Reactivity to Alcohol Cues: Isolating the Role of Perceived Availability

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Perceived availability of a substance has been proposed to play a role in cue reactivity by both traditional classical conditioning models and S. T. Tiffany’s (1990) cognitive processing model (CPM) of substance use. This study investigated the role of availability information on alcohol cue reactivity. Subjects were 134 heavy drinkers in a 2 × 2 between-subjects design, crossing cues (alcohol vs. neutral) and availability information (availability vs. unavailability). The results indicated significant main effects for cue type, with alcohol cues eliciting greater reactivity on multiple measures, and an interaction effect on the Alcohol Urge Questionnaire (M. J. Bohn, D. D. Krahn, & B. B. Staehler, 1995), such that exposure to alcohol cues in conjunction with unavailability information elicited a greater urge. This was largely a result of changes in self-reported craving and was interpreted as consistent with the CPM. Alternative methodologies and limitations are discussed.

Keywords: alcohol, cue reactivity, availability, craving, cognitive processing model

The role of classical conditioning in human addictive behavior has been typically investigated within a cue reactivity paradigm, that is, the measurement of individuals’ responses to substance use cues in a controlled environment (Niaura et al., 1988; Pomerleau, Fertig, Baker, & Cooney, 1983). However, there has been considerable inconsistency among the findings of cue reactivity research (Carter & Tiffany, 1999). According to several researchers, this inconsistency may reflect the impact of subjects’ beliefs about the availability of the substance for their consumption (Tiffany, 1990; Wertz & Sayette, 2001).

Two models of addictive behavior make predictions about expectations of availability in substance use. From a traditional classical conditioning standpoint, information that a substance is available may be encoded as an antecedent cue that predicts substance use (Wertz & Sayette, 2001). As such, the presence of availability information in a cue reactivity paradigm should enhance urges to use a substance, whereas the information that a substance is not available should dampen reactivity (Wertz & Sayette, 2001).

Alternatively, Tiffany’s (1990) cognitive processing model (CPM) proposes that information that a desired substance is unavailable may play a prominent role in cue reactivity. According to the CPM, regular drug use over time becomes an overlearned, automatic behavior, and it is only when drug-seeking behavior is interrupted that nonautomatic processing (e.g., craving, somatovisceral arousal) is required and an individual experiences acute subjective urges. According to Tiffany (1990), in a cue reactivity paradigm “the availability of the drug . . . should influence the nature and magnitude of the nonautomatic processing activated in the situation” (p. 161). Thus, the CPM predicts that the expectation of unavailability in the context of routine, automatized use would act as such an interruption and would evoke an urge state.

The empirical literature on availability and cue reactivity is generally supportive of traditional classical conditioning theory. Droungas, Ehrman, Childress, and O’Brien (1995) manipulated availability prior to a cue exposure session, and only those subjects who expected cigarette availability reported significantly greater desire to smoke and greater withdrawal symptoms compared with baseline measures. Juliano and Brandon (1998) manipulated nicotine availability information for two groups of smokers and found that those informed that nicotine would be available reported significantly increased urges following cue exposure for subjects, whereas those subjects who received information that nicotine would not be available showed slower reaction time performance. Dols, Willems, van den Hout, and Bittoun (2000) conditioned a neutral stimulus to signal nicotine availability and found that urges increased in response to that stimulus. In addition, Dols et al. (2000) found that when subjects were exposed to both smoking cues and the availability cue was presented, urges additively increased.

Tiffany and colleagues (Carter & Tiffany, 2001; Davidson, Tiffany, Johnston, Flury, & Li, 2003) have examined
the role of availability on cue reactivity by using what they term the cue-availability paradigm. This methodology uses a within-session manipulation of availability to examine differences in responses to either substance or neutral cues under various probabilities of availability. Using this approach, 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. Examining availability and alcohol cue reactivity with the cue-availability paradigm, Davidson et al. (2003) found that although alcohol cues increased urge and negative affect, there was no effect of availability information. However, according to Davidson et al. (2003), this may have been the result of methodological problems that resulted in low urge to drink and an ineffective placebo manipulation.

Wertz and Sayette (2001) conducted a comprehensive review of studies that included implicit communication of availability (e.g., inpatient vs. outpatient studies) and found that availability information appeared to generally enhance cue reactivity. As the authors acknowledge, however, it is notable that availability information was confounded with substance type (nicotine vs. alcohol) and significant differences in the degree of cue reactivity have been demonstrated between these two substances in a meta-analysis of cue reactivity research (Carter & Tiffany, 1999).

