alcoholism, 2013) may pose unique challenges compared with abstinence. Given that individuals attempting to moderate drinking regularly expose themselves to alcohol and other external alcohol-related cues, such as drinking contexts (i.e., bars), they are likely to trigger highly automated neurocognitive processes involving craving that lead to and/or sustain harmful drinking behaviors (Naqvi et al., 2015). Alcohol cues, including continued drinking or even a small priming dose of alcohol, are associated with increased craving and subsequent alcohol use (Carter & Tiffany, 1999; Christiansen, Townsend, Knibb, & Field, 2017; Hallgren, Delker, & Simpson, 2018). Understanding how alcohol cues prompt craving on a daily or momentary basis among individuals with AUD attempting to moderate is important for honing brief and heat of the moment interventions (e.g., Dulin & Gonzalez, 2017) that can interrupt the automatic processes and reduce harm.

The Association Between Craving and Drinking

Alcohol craving is a subjective state of wanting or a desire to drink (Dulin & Gonzalez, 2017; Kozlowski, Mann, Wilkinson, & Poulos, 1989). Craving is now a criterion for AUD (American Psychiatric Association, 2013), and when endorsed, it is a strong indicator of AUD among nontreatment seekers (Hartwell & Ray, 2018). Both any presence of and intensity of craving are associated with subsequent increased drinking, both proximally (e.g., within an hour or day, Dulin & Gonzalez, 2017; Fazzino, Harder, Rose, & Helzer, 2013; Moore et al., 2014; Serre, Fatseas, Denis, Swendsen, & Auriacombe, 2018) and distally (e.g., up to a week or longer, McHugh, Fitzmaurice, Griffin, Anton, & Weiss, 2016; Morgenstern, DiFranza, Wellman, Sargent, & Hanewinkel, 2016), with proximal relationships appearing to be stronger (Serre, Fatseas, Swendsen, & Auriacombe, 2015). Some studies also demonstrated that craving is a stronger predictor of drinking than even prior drinking (e.g., Flannery, Poole, Gallop, & Volpicelli, 2003). Importantly for individuals with AUD attempting to moderate their drinking, alcohol use and craving are demonstrated to have a reciprocal relationship (Browne, Wray, Stappenbeck, Krenek, & Simpson, 2016; Fazzino et al., 2013; Flannery et al., 2003), each increasing the other prospectively.

The Association Between Alcohol Cues and Craving

Alcohol cues predict alcohol craving (Carter & Tiffany, 1999), yet there is surprisingly little research on which types of cues or contexts drive alcohol craving on a daily basis (Serre et al., 2015), particularly in the context of a goal of moderation or among a general population of individuals with AUD. In vivo alcohol cues extend beyond direct exposure to alcohol itself; studies have consistently shown that contexts associated with alcohol use become cues for use themselves (Childs & de Wit, 2016). Although a number of studies have examined alcohol craving using ecological momentary assessment (EMA), few have examined type of context directly or in detail among adults, beyond experiencing negative affect (e.g., Hallgren et al., 2018; Kaysen et al., 2014; Law et al., 2016; Lukasiewicz, Benyamina, Reynaud, & Falissard, 2005; Piasecki et al., 2011; Richardson et al., 2008; Todd et al., 2005). The few studies that focused on context beyond negative affect provide information about the additional real-world alcohol cues driving craving (Dulin & Gonzalez, 2017; Lane, Carpenter, Sher, & Trull, 2016; Trela et al., 2018; Witteman et al., 2015), each focusing on a subpopulation of individuals with AUD. Witteman et al. (2015) found, not surprisingly, that exposure to advertisements for alcohol in the real world environments of alcohol dependent patients enrolled in detoxification treatment increased craving. Dulin and Gonzalez (2017) examined the effectiveness of a smartphone based intervention designed to help individuals attempting to reduce their drinking cope with craving. Participants ($N = 28$) were asked to report their daily craving intensity, craving cue type, and their coping response to the craving for 6 weeks. Researchers found that while certain cues were more common, the strongest predictors of craving and subsequent drinking were the cues: time of day or week (e.g., weekend), "people drinking around me," and being around alcohol. Trela et al. (2018) reported findings consistent with those of Dulin and Gonzalez among individuals who drink frequently with low sensitivity to alcohol. For these individuals, time of day, day of week, being with a friend, and being in a restaurant/bar predicted craving. In both studies, some external cues were more instrumental than others in predicting craving and subsequent drinking in the context of a goal of moderation or social drinking.

Another study also demonstrated the strong influence of real-world alcohol cue exposure (time of day, day of week, physical location, and social environment) on craving and drinking (Lane et al., 2016); however, this study found that the relationship was more complicated for those with a substance use disorder (SUD) compared with those without an SUD. In this study, researchers examined craving among 56 women with borderline personality disorder in treatment for SUD compared with 60 women from the community. Results demonstrated that women with borderline personality disorder reported more intense craving for alcohol and

subsequent drinking across all contexts (time of day, day of week, people, and place) than the community sample. For those with SUD, no contexts emerged as being particularly important or salient for intense alcohol craving, as it would seem craving was generalized across context for this group.

Hierarchy and Valuation of Alcohol Cues

The hierarchy of external alcohol cues according to strength of impact on drinking in response to craving and their summative effect is likely heterogeneous across individuals. Because of its burden, EMA is still a necessarily reductionistic method of measuring environment and/or context. Although EMA can gather detailed information about context (e.g., in a bar, with coworkers, specifics about which bar, positive or negative mood), each question increases the burden of the EMA battery. Thus, the more detailed the assessment, the greater chance of noncompliance.

Although physical location, environment, and who one is with while drinking can all be measured, these questions are further limited by the fact that they exclude what we term *valuation*. Valuation is defined here as the personal importance, weight, or emotional tone a person places on a particular drinking context in which they perceive it to be particularly difficult to resist drinking. Some individuals may consider specific, highly personalized contexts for drinking (e.g., after work at a specific bar with specific coworkers) the most triggering and high risk and, as a result, find it extremely difficult to moderate within these particular contexts. Within data collected via EMA, such a context may not be easily distinguished from a context that contains similar attributes (e.g., after work at a specific bar with different coworkers) but does not present the same level of challenge. One way to parsimoniously capture contexts that are valued highly may be to ask participants to preidentify settings or situations in a baseline survey that typically lead them to drink heavily. Whether they are in that individualized context can then be clarified with one EMA question assessing whether they are in a highly valued context. The present work is the first to apply such an approach to understanding the importance of context for alcohol craving.

