Examining the effect of perceived availability on craving for alcohol: A quasi-experimental approach

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Abstract
The impact of contextual cues in motivating alcohol and other drug use may be influenced by the perceived availability of the substance. This study examined the relationship between perceived availability and alcohol cue reactivity using a quasi-experimental design that harnessed the legal age of alcohol availability in the United States. Participants were 95 (76% male) heavy drinkers in a 2 x 2 between-subjects quasi-experimental design, crossing cue exposure (alcohol cues vs. neutral cues) and availability information (ages 19–20 [unavailable] versus ages 21–22 [available]). The results indicated significant main effects of cue type, with alcohol cues eliciting significantly larger increases in subjective urge to drink and positive affect, as well as increased consumption of placebo alcohol. Moreover, a significant main effect of availability information was detected, with unavailability information generating a greater urge to drink. Potential mechanisms underlying this effect and future directions are discussed.

Keywords: Alcohol, cue reactivity, availability, craving, urges, psychological reactance

Introduction
There is considerable evidence that motivation for alcohol and other drugs is substantially influenced by contextual factors. This has been reliably demonstrated using the cue reactivity paradigm (Monti et al. 1987; Niaura et al. 1988; Rohsenow et al. 1992), or controlled exposure to environmental cues to investigate their effect on individuals’
subjective (e.g., craving, affect) and objective (e.g., salivation, psychophysiological arousal) reactions. Such cue exposures typically elicit a stable profile of changes, including large effect size changes in craving and small-to-medium effect size changes on psychophysiological variables (for a meta-analysis, see Carter and Tiffany 1999). However, a great deal of heterogeneity in the magnitude and direction of effects has been evident across, and even within, cue reactivity studies (Carter and Tiffany 1999).

One explanation for this heterogeneity is that reactions to external contextual cues associated with a substance may also be influenced by internal cognitions. More specifically, it has been theorized that cue reactivity may be influenced by attributions about the availability of the substance, or whether participants believe they will be permitted to access the substance to which they are being exposed (Baker et al. 1986; Carter and Tiffany 2001; Wertz and Sayette 2001; Hogarth and Duka 2005). Depending on the circumstances, availability information may either enhance or diminish cue reactivity via a variety of potential mechanisms. For example, from a classical conditioning perspective, availability information may be conditioned as part of a compound stimulus set that precedes substance use or as a conditional stimulus itself (Wertz and Sayette 2001). Alternatively, from an operant conditioning perspective, availability information may serve as a discriminative stimulus (Wertz and Sayette 2001). Apart from learning theory, availability information may influence reactivity by its effects on affect, provoking a positive affective reaction in response to availability information and a negative affective reaction in response to unavailability information (Baker et al. 1986; Toneatto 1999; Carter and Tiffany 2001). Such affective dispositions may in turn differentially potentiate reactions to the substance cues (Baker et al. 1986; Niaura et al. 1988; Stasiewicz et al. 1997). Finally, it has been suggested that unavailability information may elicit greater desire for a substance by interrupting automatized substance use patterns (Tiffany 1990), but that this influence may vary based on the degree of unavailability (Carter and Tiffany 2001).

Empirical research generally supports the notion that perceived availability of a substance enhances cue reactivity. Wertz and Sayette (2001) reviewed cue reactivity studies in which availability information was explicitly or implicitly communicated to participants and found greater cue reactivity in studies where participants believed they would have access to the substance. In addition, Wertz and Sayette specifically reviewed alcohol cue reactivity studies, comparing alcoholics with implicit availability and unavailability information to controls, and found that when alcohol was implicitly available, alcoholics exhibited greater cue reactivity relative to when it was implicitly unavailable.