Taken together, research generally supports the notion that availability information enhances cue reactivity; however, all but one of the experimental studies are of nicotine cue reactivity. As mentioned above, the only published study examining another psychoactive substance (alcohol) reported null results due to apparent methodological issues.

Therefore, to extend the availability and cue reactivity literature, the present study investigated the role of perceived availability on alcohol cue reactivity by using a different approach. In this study, subjects were randomized into conditions in which they were provided with explicit availability information prior to either an alcohol-related or a neutral cue exposure in a $2 	imes 2$ between-subjects design. Because traditional classical conditioning conceptualizations and the CPM make differential predictions regarding availability information, the present study made no directional hypotheses. It is important to note that both groups in this design received an alcohol cue exposure and were then assessed, thus precluding immediate consumption of alcohol. Although this constituted an interruption to use, the groups critically differed in terms of their availability expectations during this interruption.

**Method**

**Subjects**

Posted advertisements and classroom—e-mail solicitations at the State University of New York at Binghamton were used to recruit prospective subjects, who then completed screening applications—telephone interviews. Inclusion criteria were heavy alcohol consumption, preference for beer, regular beer consumption, and self-reported high-hedonic value of beer. Heavy alcohol consumption was operationalized as a mean of 20 or more standard drinks per week for men and 14 or more for women. The mean number of drinks per week was assessed with the Drinking Days Questionnaire (DDQ; L. R. Collins, Parks, & Marlatt, 1985). In addition, subjects were required to report that beer was one of their three favorite alcoholic beverages, that beer was one of their top three most frequently consumed alcoholic beverages, and that their enjoyment of beer was rated as 7 or greater on a Likert-type scale ranging from 1 (not at all) to 10 (very much). The quantity criterion was intended to identify heavy drinkers most likely to be cue reactive, whereas the latter three criteria were intended to select subjects who would be a good match for the standardized cue exposure, which was oriented around beer. In addition to the above inclusion measures, the Alcohol Dependence Scale (ADS; Skinner & Horn, 1984) was administered at baseline to assess dependence, although no entry criterion was used.

In order to further increase the likelihood of responsivity to the cues, subjects were matched to their favorite category of beer (imported, domestic, light), following the recommendation of Staiger and White (1994). In addition, subjects were matched to imaginal scenes related to their most common reason for drinking from among eight possibilities: relaxation, happiness, enjoyment of the taste, anger, boredom, sadness–depression, anxiety, or out of habit. We developed these scenes in the laboratory by consulting previous research reports demonstrating evocation of cue reactive responses to imaginal scenes (Maude-Griffin & Tiffany, 1996; Payne et al., 1992). The scenes describe common environmental, interpersonal, and affective contexts of drinking as well as evocative descriptions of the orosensory properties of the beer. Nonalcoholic beer was used for all three categories of beer, on the basis of its orosensory and perceptual similarity to alcoholic beer and was rebottled as the matched commercial brand; we conducted pilot research to ascertain that the commercial beers that we selected were similar in terms of appearance and taste to the placebo beer. Finally, to ensure relatively equal motivation across subjects and to effectively use personnel resources, an unreliability criterion was implemented such that individuals who missed appointments twice were not rescheduled.

The appropriate number of subjects was established by consulting a previous between-subjects study examining cue reactivity and availability (Juliano & Brandon, 1998) and by conducting a power analysis. With power of .80, alpha at .05, and presuming a medium effect size ($f = .30$), the power analysis (Erdfelder, Faul, & Buchner, 1996) suggested a minimum sample size of 128 (32 per cell).

One hundred sixty-one individuals met criteria for the study. Of these, 13 individuals declined to participate after receiving further information about the study, and 8 individuals were excluded on the basis of the attendance criterion. In total, 140 subjects were randomly assigned by condition and completed the study. Valid data were gathered from 134 individuals, resulting in two groups of 34 and two groups of 33 subjects. Subjects were compensated in two ways: They received either required research credit for psychology courses or $5 for their participation, according to their choice.