This Study

To further understand the role of distinct drinking contexts in producing craving for individuals with AUD with a goal of moderation, including those with high valuation, we examined the relationship between drinking context and craving using EMA data from a randomized, controlled trial testing stepped care, brief interventions with individuals who drink beyond NIAAA low-risk guidelines. As craving in the context of harm reduction was our primary construct of interest, we were interested in the following research questions: (research question 1) Is craving associated with daily drinking? (research question 2) Is craving associated with today's drinking over and above the previous day's drinking? (research question 3) How do distinct contexts for drinking, including those with high valuation, relate to craving? (research question 4) Do highly valued contexts relate to greater presence and intensity of craving over and above other contexts? And (research question 5) does AUD severity moderate the impact of highly valued contexts on craving? We hypothesized that craving would relate to daily drinking, over and above the previous day's drinking, and that highly valued contexts would elicit craving over and above other drinking contexts. Finally, given that the literature illustrates that having AUD generalizes craving across contexts (e.g., Lane et al., 2016), we also posited that individuals with greater severity of AUD would be less reactive to a highly valued context, as they would be more likely to experience stronger craving across all drinking contexts compared with individuals with low severity AUD.

Method

For this analysis, data from 153 participants in a clinical trial (Registration no.: NCT02511808) testing stepped care brief interventions for AUD were utilized to explore the above research questions, for whom we had EMA data. The direct impact of stepped care will be explored in a future analysis. For this study, we focused only on the individual level responses describing drinking contexts using EMA across the entire study period. All procedures were reviewed for safety and ethics of human subject research and approved by an Internal Review Board at the Feinstein Institutes for Medical Research at Northwell Health.

Participants

Recruitment. General advertising online and in local media was used to nationally recruit participants seeking treatment to moderate their drinking. If initial eligibility criteria were met via phone screening, participants were scheduled for an in-person or online full screening assessment, depending on participant preference.

Study eligibility. Participants were considered eligible if they (a) were between ages 18 and 75 and (b) had an estimated average weekly consumption of ≥15 standard drinks per week, or 12–15 standard drinks per week and more than two binge days (four or more standard drinks per sitting) for women; had an estimated average weekly consumption of ≥24 standard drinks per week, or 14–25 drinks per week and more than two binge days (five or more standard drinks per sitting) for men. Participants were excluded if they: (a) had a substance use disorder (for any substance other than alcohol or nicotine) or were regular (defined as greater than weekly use) drug users; (b) had a serious psychiatric disorder; (c) demonstrated clinically severe AUD, as evidenced by current physical withdrawal symptoms or a history of serious withdrawal symptoms (e.g., delirium tremens, seizures); (d) ever received inpatient treatment for alcohol use (e.g., detox) and (e) were actively involved in another treatment for alcohol use (i.e., self-help groups, outpatient therapy) in the past 90 days.

Procedure

Data for this study were taken from a parent study of heavy drinkers with AUD. The parent study used a SMART design (Lei, Nahum-Shani, Lynch, Oslin, & Murphy, 2012) with multiple points of randomization of participants to interventions such as Motivational Interviewing (Morgenstern et al., 2017) and/or Behavioral Self-Control Therapy (BSCT, Hester, 1995). After a phone screening, participants completed the consent form and quiz electronically via REDCap to ensure comprehension. All following assessments were conducted via telehealth or in-person. They

then completed a screening interview during which participants completed a battery of computerized assessments to verify study eligibility. Eligible participants were enrolled in the study. One week after screening, all participants (a) completed their baseline assessment, (b) were trained on EMA (described further below), and (c) received initial brief advice. Brief advice involved providing feedback about risk for AUD, determining motivation to moderate, setting drinking goals, and discussing strategies and potential challenges for reducing drinking. Participants were reassessed for responsiveness to treatment at weeks 4 and 8 and reallocated to treatment groups accordingly. The same EMA battery was completed by all participants throughout, regardless of treatment response or assignment. Participants completed an end of treatment (week 13), as well as a posttreatment follow up (week 24), assessment. Retention was high, with rates for weeks 4, 8, 13, and 24 assessments at 92.0%, 84.7%, 77.9%, and 74.2%, respectively. At any point in the study, participants were offered referrals for community treatment for those who wanted them.

Ecological momentary assessment (EMA). Participants were assessed three times a day for 84 days. Text messages were sent via WellPass to participants as random prompts to complete online surveys during three different windows of time during the day: morning (between 6 a.m. and 12 p.m.), afternoon (between noon and 6 p.m.), and evening (between 5 p.m. and 11 p.m.). Text messages included a link to the online survey, which participants completed on their smartphones. During the morning survey, information about both the last 24 hr and the present moment was collected. Questions asked about, among other topics, alcohol consumption in the last 24 hr, desire to drink in the last 30 min, and the context in which the participant was located in last 30 min. The morning survey had 18 to 25 items, depending on skip patterns, and took 5–7 min to complete. The five- to seven-item afternoon and evening surveys collected information only about alcohol consumption thus far that day, desire to drink, and context in last 30 min. Afternoon and evening surveys took no more than 3 min to complete.

Compensation and compliance. Participants received escalating compensation for all completed assessments, as the study progressed. For cross-sectional assessments, participants received $20 to $75 for assessments at screening through follow-up. For EMA, compensation increased throughout the day and throughout the study. For the first three weeks of the study, participants received $1 for each morning survey completed, $3 for each week when at least 10 afternoon/evening surveys were completed, and an additional weekly $2.50 bonus if a randomly selected evening survey was completed. In treatment weeks 4 through 7 and 8 through 12, these compensation rates were raised to $1.10/3.50/2.75 and $1.25/4.00/3.00, respectively. Compliance rates for EMA for the entire study period across all possible reports ranged from 68.0% in the evening to 78.8% in the morning (see Table 1).

Measures

Demographics. A demographic questionnaire collected data on age, gender, educational and occupational information, race and ethnicity, medical history, and substance abuse history.

Criteria for AUD. The Composite International Diagnostic Instrument, Substance Abuse Module (CIDI-SAM; Cottler, Robins, & Helzer, 1989), a well-established diagnostic interview with excellent reliability and validity (Wittchen et al., 1991), was used to assess the number of AUD criteria a participant satisfied.