In terms of direct laboratory manipulation, early studies using pharmacological antagonism of drug effects (Meyer et al. 1976) or balanced-placebo designs (Laberg 1986) were similarly suggestive that perceived availability enhances cue reactivity. More recently, a number of studies have directly manipulated availability. Droungas et al. (1995) experimentally manipulated availability information and found that only smokers who expected cigarettes to be available reported significantly greater desire to smoke and withdrawal symptoms relative to a control group. Of particular interest, Dols et al. (2000) conducted within-laboratory excitatory conditioning with a neutral stimulus signaling nicotine availability. At testing, Dols et al. found that craving for tobacco increased in response to the availability stimulus alone and additively increased in response to the combination of the availability stimulus and nicotine cues. These data suggest that availability can be encoded as a specific conditional stimulus and subsequently elicit an increase in craving. Finally, using a within-session approach termed the “cue-availability paradigm,” Carter and Tiffany (2001) found that the expectation of nicotine availability
increased craving, positive affect, and skin conductance, and decreased latency to smoke and negative affect.

In contrast to the preceding studies, Juliano and Brandon (1998) found significant effects of both availability information and unavailability information in the same study. In that study, smokers who received explicit availability information reported significantly increased craving following a nicotine cue exposure, but those who received explicit unavailability information exhibited significantly slower reaction times in a cognitive task. This latter finding was interpreted as potentially reflecting a greater need to cope with experiential craving, which diminished cognitive capacity. The asynchrony between the effects of availability and unavailability was interpreted as implying that self-report and reaction time may reflect different underlying processes.

In addition, a recent experimental study examining the effect of availability information on alcohol cue reactivity indicated a significant influence of explicit unavailability information. MacKillop and Lisman (2005) examined the effects of an alcohol cue exposure and perceived availability on heavy drinkers and found an interaction such that the combination of alcohol cues and unavailability information generated the greatest craving on a multi-item measure, although not on a more rudimentary single-item measure of urge. Of interest, in examining the items responsible for these changes, MacKillop and Lisman found that the largest interaction effect appeared on the item "I am craving a drink." These findings were interpreted as being consistent with Tiffany's (1990) cognitive processing model of substance use.

The current study sought to further examine the influences of contextual cues and cognitive attributions on motivation for alcohol use, using MacKillop and Lisman (2005) as its point of departure. In the previous study, a $2 \times 2$ factorial design was used, crossing alcohol and neutral cue exposures with availability and unavailability information, however, the availability manipulation was relatively small, consisting only of an instructional set embedded in the study's consent form. In addition, a manipulation check revealed a range of participants' attributions about the status of alcohol availability. In the present study, the same factorial design was used, however, to enhance the magnitude of the availability manipulation it was modified to a quasi-experimental design (Cook and Campbell 1979; Rosenbaum 1995). Specifically, heavy drinkers who straddled the age of legal alcohol use (21 in New York State) were recruited from a university population, with those who were over 21 assigned to the available condition and those who were under 21 assigned to the unavailable condition. Within the experimental procedure, an instructional set was provided in which the law was explicitly invoked as the basis for either being able to drink alcohol or not drink alcohol after either an alcohol or neutral (control) cue exposure. By harnessing the widely known and understood legal stricture against underage drinking into the instructional set, the plausibility and impact of availability information was intended to be enhanced. Although a quasi-experimental design includes risks of confounding variables between nonrandomly assigned groups, it can be used powerfully when appropriate steps are taken to examine potential alternative influences (Cook and Campbell 1979; Rosenbaum 1995; Hutchison et al. 2004). In this case, to maximize the internal validity of the study and minimize the likelihood of potential confounds, participants were required to be within a circumscribed age range (19–22) and to meet uniform alcohol use criteria. Thus, the overall sample was intended to be heavy drinkers who happened to fall on one side or the other of the legal drinking age.
Method

Participants

Participants were recruited using posted advertisements and classroom/email solicitations at the State University of New York at Binghamton. Inclusion criteria were related to quantitative drinking level, age, and qualitative drinking characteristics used to ensure a good match between the participants and the alcohol cue exposure. Specifically, participants were required to be heavy drinkers, operationalized as at least 20+/14+ standard drinks per week for males/females (Dawson 2000). Participants were required to be within 24 months of their 21st birthday (ages 19–22), the age of legal alcohol consumption in New York State. Individuals who were older or younger were excluded based on the likelihood of increasingly different alcohol use/dependence patterns. Finally, participants were required to report beer as both a favorite and most often consumed alcoholic beverage, and that they rated their enjoyment of beer seven or greater on a 10-point Likert-type scale because the multimodal alcohol cue exposure was oriented around beer.