Subjects’ ages ranged from 21 to 26, with a modal age of 21 (75%). Male subjects (64%) reported drinking a mean of 33.5 standard drinks per week, ranging from 20 to 71; female subjects (36%) reported drinking a mean of 23.7, ranging from 14 to 63. Subjects reported they “liked beer” on a Likert-type scale ranging from 1 to 10 ($M = 8.50, SD = 1.05$). A chi-square test revealed that male and female subjects were distributed equally across groups, $\chi^2(3, N = 134) = 3.49, p = .32$.

On the ADS, subjects yielded a mean score of 12.2, ranging from 3 to 29. On the basis of the ADS norms (derived from
multiple alcohol-dependent samples), these subjects were, on average, slightly less dependent than 25% of those groups (Skinner & Horn, 1984). These drinking characteristics are similar to those of subjects in previous studies examining alcohol cue reactivity (e.g., Bradizza, Lisman & Payne, 1995; B. N. Collins & Brandon, 2002). The majority of subjects (68%) reported that they most often drank when they were “happy or celebrating,” followed by those who reported primarily drinking “to relax” (19%). Negligible proportions reported drinking based primarily on other motivations.

Design

Subjects were randomly assigned into one of four groups in a 2 × 2 factorial design (Cue Type × Availability), labeled alcohol cues–available (AA), alcohol cues–unavailable (AU), neutral cues–available (NA), and neutral cues–unavailable (NU). Although requiring more subjects, a between-subjects design was selected on the basis of an earlier study (Carrigan, 1998), in which manipulations of information across a within-subjects procedure had the effect of confusing subjects and the potential for order effects. It should be noted that procedurally both alcohol conditions were exposed to alcohol cues for a period during which the subjects could not drink, which constituted an interruption. As such, the two conditions can be thought of as alcohol cue exposure with a short-term interruption and the expectation of free access (alcohol available) and alcohol cue exposure with short-term interruption and the expectation of no access (alcohol unavailable).

Dependent Measures

Self-reported urge. The use of a single-question measure (SQ) of urge has been criticized for various methodological problems such as low reliability and an inability to represent different facets of the construct (Tiffany, Carter, & Singleton, 2000). Therefore, the eight-question Alcohol Urge Questionnaire (AUQ; Bohn, Krahm, & Staehler, 1995) was used in tandem with the SQ. This measure is similar to other multi-item urge measures used in alcohol (Davidson et al., 2003) and nicotine (Cox, Tiffany, & Christen, 2001) cue reactivity research. In addition, to increase the resolution of the SQ, a 100-point Likert-type scale ranging from 1 (no urge at all) to 100 (extremely strong urge) was provided.

Positive and Negative Affect Schedule (PANAS). Given previous hypotheses of craving mapping onto affect states (Baker, Morse, & Sherman, 1987), the PANAS (Watson, Clark, & Tellegen, 1988) was included as a measure of transient mood. This instrument has been shown to have adequate reliability (α = .85) as well as convergent and discriminant validity (Watson et al., 1988).

Behavioral measures. Behavioral measures of reactivity are the least often studied and may provide compelling evidence of cue reactivity in addiction research (Drummond, Tiffany, Glautier, & Remington, 1995). For this reason, four behavioral dependent variables were used. First, because all subjects were provided with both alcohol and a neutral beverage during the consumption period, beverage choice was dichotomously measured. Second, latency to first sip (in milliseconds) was used because time to drinking has successfully differentiated experimental groups in previous cue reactivity studies (e.g., Hodgson, Rankin, & Stockwell, 1979; Stockwell, Hodgson, Rankin, & Taylor, 1982). Finally, ad libitum volume of both beer and water consumed were used as dependent variables. Although published data on the utility of consumption are not available, as a face valid measure of urge to drink, consumption was considered a worthwhile dependent variable.

Procedures

All study procedures were reviewed and approved by the Binghamton University Human Subjects Research Review Committee. At baseline, subjects were asked to complete an initial consent form and baseline measures, including the SQ, AUQ, PANAS, and ADS. The initial consent form contained no information about alcohol availability and pertained only to completing the baseline measures. This was necessary to allow for premanipulation baseline data collection.

Following baseline completion of measures, subjects were provided with the second consent form with explicit availability information in enlarged font and boldface and asked to read it carefully and sign it. Specifically, the consent form with the instructional set read: Alcohol [WILL] [WILL NOT] be available at the end of the experimental session. Subjects were then asked three questions to establish that the information on the second consent form was clear, including two initial decoy questions to reduce demand characteristics and were then asked to affirm the particular availability information that they had been given. Specifically, the experimenter asked: “Will alcohol be available in this experiment at any point?” If a subject answered incorrectly, the experimenter corrected him or her, pointed out the availability status on the consent form, and repeated aloud the availability status.