AUD severity. To measure AUD severity, the Alcohol Dependence Scale (ADS; Skinner & Allen, 1982) was used. The ADS is a 25-item self-report measure used to assess severity of alcohol dependence during the in-person screen. A composite sum score was created after reverse coding the last item ($\alpha = .76$). Scores below 13 indicate symptomatology warranting no more than a brief intervention.

Time of day. Time of day is the variable accounting for the time of day an EMA survey was implemented: morning, afternoon, or evening.

Weekend. Sunday through Thursday were coded as weekday. Friday and Saturday were coded as weekend.

Treatment dosage. Treatment dosage was used as a covariate and calculated using how many additional treatment sessions a participant received beyond initial BA. Therefore, initial brief advice was coded as 0. One session of MI or BSCT was coded as 1. The condition that consisted of one MI session and four BSCT sessions was coded as 5. The treatment dosage ranged from 0 to 5.

Contexts.

Context. During each EMA survey throughout the day, participants were queried on their contemporaneous context (past 30 min). Response options were: "in a place where alcohol is usually served: bar, restaurant, party or club," "Been at a social event where you and your friends often drink: dinner at someone's home, sporting event, girls night," "Been in a situation where you often drink, even if friends are not present: at home, after working to unwind, before going out to a party," "Felt especially upset, tense, stressed or angry," in an HVC (defined below), "Been already drinking," and "None of the above." Responses were not mutually exclusive, and participants selected all that applied. Face valid options for the response set were adapted from past scripts for EMA in previous studies (e.g., Mereish, Kuerbis, & Morgenstern, 2018). For these analyses, each type of setting, except none of the above, were represented by dichotomous variables (0 = not in setting, 1 = in setting).

Highly valued context (HVC). In an attempt to parsimoniously capture contexts that are valued highly, participants were asked to identify and describe settings/contexts/situations in which they typically drink heavily and/or they find particularly difficult to control their drinking during the initial face-to-face, baseline interview. Participants could name as many of these situations as they wanted, and these became labeled the participant's HVCs. For each HVC, information was collected about its frequency, its attributes (e.g., at home, with others, alone, time of day), and their motivation for drinking associated with that HVC. Only two participants reported more than three HVCs. Although all HVCs were included in the regression models, only descriptive data on participants' first three HVCs are included here.

Participants were reminded of their HVCs in each text message with a short summary phrase. When participants reported they were in an HVC in the last 30 min, within the context variable above, they were asked to identify in which HVC they were. Participants could report more than one HVC. Participants were given prompt reminders of their HVCs to increase accuracy. Due to the fact that only 1.5% of across all reports had multiple HVCs, the HVC variable included in this analysis did not account for

Table 1
Baseline Characteristics of Study Sample and EMA Compliance

Variable	Overall sample (N = 153)	
	M or %	*SD*
Demographics		
Age (years)	51.0	11.9
Male	31.4	
Race/ethnicity		
Non-Hispanic, White/Caucasian	90.8	
Hispanic/Latino, any race	6.5	
Other	2.7	
Education		
High school diploma/GED and under	3.9	
Some college/associate's	22.2	
Bachelor's degree	26.8	
Some graduate school or higher	47.1	
Employment		
Employed	77.0	
Unemployed/looking for work	3.9	
Not in labor force/not looking for work	19.1	
Drinking severity		
Mean sum of standard drinks per week	31.7	14.9
Mean drinks per drinking day	5.7	2.7
Alcohol Dependence Scale (ADS)	13.2	5.7
Number of alcohol dependence criteria met	6.8	2.2
Number of criteria endorsed for *DSM–5* Alcohol Use Disorder (AUD)		
2–3 criteria, mild AUD	7.9	
4–5 criteria, moderate AUD	21.0	
6 or more criteria, severe AUD	71.1	
EMA compliance (%, of N = 12,124 reports)		
Morning	78.8	
Afternoon	73.9	
Evening	68.0	

Note. *DSM–5* = *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*; EMA = ecological momentary assessment; GED = general education diploma.

multiple HVC in the last 30 min. If they were in any HCV, it was coded as 1.

Craving. On all three EMA surveys, participants were asked "How much do you desire or have a craving to drink right now (right now includes the last 30 minutes)" with responses ranging from 0 (*no desire or cravings/urge*) to 8 (*extreme desire or craving urge*).

Drinking outcome. Drinking in the past 24 hr was measured using the morning survey, in which the number of standard drinks consumed in the last 24 hr were totaled and then lagged to be concurrent with reports of craving. Historically, this measure is shown to be correlated with drinking data collected using the Timeline Followback method (Kuerbis, Houser, Levak, Shao, & Morgenstern, 2018).

Analytic Plan

Analyses were performed in steps to answer the present research questions. Multilevel models (MLM) were estimated in SAS 9.4 (SAS Institute Inc., 2002–2012). MLM are appropriate for these data because they accommodate nested data, accounting for the nonindependence of observations, are robust to missing data, and can include random terms to model individual variability (Gibbons, Hedeker, & DuToit, 2010; Raudenbush & Bryk, 2002; Singer & Willett, 2003).

For question 1, the relationship of craving and drinking was tested to confirm that craving was indeed associated with drinking in this sample. We tested the impact of craving independently (i.e., alone), and then, for research question 2, we tested the same model with the covariate previous day's drinking on daily drinking, as measured by a count of drinks consumed. The MLM was fit to these count data using a Poisson distribution, with a log function specified, and a variance component structure, as it provided the best model fit when compared with alternative distributions and other covariance matrix structures. For these models, the GLIMMIX procedure was used.

Next, descriptives related to drinking context, and the related levels of craving were generated. For research questions 3 and 4, the impact of context on craving was explored using MLMs which employed two forms of craving as an outcome variable. First, a dichotomous outcome of experiencing any craving was utilized (1 = any craving; 0 = no craving). Generalized MLMs were fit to these data using a binary distribution, with a log link function specified, and a variance components covariance structure. For these models, the GLIMMIX procedure was used. Among those participants who reported any craving, the intensity of craving was modeled as a continuous outcome in MLMs with a normal distribution and an identity link function, with unstructured covariance. For these models, MIXED procedure was used.