Ninety-five participants (76% male) met the criteria. Participants were randomly assigned to either the alcohol or neutral cue exposure conditions and were assigned by age to either the available or unavailable conditions. Two groups contained 25 participants (available-neutral cues, unavailable-neutral cues), one group contained 24 participants (available-alcohol cues), and one group contained 21 participants (unavailable-alcohol cues). The groups had somewhat uneven sample sizes due to participant nonattendance; a $\chi^2$ test indicated the condition sizes were not significantly different from each other ($\chi^2 (3, N=95) = 0.45, p > 0.90$). In terms of alcohol use variables, male participants reported mean consumption of 34.3 (SE = 1.6) drinks/week; female participants reported mean consumption of 22.3 (SE = 1.8) standard drinks/week. These levels are at the 96th and 99th percentiles of alcohol consumption for this cohort (Meilman and Pressley 1997), respectively. To evaluate the gender distribution across groups, a $\chi^2$ test was conducted and revealed nonsignificantly different distributions across groups ($\chi^2 (3, N=95) = 3.81, p > 0.25$). In terms of alcohol dependence, participants scored a mean of 12.4 (SE = 0.48) on the Alcohol Dependence Scale (ADS; described in detail in Measures), with a range from 1 to 33. This approaches the 25th percentile of severity of alcohol dependence for treatment-seeking outpatients (Skinner and Horn 1984). These characteristics are similar to those of collegiate heavy drinkers in previous studies of alcohol cue reactivity (e.g., Bradizza et al. 1995; Collins and Brandon 2002; MacKillop and Lisman 2005). Age at participation was calculated in years and months, and translated into a base-10 metric for descriptive statistics. Participants in the Available conditions were a mean age of 21.60 (SE = 0.06; range = 21–22.75) years and participants in the Unavailable conditions were a mean age of 19.86 years (SE = 0.08; range = 19–20.92). Participants were compensated with required research credit for psychology courses or $5 for their participation, according to their preference.

Design

Participants were quasi-randomly assigned into one of four groups in a 2 (alcohol versus neutral cues) × 2 (availability versus unavailability information) design. Participants were randomized to either the alcohol or neutral cue exposure conditions and were directly assigned to the Available or Unavailable conditions based on their age (under 21 versus over 21). Although requiring more participants, a between-subjects design was selected.
because an earlier study on alcohol cue reactivity and availability information (Carrigan 1998) that used a within-subjects procedure had the effect of confusing participants, and also because of the potential for carryover effects in alcohol cue reactivity research (e.g., Monti et al. 1987).

**Alcohol and neutral cue exposures**

The alcohol cue exposure consisted of exposure to visual, olfactory, tactile, imaginal and proprioceptive cues. Participants were introduced into a dimmed laboratory room (8' x 6' x 8') decorated with alcohol-related paraphernalia (posters and advertisements of beer, barroom trifolds, empty beer bottles). A Research Assistant (RA) then brought three full bottles of beer, poured one into a beer glass, and departed. After one minute of observing the array of cues, participants were asked through intercom to listen to a tape-recorded imaginal scene related to drinking while holding the beer up to their nose and deeply inhaling the smell of the beer. The imaginal scenes were developed based on previous research on imaginal scenes in cue reactivity research (Payne et al. 1992; Maude-Griffin and Tiffany 1996). The scenes described common environmental, interpersonal, and affective contexts of drinking as well as evocative descriptions of the orosensory properties of beer. The neutral cue exposure was matched to the alcohol cue exposure on all dimensions but took place in a different room that was decorated with cues related to water and the imaginal scene was oriented around drinking water. No mention of alcohol was made at any point during the neutral cue exposure. The alcohol and neutral cue exposure periods were of equivalent times (~6 minutes).