Following the consent procedure, subjects were led to one of the two experimental rooms (8 ft × 6 ft × 8 ft [2.44 m × 1.83 m × 2.44 m]) fitted with one-way mirrors and containing either alcohol cues or neutral cues. The room containing the alcohol-cue complex included visual, olfactory, tactile, proprioceptive, and imaginal cues. Subjects sat at a table with various empty beer bottles and advertising tri-folds from bars. Numerous posters and images of beer decorated the walls of the experimental room. An imaginal scenario was provided via a portable tape recorder, and the placebo beer was transported into the room in a six-pack holder, opened in front of the subject, and poured into a beer stein. The room containing the neutral-cue complex included each of the same modalities of cue, but they were related only to the consumption of water.

Following the pouring of the beverage, subjects were given 1 min to observe the cue-exposure room and the array of cues. They were then given instructions via intercom to pick up the glass, deeply inhale the smell of the beverage, and listen to the imaginal scene, paying close attention and trying to imagine the scene as clearly as they could. For all four groups, the cue-exposure periods were of equivalent times (~6 min), and at the conclusion of the cue exposure, an experimenter returned and asked the subject to complete self-report dependent measures.

After the postexposure assessment, subjects were permitted to consume beer and/or water ad libitum; a total of six, 12-oz. commercially labeled bottles of beer and water were provided (three of each), including the one already opened (beer or water, depending on the condition). Those who had received instructions of unavailability were informed that a mistake had been made earlier and they could drink as much beer or water as they desired after all. The subjects were provided 5 min to consume as much of either beverage as they chose, although they were not informed how long the period was. The first beverage selected and the latency to drink either beverage were assessed. After the consumption period, subjects were asked to complete urge and affect measures for the last time.
Results

Manipulation Checks

To assess the sufficiency of the availability manipulation, during the postexperimental interview subjects were asked to rate “How surprised were you to receive beer in this experiment?” on a 7-point Likert-type scale ranging from 1 (not surprised at all) to 7 (extremely surprised). A univariate analysis of variance (ANOVA) was conducted between the availability conditions and was significant, \( F(1, 132) = 15.67, p < .001 \), suggesting the manipulation of perceived availability was successful.

To avoid potentially alerting subjects to the nonalcoholic nature of the beer, subjects were not explicitly asked whether they thought the beer was alcoholic or how much alcohol was in the beer. Rather, as an oblique measure, the subjects were asked how similar the beer they drank was to their regular beer. On a 10-point Likert-type scale (1 = not similar at all; 10 = extremely similar) measuring the similarity of the beer used in the study to the subjects’ regularly consumed beer, the mean response was 7.1, suggesting that the subjects substantially believed that the placebo beer actually contained alcohol. A univariate ANOVA was conducted to assess any differences between groups and was found insignificant, \( F(1, 121) = .90, p = .44 \).

Open-ended questions regarding expectations of the experiment were included in the postexperimental questionnaire to assess demand characteristics of the study. Although the majority accurately identified that the intent of the experiment was to study the influence of environmental cues, none identified the availability manipulation as the goal.

Data Analysis

Following the suggestions of Huberty and Morris (1989), a series of univariate analyses were conducted when preliminary correlational analyses failed to identify correlations between dependent variables, which would suggest the usefulness of a multivariate analysis.

In addition, prior to analysis, all scales were assessed for reliability using Cronbach’s alpha. The AUQ, ADS, and both positive and negative scales of the PANAS showed strong internal consistency (AUQ: \( \alpha = .89 \); ADS: \( \alpha = .78 \); PANAS–Positive Affect: \( \alpha = .84 \); PANAS–Negative Affect: \( \alpha = .80 \)). In addition, the data were assessed for distribution normality and outlying data points. Negative Affect showed a substantial positive skew and required an inverse transformation; consumption of alcohol and water were both positively skewed and required square root transformations. Latency also displayed substantial positive skew, which was corrected by a logarithmic transformation. All other variables were sufficiently normally distributed. Two univariate outliers were detected on latency, and having been assessed as legitimate data points, they were reassigned values one raw score unit away from the next highest case that was not an outlier as suggested by Tabachnik and Fidell (2001).