Because craving was measured at multiple timepoints within day, all models included both random intercept and slope for time of day and EMA day in the study, permitting individual variability in craving over time in the study. Age, gender, education, employment, AUD diagnosis, whether participant received in person or telehealth assessments, receipt of treatment (dosage), count of day in the study (EMA day), type of day (weekday or weekend), and time of day were tested independently as covariates predicting craving (for both outcomes). All but the count of day in the study, weekend, and time of day were nonsignificant ($p > .05$) and were excluded. For research questions 3 and 4, we entered all of the dichotomous variables of context into the model together, including already drinking.

Finally, for research question 5, after testing the main effect of alcohol dependence symptoms, as measured by the ADS, on craving, we examined whether there was a moderating impact of ADS score on the relationship between HVC and craving by including a two-way interaction term. For this model, all continuous variables were grand mean centered.

Last, sensitivity analyses were conducted to ensure that findings were specific to the effect of context on a specific day relating to craving at that same time point. Inclusion of individual averages for each participant disaggregated the influence of today's context from the participant's own average amount of time spent in that context over the course of the EMA monitoring period. None of our results were changed by the inclusion of person aggregates, and these were excluded from final models for parsimony.

Results

Demographics

Table 1 shows basic demographics and characteristics of study participants. The sample was around 51 years old, primarily Caucasian, female, and at least college-educated. Participants reported moderately heavy drinking (averages of 32 weekly drinks and six drinks per drinking day). All participants met criteria for *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (*DSM–5*) AUD (range: 2–11 criteria endorsed; *M*: 6.8 criteria). However, ADS scores were relatively low ($M < 14$), confirming the appropriateness of an initially brief intervention for this sample.

Association Between Craving and Drinking

The intraclass correlation coefficient of drinking was .319 and indicated that 31.9% of the variance was attributable to person differences, and 68.1% of the variance in drinking was attributable to day-to-day variability within person. As hypothesized, craving was associated with daily drinking ($b = .17$, $SE = .00$, $p < .001$), such that for every unit increase in craving, drinking increased by almost a fifth of a standard drink. Craving remained significant in the context of previous day's drinking ($b = .20$, $SE = .00$, $p < .001$).

HVC Characteristics

Basic characteristics of the possible three HVCs per participant are shown in Table 2. The nonmutually exclusive categories show that over half of HVCs took place at home. Most HVCs were set exclusively in the evening. Just under half took place while the participant was alone. The primary motivations for drinking in an HVC were to enhance a good mood and liking the taste alcohol. Coping with negative affect comprised more than 70% of HVCs.

Table 2
Basic Characteristics of All HVCs

Characteristic	HVC % ($N = 364$)
Location this cue takes place: At home	61.3
Time of day this cue takes place: Evening	84.2
With whom does this cue take place: Alone	47.5
Motivation for drinking in an highly valued context (HVC)	
Enhance good mood or fun activity	82.0
Enjoy the taste of alcohol	82.9
Help deal with stress, anxiety, tension, irritation, anger	73.5
Help deal with sadness, loneliness, or feeling depressed	71.2
To socialize, feel more talkative, make social gathering more fun	57.7

Note. These characteristics were not mutually exclusive. All descriptors of the HVCs were collected during the in-person, baseline interview. HVC = highly valued context.

Frequency of Drinking Contexts and Associated Level of Craving

Table 3 shows the percentage of reports for each nonmutually exclusive type of context. Overall, not being in a drinking context at all was most common location, reflecting 63.9% of the total number of random-prompt reports. Among drinking contexts, HVCs were the most common, making up 19.1% of the random prompt reports. Already drinking was the next most common context, reflecting 12.3% of reports. Mean level of craving within each context is also shown in Table 3. All contexts were significantly higher in craving compared with the nondrinking context. Craving did not widely differ across context, as all were within about a one point range of one another.

Context as a Predictor of Craving

Experiencing any craving. The intraclass correlation coefficient was .163. This indicated that 16.3% of the variance was attributable to person differences, and 83.7% of the variance was attributable to day-to-day variability within person. All contexts were strongly associated with any craving, when controlling for the others (see Table 4). Already drinking, negative affect, and being in a usual drinking setting emerged with the strongest relations to any craving. Those who reported they were already drinking had 6.4 times the odds of experiencing any craving compared with those who were not already drinking. Those experiencing negative affect had 3.3 times the odds of reporting any craving compared with those not experiencing negative affect. For those in a usual setting where they drink, odds of any craving increased more than threefold compared with those not in a usual setting. Those participants in an HVC experienced 2.4 times the odds of any craving, over and above the other contexts, compared with those not in and HVC. For those in a place where alcohol is

Table 3
Descriptives and Mean Craving by Context (N = 28,842 Reports)

Context	Proportion of total reports (%)	Craving in context (includes 0) *M* (*SD*)
Been in a place where alcohol is usually served: bar, restaurant, party, or club. (*Place where alcohol served*)	5.1	3.4 (2.4)
Been at a social event where you and your friends often drink: dinner at someone's home, sporting event, girls' night out. (*Social event*)	3.2	3.8 (2.3)
Been in a situation where you often drink, even if friends are not present: at home after working to unwind, before going out to a party. (*Usual setting*)	9.6	3.5 (2.4)
Felt especially upset, tense, stressed or angry. (*Negative affect)*	5.6	3.2 (2.6)
In an HVC	19.1	3.1 (2.5)
Already drinking	12.3	4.3 (2.1)
None of the above	63.9	.8 (1.5)

Note. HVC = highly valued context. HVCs were identified at the screening interview by participants. The total number of possible observations across all times of day was 28,842.

usually served, odds of any craving increased over twofold compared with those not in a place where alcohol is usually served. Finally, for those at a social event, odds of any craving increased just under twofold compared with those not in a social setting.

Intensity of craving. The intraclass correlation coefficient for intensity of craving was .143, indicating that 14.3% of the variance in any craving was due to person differences and 85.7% of the variance was due to day-to-day changes within person. Being in any of the drinking contexts also significantly related to craving intensity, with already drinking, negative affect, and being in an HVC having the strongest relations to increased craving. Those who were already drinking reported craving levels that were almost a full unit of intensity higher compared with those who were not already drinking. Those experiencing negative affect experienced greater intensity of craving by an average of .81 units compared with those not experiencing negative affect. Those participants in an HVC experienced greater intensity of craving by an average of just over a third of a unit, compared with those not in and HVC. For those in a usual setting where they drink, intensity of craving was, on average, more than a third of a unit higher compared with those not in a usual setting. For those in a place where alcohol is usually served, intensity of craving was, on average, just under a third of a unit higher compared with those not in a place where alcohol is usually served. Finally, for those at a social event, intensity of craving was, on average, just over a fifth of a unit higher compared with those not in a social setting.