Two approaches were used to enhance the congruence between the alcohol cue exposure and participants’ conditioning histories. Participants were matched to their favorite category of beer from three nonmutually exclusive types (imported, domestic, light), following the recommendation of Staiger and White (1991). Participants were also matched to the imaginal scenes that related to their most common reason for drinking from among seven possibilities: Relaxation, happiness, enjoyment of the taste, anger, boredom, sadness/depression, anxiety, or habit. Favorite beer and appropriate imaginal scene had been assessed during screening. Twenty-one percent of participants reported preferring domestic beer, 50% reported preferring imported beer, and 29% reported preferring light beer. Participants primarily reported that they most often drank when they were ''happy or celebrating'' (71%) or ''to relax'' (13%), with negligible proportions reported drinking for the taste (6%), based on boredom (4%) or anxiety (1%), or out of habit (5%). No participants reported principally drinking because they were depressed. As in MacKillop and Lisman (2005), nonalcoholic beer was used for all three categories of beer based on Institutional Review Board concerns about intoxicated participants and previous research demonstrating its orosensory and perceptual similarity to alcoholic beer (Keane et al. 1980). Pilot research was conducted prior to MacKillop and Lisman (2005) to ascertain which commercial beers of the three pertinent categories (imported, domestic, light) were similar in terms of appearance and taste to the placebo beer. The placebo beer was rebottled as the matched commercial brand immediately prior to the laboratory session in order to not affect the carbonation of the beverage.

**Measures**

*Drinking days questionnaire (DDQ).* The DDQ is a 7-item, face-valid measure of an individual’s average alcohol consumption per week. The DDQ has been shown to have
adequate psychometric properties (Collins et al. 1985; Kivlahan et al. 1990) and its seven items correspond to the average amount consumed for each day of the week.

**Alcohol dependence scale (ADS).** The ADS is a 25-item continuous measure of alcohol dependence symptoms that has been extensively previously validated (Skinner and Horn 1984). The ADS generated an internal consistency coefficient $\alpha$ of 0.77 in this sample.

**Alcohol urge questionnaire (AUQ).** The AUQ is an 8-item self-report measure of urge that has been psychometrically validated (Bohn et al. 1995; Drummond and Philips 2002). The AUQ generated a baseline coefficient $\alpha$ of 0.84 in this sample.

**Positive and negative affect schedule (PANAS).** The PANAS is a 20-item measure of transient mood that has undergone extensive previous psychometric validation (Schmukle et al. 2002; Watson et al. 1988). The positive affect subscale of the PANAS generated a baseline coefficient $\alpha$ of 0.87 and the negative affect subscale generated a baseline coefficient $\alpha$ of 0.78.

**Behavioral measures.** Tiffany and colleagues (Tiffany and Carter 1998; Tiffany and Conklin 2000) have criticized cue reactivity research for rarely reporting the relationship between self-report variables (e.g., craving, affect) and actual substance use. Therefore, a number of behavioral dependent variables were used. First, beverage choice (beer or water) following the cue exposure was dichotomously measured. Second, latency to first sip (in milliseconds) was used based on previous cue reactivity studies. Third, *ad libitum* volume of both beer and water consumed following the cue exposure was assessed by first weighing the containers and liquid, and then subtracting the remaining weight immediately following consumption. However, because only the participants who were older than 21 were permitted access to alcohol, the behavioral dependent variables apply only to those participants.

**Experimental procedure**

All study procedures were reviewed and approved by the State University of New York at Binghamton's Human Subjects Research Review Committee. All laboratory sessions were conducted in the Alcohol and Behavior Laboratory and took place in the evening (between 6 pm and 10 pm) to accord with common times for alcohol consumption. In advance of the laboratory session, participants were informed the session would last 1 h and were provided with a broad description of the study, including that it would involve exposure to environmental cues and assessment of their reactions. This information did not include any mention of alcohol cues or the availability of alcohol.