Baseline

Following assessment of distribution normality and outliers, univariate ANOVAs were conducted on demographic variables, urge, affect, and dependence to establish equivalence. No significant differences between groups were detected.

Postexposure Cue Reactivity

Univariate \( 2 \times 2 \) (Cue Type \( \times \) Availability) analyses of covariance (ANCOVAs) were conducted to test for main effects and interaction of the independent variables, with an a priori decision to covary baseline urge reports. All means, \( F \) ratios, significance, and effect sizes are presented in Table 1; a Bonferroni multiple comparison significance correction was applied reducing the critical \( p \) value to .01. Significant main effects were found for cue type on the SQ and AUQ and were in the expected direction: Individuals in the alcohol conditions reported significantly higher ratings on both measures of urge. Although not reaching statistical

<table>
<thead>
<tr>
<th>Variable</th>
<th>Alcohol (M)</th>
<th>Water (M)</th>
<th>( F )</th>
<th>( \eta^2 )</th>
<th>Available (M)</th>
<th>Unavailable (M)</th>
<th>( F )</th>
<th>( \eta^2 )</th>
<th>( F )</th>
<th>( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUQ</td>
<td>37.48</td>
<td>31.53</td>
<td>16.71**</td>
<td>.12</td>
<td>30.26</td>
<td>34.71</td>
<td>1.00</td>
<td>.00</td>
<td>6.84*</td>
<td>.05</td>
</tr>
<tr>
<td>SQ</td>
<td>69.29</td>
<td>53.19</td>
<td>36.15**</td>
<td>.22</td>
<td>63.02</td>
<td>59.40</td>
<td>1.92</td>
<td>.02</td>
<td>4.49</td>
<td>.03</td>
</tr>
<tr>
<td>PA</td>
<td>32.19</td>
<td>30.61</td>
<td>2.90</td>
<td>.02</td>
<td>31.91</td>
<td>30.90</td>
<td>1.17</td>
<td>.01</td>
<td>0.26</td>
<td>.00</td>
</tr>
<tr>
<td>NA(^a)</td>
<td>14.31</td>
<td>13.91</td>
<td>0.42</td>
<td>.00</td>
<td>13.63</td>
<td>14.61</td>
<td>3.12</td>
<td>.02</td>
<td>1.36</td>
<td>.01</td>
</tr>
<tr>
<td>Latency(^a)</td>
<td>70.00</td>
<td>83.00</td>
<td>4.88*</td>
<td>.04</td>
<td>71.00</td>
<td>82.00</td>
<td>4.28</td>
<td>.03</td>
<td>1.31</td>
<td>.01</td>
</tr>
<tr>
<td>Alcohol(^b)</td>
<td>315.21</td>
<td>361.41</td>
<td>1.37</td>
<td>.01</td>
<td>348.16</td>
<td>327.96</td>
<td>0.55</td>
<td>.00</td>
<td>0.50</td>
<td>.00</td>
</tr>
<tr>
<td>Water(^b)</td>
<td>89.81</td>
<td>94.44</td>
<td>0.25</td>
<td>.00</td>
<td>78.55</td>
<td>105.86</td>
<td>1.92</td>
<td>.02</td>
<td>0.00</td>
<td>.00</td>
</tr>
</tbody>
</table>

Note. AUQ = Alcohol Urge Questionnaire; SQ = single-question measure; PA = Positive Affect; NA = Negative Affect.

\(^a\) Although a transformation was used, the untransformed means are presented for interpretational clarity.

\(^b\) Consumption variables were measured in grams based on consultation (Spear, personal communication, April 23, 2002) and were not combined into a single metric based on different specific gravities.

\(* p \leq .05 \)  \( ** p \leq .01 \). Bonferroni correction applied reducing critical \( p \) to .01.
significance, latency to drink either beverage and positive affect indicated statistical trends ($p = .03$ and .09, respectively), reflecting faster latency and increased positive affect following the alcohol cue exposure.

In terms of main effects of availability information, latency to consume either beverage and negative affect showed trends approaching statistical significance ($p < .04 \text{ and } .08$, respectively), such that availability information resulted in faster latency to consumption of either beverage and lower negative affect. No significant main effects of availability were found on urge measures or positive affect (see Table 1). Equally, no availability main effect was detected for beer or water consumption.