Main Effect of Severity of Alcohol Dependence on Craving

Experiencing any craving. When controlling for all drinking contexts, day of the study, weekend, and time of day, ADS score was significantly yet weakly associated with any craving ($b = .03$, $SE = .01$, $p < .05$), such that for every unit increase in ADS score, the odds of experiencing any craving increased by 3% ($OR = 1.03$, 95% CI [1.001, 1.06]).

Intensity of craving. There was no main effect of ADS score on intensity of craving.

Moderating Impact of Severity of Alcohol Dependence on HVC Predicting Craving

Experiencing any craving. There was a significant interaction between ADS score and HVC (Type III Tests of fixed effects, $F = 6.16$, $p < .01$; $b = .03$, $SE = .01$). Figure 1 demonstrates the model-based (empirical Bayes) relationship between these variables and any craving. While the predicted probability of reporting any craving was higher in an HVC for all participants, participants with higher ADS scores had even higher probability of craving in HVC, compared with both being in a non-HVC and at lower ends of the ADS scores.

Intensity of craving. For intensity of craving, the interaction term between ADS score and HVC did not yield a significant effect (Type III Tests of fixed effects, $F = 3.15$, $p = .08$).

Table 4
Results of Multilevel Models of Context Predicting Any Craving and Intensity of Craving

	Any craving			Intensity of craving		
Context	*b* (*SE*)	*p*	*OR*	*LLCI, ULCI*	*b* (*SE*)	*p*
Already drinking	1.86 (.09)	<.001	6.4	5.42, 7.61	.94 (.04)	<.001
Negative affect	1.19 (.09)	<.001	3.3	2.77, 3.94	.81 (.05)	<.001
Usual drinking setting	1.13 (.08)	<.001	3.1	2.61, 3.63	.36 (.04)	<.001
In an HVC	.89 (.06)	<.001	2.4	2.16, 2.77	.37 (.03)	<.001
Place where alcohol served	.78 (.09)	<.001	2.2	1.82, 2.64	.29 (.05)	<.001
Social event	.67 (.13)	<.001	1.9	1.51, 2.51	.23 (.06)	<.001

Note. HVC = highly valued context. All context predictors were entered into each of the models together.

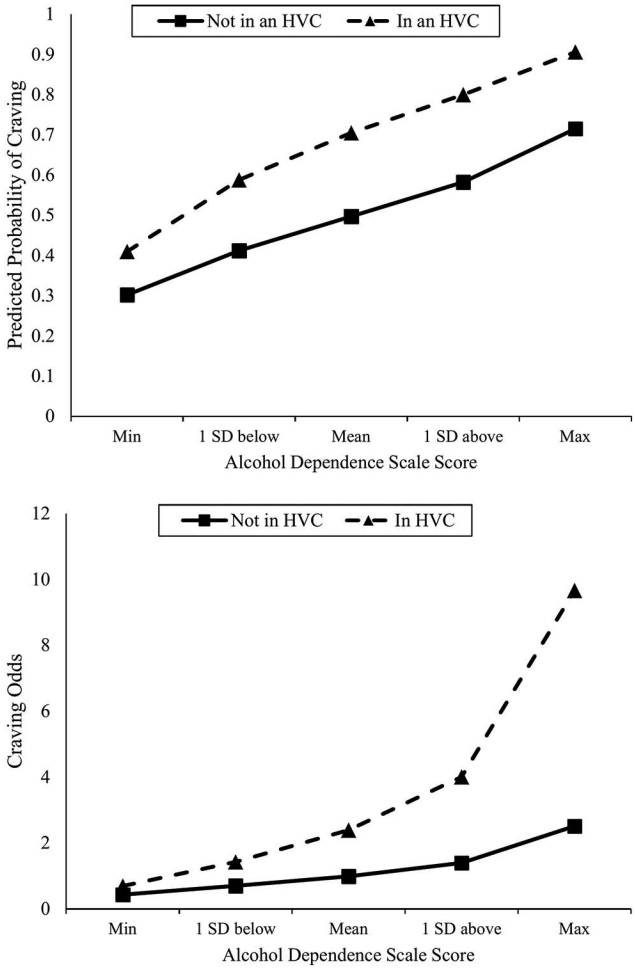

Figure 1. Model-based predicted probability of craving and odds of craving across context at varying levels of the Alcohol Dependence Scale (ADS). Min and Max refer to minimum and maximum ADS scores for this sample, respectively. *SD* = standard deviation. HVC = highly valued context.

Discussion

This study contributes important knowledge to the relatively sparse literature on the relation of specific contexts to craving for individuals with AUD attempting to moderate their drinking. As expected, all measured drinking contexts were associated with heightened craving compared with a nondrinking context. "Already drinking" had the strongest relation to both experiencing any craving and intensity of craving. Negative affect was also strongly related to both any craving and intensity of craving, consistent with previous studies of daily or within day craving among individuals with AUD and SUD (Hallgren et al., 2018; Moore et al., 2014). These and other drinking contexts were selected based both on the literature and clinical experience regarding contexts that tend to lead to relapse among drinkers attempting to remain abstinent. The present work suggests that these contextual influences also matter for drinkers who were attempting to moderate their drinking. Moreover, the highly valued contexts, those personally identified as posing the most risk for exceeding set drinking limits, related to craving over and above other influences.

HVCs were associated with both any craving and intensity of craving. Importantly, HVC was related to craving over and above the competing influences of already drinking, negative affect, and other contextual variables. Treatment providers have long focused on HVCs as a point of intervention, as a part of identifying high risk situations for continued use or relapse prevention (Rotgers, 2003), and laboratory researchers have posited for some time that personalized cues would be more robust than general cues (Conklin, Perkins, Robin, McClernon, & Salkeld, 2010), owing to particularly strong and salient associations with use and subsequent rewards. Regardless, this study is the only study known to these authors to empirically explore the daily and within day relationship between valuation and alcohol craving among individuals with AUD attempting to moderate their drinking. Even when controlling for the attributes of drinking contexts, HVCs emerged as significantly associated with both any craving and intensity of craving, suggesting that understanding the value drinker's place on a specific drinking setting is an important part of intervention. Only one other study utilized a similar approach to the present study and examined the impact of person-specific cues on craving among individuals with SUD attempting to abstain from all mood altering substances (Fatseas et al., 2015). Fatseas et al. found that compared with substance-specific cues, only person-specific cues continued to increase intensity of craving throughout the day. Furthermore, Fatseas et al. draw an important connection between the possibility of HVCs explaining the high rate of resumption of learned behaviors (i.e., relapse) after extinction, when exposed to the original conditioning environment. Thus, findings from both studies underscore the importance of addressing person-relevant cues in the context of personalized medicine for addiction.