At baseline, participants completed informed consent and baseline measures, including the AUQ, PANAS, and ADS. Participants in the available conditions were then given a more detailed description of the procedures and the availability information. For example, the following instructional set was provided to participants who were to receive an alcohol cue exposure and for whom alcohol would be available: “*In a moment I’m going to bring you into a room that will have a variety of cues relating to beer and drinking. We’re going to ask you to listen to a tape describing a drinking situation. After that, we’re going to ask you to fill out some...*”
more questionnaires, and then you will be able to drink as much beer as you want.” The boldface portion was intentionally read slowly and emphasized. At this point, participants were also asked if there was any specific reason they could not drink if they chose to do so (e.g., illness, medication, examination) and rescheduled if that was the case. In addition, participants were informed that if they chose to drink and felt impaired, the laboratory staff would make arrangements for them to get home safely. The possibility of staying longer than 1 h was not offered as an option to eliminate a negative contingency against drinking.

In contrast, participants who were to receive an alcohol cue exposure, but for whom alcohol would be unavailable were informed: “In a moment I’m going to bring you into a room that will have a variety of cues relating to beer and drinking. We’re going to ask you to listen to a tape describing a drinking situation. After that, we’re going to ask you to fill out some more questionnaires. According to New York State law, no one under the age of 21 is permitted to drink alcohol. At no point during the study will you be able to drink alcohol. It is important that you know that alcohol will not be available in this study.” As above, the boldface portion was intentionally read slowly and emphasized. In order to continue, participants in both availability conditions were then required to correctly answer that alcohol would or would not be available in response to the direct question “Will alcohol be available in this study?” For all participants receiving neutral cue exposures, the previous instructions were identical in terms of availability information, but specified that a neutral cue exposure would follow.

Following the consent procedure and baseline measures, participants underwent the cue exposure procedure described above. At its conclusion, a RA returned and asked the participant to complete the AUQ and PANAS. After the postexposure assessment, participants in the unavailable conditions were provided with debriefing information and compensation.

Consistent with their experimental instructional set, participants in the available condition were provided access to beer following the cue exposure. Specifically, these participants were brought three additional bottles of the beverage to which they had not been exposed (e.g., bottles of water were brought in for those participants who received an alcohol cue exposure) and were permitted to consume beer and/or water ad libitum. They were provided a 5-minute consumption period, although they were not informed of the duration. The first beverage selected and the latency to drink either beverage were assessed via a one-way mirror. After the consumption period, participants were asked to complete urge and affect measures for the last time. They then underwent the same debriefing procedure as the Unavailable condition.

Following completion of the study, a more detailed debriefing session was held to inform participants of the aspects of the study for which earlier disclosure would have jeopardized the study’s validity (e.g., hypotheses, beer status).

Data analysis

The data were examined for outlying data points and distribution normality. One outlier was detected for water consumption and two were detected for latency to drink. Having been established as legitimate values, all were recoded as greater than the next highest value by the appropriate number of increments, as recommended by Tabachnick and Fidell (2001). Following these modifications, all variables were sufficiently normally distributed. In terms of missing data, during the procedure one participant did not complete the negative affect subscale of the PANAS and three participants did not complete the positive affect subscale.
of the PANAS. For the self-report dependent variables (i.e., AUQ, PANAS subscales), univariate analyses were conducted on change scores (post-cue exposure performance minus pre-cue exposure performance) using $2 \times 2$ analyses of variance (ANOVAs). For behavioral dependent variables (conducted only on the available conditions), one-way between-subjects ANOVAs were conducted on continuous variables (beverage consumption, latency) and a $\chi^2$ test was used to analyze first beverage choice. Following the principal analyses, where significant effects were evident, exploratory analyses were conducted to determine potential differences across items on the AUQ. Statistical significance was set at $p < 0.05$. For significant effects, partial eta squared ($\eta^2_p$) was calculated as a measure of effect size. A Bonferroni multiple test error correction was implemented for tests where no hypotheses were proposed (i.e., baseline differences across groups, gender analyses), but not for analyses where a priori hypotheses were tested (i.e., effects of cue exposure and availability). The exception to this was in examining potential differences between the two nonrandomly assigned age groups where, although no hypotheses were made, increased sensitivity to potential differences was desirable.