A significant interaction between cue type and availability was detected on the AUQ. Post hoc pairwise comparisons revealed significantly higher urge to drink in the AU condition relative to the three other conditions, as depicted in Figure 1. In addition, post hoc tests revealed that, as anticipated by the cue-type main effect, the AA condition was significantly higher in urge relative to NU ($p < .01$), and the NA and NU conditions were equivalent ($p = .11$); however, the AA and NA conditions were not statistically different ($p = .30$). Given the initial use of a conservative Bonferroni error correction, no multiple comparison correction was used for post hoc tests. Although the between-subjects design precluded removal of nonresponders to the alcohol cue complex, examination of the SQ and AUQ performance in the alcohol cue exposure groups revealed that 94% of subjects showed an increase in urge in response to the exposure.

Chi-square analyses were conducted on first choice of beverage and were nonsignificant; cue type: $\chi^2(1, N = 134) = .541, p = .462$; availability: $\chi^2(1, N = 134) = 1.50, p = .221$.

**Individual Item Analyses**

Because a significant interaction effect was detected only on the AUQ, which is composed of eight items, each item was examined to explore the source of the effect. Using the same approach, we conducted $2 \times 2$ ANCOVAs (Cue Type $\times$ Availability) for each of the items. $F$ ratios, effect sizes, and significance are presented in Table 2. These exploratory analyses revealed that of the eight total items, three items revealed significant interaction effects in the same form as the one reported above, the combination of alcohol cue and unavailability information generating a significantly greater urge than any other condition. The largest effect was evident on the item *I crave a drink right now*, depicted in Figure 2. One additional item (*It would be difficult to turn down a drink this minute*) exhibited the same interaction but only exhibited a statistical trend ($p = .09$). Two items exhibited only a main effect of alcohol urges, and two items did not appear to be sensitive to either alcohol

![Figure 1](image-url)
Table 2

Results of 2 × 2 (Cue Type × Availability) Analyses of Covariance for Each Alcohol Urge Questionnaire Item

<table>
<thead>
<tr>
<th>Item and variable</th>
<th>F(1, 133)</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>All I want to do now is have a drink.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cue (C)</td>
<td>19.58***</td>
<td>.13</td>
</tr>
<tr>
<td>Availability (A)</td>
<td>0.00</td>
<td>.99</td>
</tr>
<tr>
<td>C × A</td>
<td>4.04*</td>
<td>.03</td>
</tr>
<tr>
<td>I do not need to have a drink right now. (reversed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1.73</td>
<td>.01</td>
</tr>
<tr>
<td>A</td>
<td>2.75</td>
<td>.02</td>
</tr>
<tr>
<td>C × A</td>
<td>2.34</td>
<td>.02</td>
</tr>
<tr>
<td>It would be difficult to turn down a drink this minute.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>8.21**</td>
<td>.06</td>
</tr>
<tr>
<td>A</td>
<td>2.58</td>
<td>.02</td>
</tr>
<tr>
<td>C × A</td>
<td>2.83</td>
<td>.02</td>
</tr>
<tr>
<td>Having a drink now would seem just perfect.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>5.07*</td>
<td>.04</td>
</tr>
<tr>
<td>A</td>
<td>1.43</td>
<td>.01</td>
</tr>
<tr>
<td>C × A</td>
<td>2.80</td>
<td>.02</td>
</tr>
<tr>
<td>I want a drink so bad I can almost taste it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>9.24***</td>
<td>.07</td>
</tr>
<tr>
<td>A</td>
<td>0.03</td>
<td>.00</td>
</tr>
<tr>
<td>C × A</td>
<td>4.89*</td>
<td>.04</td>
</tr>
<tr>
<td>Nothing would be better than a drink right now.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>3.94*</td>
<td>.03</td>
</tr>
<tr>
<td>A</td>
<td>0.01</td>
<td>.00</td>
</tr>
<tr>
<td>C × A</td>
<td>1.29</td>
<td>.01</td>
</tr>
<tr>
<td>If I had the chance to have a drink, I do not think I would drink it. (reversed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.52</td>
<td>.00</td>
</tr>
<tr>
<td>A</td>
<td>0.17</td>
<td>.00</td>
</tr>
<tr>
<td>C × A</td>
<td>1.39</td>
<td>.01</td>
</tr>
<tr>
<td>I crave a drink right now.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>11.52***</td>
<td>.08</td>
</tr>
<tr>
<td>A</td>
<td>0.01</td>
<td>.00</td>
</tr>
<tr>
<td>C × A</td>
<td>11.23***</td>
<td>.08</td>
</tr>
</tbody>
</table>

*p ≤ .05  ** p ≤ .01  *** p ≤ .001.

or availability manipulations on the basis of no statistically significant main effects or interactions.