Hypotheses about the impact of AUD severity on HVC and craving were only partially supported. Being in an HVC related to higher odds of any craving, overall, but these odds were substantially greater with increasing severity of the participant's AUD symptoms. These findings are consistent with a previous study of individuals with AUD that found that higher ADS scores reduced the likelihood of successfully moderating drinking across 15 months, regardless of receipt of treatment (Kuerbis, Morgenstern, & Hail, 2012). Although speculative, these findings suggest that greater presence of craving, especially when exposed to HVCs, may explain the mechanism that prevents individuals with severe AUD from achieving successfully controlled drinking. Interestingly, this impact may be isolated to have any craving versus no craving, as having greater severity of AUD and being in an HVC did not differentially impact intensity of craving.

Findings from this study underscore the difficulty individuals with AUD may have in attempting to moderate, even if they acknowledge and avoid the situations they identify as the most tempting. Findings also support the potential for different types of interventions. Heat of the moment, mobile interventions that account for context, such as A-CHESS (Gustafson et al., 2014), could be particularly helpful in preparing an individual to cope with craving. It also suggests that such microinterventions should target the participant prior to drinking initiation, given that once a person initiates drinking, their odds of craving and intensity of craving go up—likely leading to additional drinking. Furthermore, specific moderation strategies suggested by Moderation Manage-

ment, such as establishing a period of abstinence prior to an attempt to moderate (Rotgers, Kern, & Hoeltzer, 2002), likely reduces craving overall, as demonstrated in a previous study (Hallgren et al., 2018), presumably allowing for greater coping across drinking contexts when there is a return to drinking. This return to drinking can then take into consideration HVCs, which may prompt an additional threat to return to high-risk drinking (Fatseas et al., 2015). Future research on moderation should utilize EMA to test whether and *how* specific mobile intervention techniques, like those developed by Dulin and Gonzalez (2017), facilitate or inhibit the experience of craving, thus subsequently increasing chances of successful moderation.

Limitations

The findings of this study should be considered in the context of its limitations. Only limited information about the HVCs was gathered, which was reliant on participants' subjective evaluation, and were assessed at one point in time. Information gathered about context is also limited by the fact that little detail was collected about how drinking contexts differed from one another other than the preselected choices. Crucial information about a drinking context (e.g., during the holidays) that would be typically collected in a clinical setting and that would differentiate its contribution to craving may be missing. In addition, the item for negative affect excluded from its list of examples several other types of possible negative emotions, such as shame, sadness, and depression. It is unknown as to whether participants did or did not endorse this item if they were feeling negative emotions not listed. Thus, results are limited by the questions asked and models used to test these highly variable data, the observations for which are also highly correlated. Despite the fact that MLM can account for much of this autocorrelation, results are further limited by the statistics used to test these highly variable data, in that our models may not be complex enough to control for the multitude of factors involved in context-based craving.

Future Research

As the limitations suggest, future research is needed to better understand details and nuance of drinking context on craving for those attempting moderate their drinking. Is drinking context like a blunt instrument—no matter the context, craving is elicited? Or are there contexts that yield important gradations of craving or a piling on of craving that then predict whether or not a person will drink heavily in that particular situation? These questions are challenging to answer given the methodological limitations of EMA and the need for low participant burden. In addition, future research should explore whether drinking outcomes differ in any way from craving outcomes, as these individuals with AUD were actively trying to resist heavy drinking in spite of experiencing craving. Craving is not necessarily a proxy for drinking, and similar analyses should be performed to ascertain whether craving is a mediator of drinking in the context of proactive attempts to reduce drinking.

Conclusion

Despite its limitations, this study provides important information about the impact of drinking context among individuals with AUD attempting to moderate their drinking. It is the first study to explore the impact of participant-identified highly valued drinking contexts over and above other characteristics of drinking contexts with participants attempting to moderate their drinking. This is particularly important in that such knowledge can be helpful for development of targeted heat of the moment interventions. This study reveals the complexity of context and suggests several future avenues for empirical exploration. Importantly, these findings can inform interventions with individuals with AUD via heat of the moment interventions, with attention to context and valuation.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Browne, K. C., Wray, T. B., Stappenbeck, C. A., Krenek, M., & Simpson, T. L. (2016). Alcohol consumption, craving, and craving control efforts assessed daily in the context of readiness to change among individuals with alcohol dependence and PTSD. *Journal of Substance Abuse Treatment, 61,* 34–41. http://dx.doi.org/10.1016/j.jsat.2015.09.005

Carter, B. L., & Tiffany, S. T. (1999). Meta-analysis of cue-reactivity in addiction research. *Addiction, 94,* 327–340. http://dx.doi.org/10.1046/j.1360-0443.1999.9433273.x

Childs, E., & de Wit, H. (2016). Alcohol-induced place conditioning in moderate social drinkers. *Addiction, 111,* 2157–2165. http://dx.doi.org/10.1111/add.13540

Christiansen, P., Townsend, G., Knibb, G., & Field, M. (2017). Bibi ergo sum: The effects of a placebo and contextual alcohol cues on motivation to drink alcohol. *Psychopharmacology, 234,* 827–835. http://dx.doi.org/10.1007/s00213-016-4518-0

Conklin, C. A., Perkins, K. A., Robin, N., McClernon, F. J., & Salkeld, R. P. (2010). Bringing the real world into the laboratory: Personal smoking and nonsmoking environments. *Drug and Alcohol Dependence, 111,* 58–63. http://dx.doi.org/10.1016/j.drugalcdep.2010.03.017