**Results**

**Baseline analyses**

Given the use of a quasi-experimental design, potential baseline differences were examined between the two groups (unavailable [under 21] versus available [over 21]) in the nonrandomly assigned conditions. One-way, two-group ANOVAs revealed no significant differences between the two groups in terms of drinks/week ($F(1, 93) = 2.11, p > 0.15$) or alcohol dependence ($F(1, 93) = 1.45, p > 0.20$), as measured by the ADS. Mean drinks/week for the available condition was 33.33 (SD = 15.30) and mean drinks/week for the unavailable condition was 29.20 (SD = 12.07). Mean ADS score for the available condition was 11.39 (SD = 4.39) and mean ADS score for the unavailable condition was 12.67 (SD = 5.65). No significant differences were evident between the available and unavailable conditions in terms of AUQ urge ($F(1, 92) = 1.08, p > 0.30$), positive affect ($F(1, 92) = 0.37, p > 0.50$), or negative affect ($F(1, 92) = 0.10, p > 0.70$). Baseline reports were also examined for each dependent variable across all four groups. Regardless of the Bonferroni correction, no significant differences were evident for AUQ urge ($F(3, 91) = 0.87, p > 0.45$), positive affect ($F(3, 91) = 0.31, p > 0.80$), or negative affect ($F(3, 91) = 0.35, p > 0.70$).

**Effects of cue exposure and availability information**

To evaluate the effects of cue exposure and availability information, $2$ (cue type) $\times 2$ (availability) ANOVAs were conducted for each self-report dependent variable. For AUQ urge, significant main effects for both cues ($F(1, 91) = 9.16, p < 0.005, \eta^2_p = 0.10$) and availability ($F(1, 91) = 3.92, p = 0.05, \eta^2_p = 0.04$) were detected, but no significant interaction effect ($F(1, 91) = 0.15, p > 0.70$) was evident. These effects were of medium effect size and are depicted in Figures 1 and 2, respectively. Raw baseline and post cue exposure values for both effects are also provided in Tables I and II.

For positive affect, a significant main effect of alcohol cues was detected ($F(1, 88) = 6.16, p < 0.05, \eta^2_p = 0.07$), but no main effect of availability information ($F(1, 88) = 0.57, p > 0.45$) or interaction effect ($F(1, 88) = 2.21, p > 0.10$) was evident. The significant effect was the result of a modest increase in positive affect in the alcohol cues group ($M = 0.66, SE = 0.73$)
and a modest decrease in positive affect in the neutral cues group ($M = -1.89$, $SE = 0.72$). For negative affect, main effects of neither of neither cues ($F (1, 90) = 1.20$, $p > 0.25$), nor availability ($F (1, 90) = 0.02$, $p > 0.90$) were significant, and no interaction effect ($F (1, 90) = 0.21$, $p > 0.60$) was evident.

In terms of the effects of the alcohol cue exposure during the consumption period, one-way, two-group ANOVAs comparing the two groups with participants over 21 revealed a significant effect of alcohol cues on amount of beer consumption ($F (1, 47) = 6.71$, $p < 0.01$, **p < 0.001.**

![Figure 1. Effects of cue exposure (alcohol vs. neutral cues) on change in urge as measured by the Alcohol Urge Questionnaire. Means and SEs are provided; **p < 0.001.](image1)

![Figure 2. Effects of availability information (available vs. unavailable) on change in urge as measured by the Alcohol Urge Questionnaire. Means and SEs are provided; *p < 0.05.](image2)
but no effect on water consumption ($F(1, 47) = 0.55, p > 0.45$), both depicted in Figure 3. In addition, exposure to alcohol cues had no effect on latency to first sip ($F(1, 47) = 1.92, p > 0.15$). Finally, a $\chi^2$ test revealed that participants who received an alcohol cue exposure chose beer first more often than those who received a neutral cue exposure ($\chi^2(1, N = 49) = 7.53, p < 0.01$).

Pearson’s product-moment correlations were conducted between the postcue exposure self-report dependent variables and beer consumption. Significant correlations were evident
between both the AUQ and beer consumption ($r = 0.40, p < 0.005$) and between positive affect and beer consumption ($r = 0.62, p < 0.001$). No significant association was evident between negative affect ($r = 0.16, p > 0.25$) and beer consumption.