Cottler, L. B., Robins, L. N., & Helzer, J. E. (1989). The reliability of the CIDI-SAM: A comprehensive substance abuse interview. *British Journal of Addiction, 84,* 801–814. http://dx.doi.org/10.1111/j.1360-0443.1989.tb03060.x

Dulin, P. L., & Gonzalez, V. M. (2017). Smartphone-based, momentary intervention for alcohol cravings amongst individuals with an alcohol use disorder. *Psychology of Addictive Behaviors, 31,* 601–607. http://dx.doi.org/10.1037/adb0000292

Fatseas, M., Serre, F., Alexandre, J. M., Debrabant, R., Auriacombe, M., & Swendsen, J. (2015). Craving and substance use among patients with alcohol, tobacco, cannabis or heroin addiction: A comparison of substance- and person-specific cues. *Addiction, 110,* 1035–1042. http://dx.doi.org/10.1111/add.12882

Fazzino, T. L., Harder, V. S., Rose, G. L., & Helzer, J. E. (2013). A daily process examination of the bidirectional relationship between craving and alcohol consumption as measured via interactive voice response. *Alcoholism: Clinical and Experimental Research, 37,* 2161–2167. http://dx.doi.org/10.1111/acer.12191

Flannery, B. A., Poole, S. A., Gallop, R. J., & Volpicelli, J. R. (2003). Alcohol craving predicts drinking during treatment: An analysis of three assessment instruments. *Journal of Studies on Alcohol, 64,* 120–126. http://dx.doi.org/10.15288/jsa.2003.64.120

Gibbons, R. D., Hedeker, D., & DuToit, S. (2010). Advances in analysis of longitudinal data. *Annual Review of Clinical Psychology, 6,* 79–107. http://dx.doi.org/10.1146/annurev.clinpsy.032408.153550

Gustafson, D. H., McTavish, F. M., Chih, M. Y., Atwood, A. K., Johnson, R. A., Boyle, M. G., . . . Shah, D. (2014). A smartphone application to support recovery from alcoholism: A randomized clinical trial. *Journal*

of the American Medical Association Psychiatry, 71, 566–572. http://dx.doi.org/10.1001/jamapsychiatry.2013.4642

Hallgren, K. A., Delker, B. C., & Simpson, T. L. (2018). Effects of initiating abstinence from alcohol on daily craving and negative affect: Results from a pharmacotherapy clinical trial. *Alcoholism: Clinical and Experimental Research, 42,* 634–645. http://dx.doi.org/10.1111/acer.13591

Hartwell, E. E., & Ray, L. A. (2018). Craving as a *DSM–5* symptom of alcohol use disorder in non-treatment seekers. *Alcohol and Alcoholism, 53,* 235–240. http://dx.doi.org/10.1093/alcalc/agx088

Hester, R. (1995). Self-control training. In R. K. Hester & W. R. Miller (Eds.), *Handbook of alcoholism treatment approaches: Effective alternatives* (2nd ed., pp. 148–159). Needham Heights, MA: Allyn & Bacon.

Kaysen, D., Atkins, D. C., Simpson, T. L., Stappenbeck, C. A., Blayney, J. A., Lee, C. M., & Larimer, M. E. (2014). Proximal relationships between PTSD symptoms and drinking among female college students: Results from a daily monitoring study. *Psychology of Addictive Behaviors, 28,* 62–73. http://dx.doi.org/10.1037/a0033588

Kozlowski, L. T., Mann, R. E., Wilkinson, D. A., & Poulos, C. X. (1989). "Cravings" are ambiguous: Ask about urges or desires. *Addictive Behaviors, 14,* 443–445. http://dx.doi.org/10.1016/0306-4603(89)90031-2

Kuerbis, A., Houser, J., Levak, S., Shao, S., & Morgenstern, J. (2018). Exploration of treatment matching of problem drinker characteristics to motivational interviewing and non-directive client-centered psychotherapy. *Journal of Substance Abuse Treatment, 86,* 9–16. http://dx.doi.org/10.1016/j.jsat.2017.12.002

Kuerbis, A., Morgenstern, J., & Hail, L. (2012). Predictors of moderated drinking in a primarily alcohol-dependent sample of men who have sex with men. *Psychology of Addictive Behaviors, 26,* 484–495. http://dx.doi.org/10.1037/a0026713

Lane, S. P., Carpenter, R. W., Sher, K. J., & Trull, T. J. (2016). Alcohol craving and consumption in borderline personality disorder: When, where, and with whom. *Clinical Psychological Science, 4,* 775–792. http://dx.doi.org/10.1177/2167702615616132

Law, B., Gullo, M. J., Daglish, M., Kavanagh, D. J., Feeney, G. F., Young, R. M., & Connor, J. P. (2016). Craving mediates stress in predicting lapse during alcohol dependence treatment. *Alcoholism: Clinical and Experimental Research, 40,* 1058–1064. http://dx.doi.org/10.1111/acer.13034

Lei, H., Nahum-Shani, I., Lynch, K., Oslin, D., & Murphy, S. A. (2012). A "SMART" design for building individualized treatment sequences. *Annual Review of Clinical Psychology, 8,* 21–48. http://dx.doi.org/10.1146/annurev-clinpsy-032511-143152

Lukasiewicz, M., Benyamina, A., Reynaud, M., & Falissard, B. (2005). An in vivo study of the relationship between craving and reaction time during alcohol detoxification using the ecological momentary assessment. *Alcoholism, Clinical and Experimental Research, 29,* 2135–2143. http://dx.doi.org/10.1097/01.alc.0000191760.42980.50

McHugh, R. K., Fitzmaurice, G. M., Griffin, M. L., Anton, R. F., & Weiss, R. D. (2016). Association between a brief alcohol craving measure and drinking in the following week. *Addiction, 111,* 1004–1010. http://dx.doi.org/10.1111/add.13311

Mereish, E. H., Kuerbis, A., & Morgenstern, J. (2018). A daily diary study of stressful and positive events, alcohol use, and addiction severity among heavy drinking sexual minority men. *Drug and Alcohol Dependence, 187,* 149–154. http://dx.doi.org/10.1016/j.drugalcdep.2018.03.003

Moore, T. M., Seavey, A., Ritter, K., McNulty, J. K., Gordon, K. C., & Stuart, G. L. (2014). Ecological momentary assessment of the effects of craving and affect on risk for relapse during substance abuse treatment. *Psychology of Addictive Behaviors, 28,* 619–624. http://dx.doi.org/10.1037/a0034127

Morgenstern, J., Irwin, T. W., Wainberg, M. L., Parsons, J. T., Muench, F., Bux, D. A., Jr., . . . Schulz-Heik, J. (2007). A randomized controlled trial of goal choice interventions for alcohol use disorders among men who have sex with men. *Journal of Consulting and Clinical Psychology, 75,* 72–84. http://dx.doi.org/10.1037/0022-006X.75.1.72

Morgenstern, J., Kuerbis, A. N., Chen, A. C., Kahler, C. W., Bux, D. A., Jr., & Kranzler, H. R. (2012). A randomized clinical trial of naltrexone and behavioral therapy for problem drinking men who have sex with men. *Journal of Consulting and Clinical Psychology, 80,* 863–875. http://dx.doi.org/10.1037/a0028615

Morgenstern, J., Kuerbis, A., Houser, J., Levak, S., Amrhein, P., Shao, S., & McKay, J. R. (2017). Dismantling motivational interviewing: Effects on initiation of behavior change among problem drinkers seeking treatment. *Psychology of Addictive Behaviors, 31,* 751–762. http://dx.doi.org/10.1037/adb0000317

Morgenstern, M., DiFranza, J. R., Wellman, R. J., Sargent, J. D., & Hanewinkel, R. (2016). Relationship between early symptoms of alcohol craving and binge drinking 2.5 years later. *Drug and Alcohol Dependence, 160,* 183–189. http://dx.doi.org/10.1016/j.drugalcdep.2016.01.008

Moss, H. B., Chen, C. M., & Yi, H. Y. (2007). Subtypes of alcohol dependence in a nationally representative sample. *Drug and Alcohol Dependence, 91,* 149–158. http://dx.doi.org/10.1016/j.drugalcdep.2007.05.016

Naqvi, N., Ochsner, K., Kober, H., Kuerbis, A., Feng, T., Wall, M., & Morgenstern, J. (2015). Cognitive regulation of craving in alcohol-dependent and social drinkers. *Alcoholism: Clinical and Experimental Research, 39,* 343–349. http://dx.doi.org/10.1111/acer.12637

National Institute on Alcohol Abuse and Alcoholism. (2013). *Rethinking drinking*. Bethesda, MD: U.S. Department of Health and Human Services.

Piasecki, T. M., Jahng, S., Wood, P. K., Robertson, B. M., Epler, A. J., Cronk, N. J., . . . Sher, K. J. (2011). The subjective effects of alcohol-tobacco co-use: An ecological momentary assessment investigation. *Journal of Abnormal Psychology, 120,* 557–571. http://dx.doi.org/10.1037/a0023033

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks, CA: Sage.

Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y., & Patra, J. (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *The Lancet, 373,* 2223–2233. http://dx.doi.org/10.1016/S0140-6736(09)60746-7

Richardson, K., Baillie, A., Reid, S., Morley, K., Teesson, M., Sannibale, C., . . . Haber, P. (2008). Do acamprosate or naltrexone have an effect on daily drinking by reducing craving for alcohol? *Addiction, 103,* 953–959. http://dx.doi.org/10.1111/j.1360-0443.2008.02215.x

Rosenberg, H. (1993). Prediction of controlled drinking by alcoholics and problem drinkers. *Psychological Bulletin, 113,* 129–139. http://dx.doi.org/10.1037/0033-2909.113.1.129

Rotgers, F. (2003). Cognitive-behavioral theories of substance abuse. In F. Rotgers, J. Morgenstern, & S. T. Walters (Eds.), *Treating substance abuse: Theory and technique* (2nd ed., pp. 166–189). New York, NY: Guilford Press.

Rotgers, F., Kern, M. F., & Hoeltzer, R. (2002). *Responsible drinking: A Moderation Management approach for problem drinkers*. Oakland, CA: New Harbinger Publications, Inc.

SAS Institute Inc. (2002–2012). SAS software (Version 13.1 for Windows) [Computer software]. Cary, NC: Author.

Serre, F., Fatseas, M., Denis, C., Swendsen, J., & Auriacombe, M. (2018). Predictors of craving and substance use among patients with alcohol, tobacco, cannabis or opiate addictions: Commonalities and specificities across substances. *Addictive Behaviors, 83,* 123–129. http://dx.doi.org/10.1016/j.addbeh.2018.01.041

Serre, F., Fatseas, M., Swendsen, J., & Auriacombe, M. (2015). Ecological momentary assessment in the investigation of craving and substance use

in daily life: A systematic review. *Drug and Alcohol Dependence, 148,* 1–20. http://dx.doi.org/10.1016/j.drugalcdep.2014.12.024

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. New York, NY: Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780195152968.001.0001

Skinner, H. A., & Allen, B. A. (1982). Alcohol dependence syndrome: Measurement and validation. *Journal of Abnormal Psychology, 91,* 199–209. http://dx.doi.org/10.1037/0021-843X.91.3.199

Todd, M., Armeli, S., Tennen, H., Carney, M. A., Ball, S. A., Kranzler, H. R., & Affleck, G. (2005). Drinking to cope: A comparison of questionnaire and electronic diary reports. *Journal of Studies on Alcohol, 66,* 121–129. http://dx.doi.org/10.15288/jsa.2005.66.121

Trela, C. J., Hayes, A. W., Bartholow, B. D., Sher, K. J., Heath, A. C., & Piasecki, T. M. (2018). Moderation of alcohol craving reactivity to drinking-related contexts by individual differences in alcohol sensitivity: An ecological investigation. *Experimental and Clinical Psychopharmacology, 26,* 354–365. http://dx.doi.org/10.1037/pha0000206

Wittchen, H. U., Robins, L. N., Cottler, L. B., Sartorius, N., Burke, J. D., & Regier, D. (1991). Cross-cultural feasibility, reliability and sources of variance of the Composite International Diagnostic Interview (CIDI). *The British Journal of Psychiatry, 159,* 645–653. http://dx.doi.org/10.1192/bjp.159.5.645

Witteman, J., Post, H., Tarvainen, M., de Bruijn, A., Perna, E. S., Ramaekers, J. G., & Wiers, R. W. (2015). Cue reactivity and its relation to craving and relapse in alcohol dependence: A combined laboratory and field study. *Psychopharmacology, 232,* 3685–3696. http://dx.doi.org/10.1007/s00213-015-4027-6

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