**Individual item analyses**

To explore which aspects of the urge state were responsible for the significant main cue and availability effects on the AUQ, 2 x 2 ANOVAs were conducted on change scores for each of the eight AUQ items. The most relevant item to the overall main effects of alcohol cues and unavailability information was the item “I crave a drink right now” where a significant main effect for both cue-type ($F(1, 91) = 11.11, p < 0.001, \eta^2_p = 0.11$) and a marginally significant effect for availability ($F(1, 91) = 3.72, p = 0.057, \eta^2_p = 0.04$) were evident. The effects reflected greater urge in response to alcohol cues and in response to unavailability information. Significant main effects of cue-type were also evident for the following items: “I do not need to have a drink right now” ($F(1, 91) = 6.53, p < 0.05, \eta^2_p = 0.07$), “It would be difficult to turn down a drink right now” ($F(1, 91) = 3.92, p < 0.05, \eta^2_p = 0.04$), “Having a drink right now would seem just perfect” ($F(1, 91) = 5.66, p < 0.05, \eta^2_p = 0.06$), “I want a drink so bad I can taste it” ($F(1, 91) = 4.39, p < 0.05, \eta^2_p = 0.05$), and “Nothing would be better than a drink right now” ($F(1, 91) = 3.78, p < 0.05, \eta^2_p = 0.04$). All effects reflected greater urge in response to alcohol cues. A marginally significant interaction was evident on the item “If I had a chance to drink I do not think that I would drink it” ($F(1, 91) = 3.84, p = 0.053, \eta^2_p = 0.04$). This was a result of conditions alcohol-available ($M = 0.46, SE = 0.39$) and neutral-unavailable ($M = 0.84, SE = 0.38$) exhibiting increases in urge, condition alcohol-unavailable exhibiting negligible change ($M = 0.09, SE = 0.41$), and condition neutral-available exhibiting a decrease ($M = -0.32, SE = 0.38$). No significant main effects or interaction were evident for item “All I want to do is have a drink” ($p’s > 0.25$).

**Discussion**

This study sought to further examine interactions between contextual and cognitive attributions on motivation for alcohol using a sample of heavy drinkers who straddled the legal age of alcohol use. Consistent with previous cue reactivity research (e.g., Monti et al. 1987; Carter and Tiffany 1999), the multimodal alcohol cue exposure generated significantly greater craving relative to neutral cues and a modest increase in positive affect relative to neutral cues. In addition, for those who were given access to placebo beer and water, the alcohol cue exposure resulted in a greater likelihood of choosing beer first and greater beer consumption. More importantly, participants who received explicit unavailability information reported greater urge to drink relative to those who received explicit availability information. This effect was independent of the type of cue exposure used. Regardless of whether participants were exposed to alcohol or neutral cues, explicit unavailability information generated a greater self-reported desire to drink.

Interestingly, the effect of unavailability information in this study was somewhat different from that reported by MacKillop and Lisman (2005). In that study, unavailability information interacted with exposure to alcohol cues to selectively generate an increase in urge to drink relative to the other conditions. From a theoretical perspective, MacKillop and Lisman’s (2005) results were interpreted as consistent with Tiffany’s (1990) cognitive processing model (CPM). Specifically, the presence of unavailability information in
a context that was congruent with habitual substance use was interpreted as interrupting a previously automatized behavior and therebyeliciting an elevated urge to drink. However, in this case, Tiffany's CPM is not a viable explanatory model. Exposure to a multimodal water cue complex would not be predicted to elicitan automatized alcohol use routine and the main effect of unavailable information was evident across both cue exposures.

Alternatively, the current results may be better understood using the social psychological construct of reactance (Brehm 1966; Brehm and Brehm 1981). According to reactance theory, people perceive themselves to have certain freedoms, and when those perceived freedoms are threatened, they react with a defensive compensatory motivation to regain them. In other words, proscribing an individual from an activity that is believed to be a personal right can generate a compensatory desire to engage in the activity, a phenomenon that has been supported by a large body of experimental (Brehm 1966; Brehm and Brehm 1981) and clinical (Miller et al. 1993) research. In addition, Sayette and Hufford (1995) have previously raised the possibility of reactance playing a role in the role of availability and cue reactivity.

Applying reactance theory to this case, it can be inferred that, based on a lifestyle of drinking approximately 30 drinks per week, the underage participants considered that access to alcohol, although illegal, was part of their domain of personal freedoms. This perception would not necessarily be an explicit attribution about freedom to drink in the experiment, but rather a generalized implicit attribution about alcohol use. As a result, the explicit unavailability information in the instructional set may have elicited a defensive desire to drink.

This explanation has the potential to reconcile the current results with those reported by MacKillop and Lisman (2005). In that study, all the participants were at least 21 years old, and it may have been that unavailability information instigated a defensive reactive response only when in conflict with the apparent opportunity to consume alcohol. In contrast, unavailability information may have been discounted as irrelevant by drinkers of legal age when followed by a neutral cue exposure. However, in the current study, for the participants in the unavailable condition – heavy underage drinkers whose lifestyle involved actively defying the law – unavailability information may have been highly salient regardless of cues, eliciting a defensive increase in urge independent of cue exposure. Although this explanation is speculative, it nonetheless reconciles the data from both studies and could be directly tested by integrating the current design and that used in MacKillop and Lisman (2005).

If reactance does account for these findings, the question remains as to why unavailability elicited a reactant increase in urge to drink in this study in contrast to the enhancing effect of availability information in previous studies (Droungas et al. 1995; Dols et al. 2000; Carter and Tiffany 2001). One explanation is that both MacKillop and Lisman (2005) and the current study focus on alcohol cue reactivity and availability information, whereas the previous experimental studies indicating that availability information enhances cue reactivity have largely used nicotine cue reactivity. Rather than a difference in pharmacology, however, the important distinction may be between local and distal availability. According to Carter and Tiffany (2001), there is an important distinction between local and distal availability that may influence substance urges. Local availability refers to the availability of the substance within the experimental session, whereas distal availability refers to the availability of the substance beyond the session. In nicotine cue reactivity studies, participants are most often heavy daily smokers (Carter and Tiffany 2001) who presumably have cigarettes with them to the laboratory session. Under those circumstances, unavailability is only local because nicotine will be immediately available following the session. In contrast, it is unlikely that any of the heavy drinkers in this study or its predecessor brought alcohol with them, thus creating
a situation of both local and distal unavailability. Thus, it is possible that under conditions of distal unavailability, explicit unavailability information will elicit a defensive increase in urge for the substance. This hypothesis could be tested using direct experimental manipulations of local and distal substance availability.

An important consideration regarding this study is the use of a quasi-experimental design, where nonrandom assignment of one or more independent variables creates the possibility of a third-variable confound (Cook and Campbell 1979; Rosenbaum 1995; Hutchison et al. 2004). In this case, it is possible that significant differences between the two age groups substantially influenced the results. This appears to be unlikely, given that the participants were within a relatively tight range of ages (19–22) and thorough examination revealed no significant differences between underage and of-age individuals on the pertinent variables (i.e., drinks/week, symptoms of alcohol dependence, urge to drink, affective state). Although the equivalence of the two groups suggests that the study was internally valid, it is nonetheless possible that unmeasured variables did exist and contributed to these findings.

Most broadly, the current study complements its predecessor (MacKillop and Lisman 2005), revealing that under laboratory conditions explicit unavailability information actually increased desire for alcohol. As such, it joins a number of previous human laboratory studies (Droungas et al. 1995; Juliano and Brandon 1998; Dols et al. 2000; Carter and Tiffany 2001) that have revealed that reactions to substance cues reflect an active interplay of environmental context and cognitive expectations, a cornerstone of modern learning theory (Bradizza et al. 1994; Kirsch et al. 2004). Importantly, however, the current study also supports the notion that such cognitive variables do not necessarily have uniform effects (Baker et al. 1986; Carter and Tiffany 2001), and indicates the need for further investigation to clarify the internal and external contextual variables that differentially determine drug motivation.

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References


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