Postconsumption

Following the ad libitum consumption period, 2 × 2 (Cue Type × Availability) ANCOVAs covarying baseline were conducted on the AUQ, SQ, PANAS–Positive Affect, and PANAS–Negative Affect to determine whether cue exposure type or availability differentially influenced groups' postconsumption responses. A Bonferroni correction was used reducing the critical p value to .01. No significant effects were found for either independent variable or interaction.

Discussion

This study sought to experimentally investigate the role of perceived availability information on alcohol cue reactivity. The results replicate the extensive, previously reported finding that an alcohol cue exposure induces a sub-jective urge state (e.g., Litt, Cooney, Kadden, & Gaupp, 1990; Niaura et al., 1988; Rohsenow et al., 1992) and indicated an interaction effect between cue type and availability information on the AUQ such that individuals exposed to alcohol cues and informed they would not be permitted to drink alcohol reported a significantly stronger urge to drink.

Although these findings diverge from the traditional classical conditioning model’s prediction that availability information would increase alcohol cue reactivity (e.g., Wertz & Sayette, 2001), they converge with a prediction derived from Tiffany’s (1990) CPM. According to this model, the behaviors associated with substance use over time become part of a nonvolitional, automatic process. Over time, substance use is not necessarily preceded by an acute urge state, but only when automatic behavior is interrupted and the individual has to consciously marshal cognitive resources to procure and use the drug.

According to the model, the subjects in the alcohol-unavailable condition in this study reported a higher urge than all other groups because the alcohol cue exposure provided both the environment in which automatized consumption would typically take place and the unavailability information interrupted automatic processing. Thus, these findings support the cognitive processing conceptualization of addictive behavior as a combination of automatic and volitional behavior in which subjective craving is a frequent, but not necessary, antecedent of use (Tiffany, 1990).

It is important to note that, in fact, both groups receiving an alcohol cue exposure were subject to an interruption in automatized drinking behavior. Under normal circumstances, it would be extremely unusual to be served a glass of beer and then asked to listen to a story describing drinking the beer while smelling the beer without being permitted to drink it. Thus, independent of availability instructions, both groups experienced an interruption in normal drinking behavior. This does not detract from the experimental design because both alcohol cue groups received the same interruption and differed only on availability information. Both the traditional classical conditioning model and Tiffany’s (1990) model would predict main effects on urge based on cue type, as were seen, but only the latter would predict unavailability information and would further interrupt automatic processing and generate a higher urge state. Stated differently, these results suggest that the alcohol cue exposure and unavailability information additively produced greater nonautomatic processing.

The item-level analysis provides further insight into the nature of the interaction effect indicated in this study. In this case, the interaction effect on the AUQ was the result of three of the eight items generating significant interaction effects and a fourth item generating the same pattern and approaching statistical significance. Each of these items appeared to reflect more compulsive facets of urge to drink, and the largest magnitude effect was evident on the item I crave a drink right now.

Taken together, this indicates that the combination of an alcohol cue exposure and unavailability information did not increase a general urge state but literally generated a sig-
nificantly higher subjective craving and other specific aspects of an urge state, reflecting urgency and compulsiveness. This suggests that subordinate semantic representations of urges are dissociable from a single supraordinate category of “urge state” and may respond differentially depending on experimental manipulation. In addition, these results suggest that craving and related representations implicitly reflect desire for an object without access to it in a way that simple urge does not. Stated differently, strong anticipatory desire may be translated into a self-report of craving when it is accompanied by perceived deprivation from the desired object.

As with the initial interpretation, these data converge with the predictions of the CPM. According to the model, “the verbal structure of drug urges may be more complex than can be captured by current [single-item] urge assessments” (Tiffany, 1990, p. 162). Thus, the CPM recognizes that the experience of an interruption may vary on the basis of the experiential expectancies during that interruption in a relatively fine-grained way, a proposal that is highly consistent with this study’s findings.

Although beyond the central aims of the current article, it is also of significant interest that two of the AUQ items were insensitive to either manipulation. Both of these items, If I had the chance to have a drink, I do not think I would drink it and I do not need to have a drink right now, were reverse scored and exhibited no significant changes to the alcohol cue induction or availability instructions. Although in general this study suggests that multi-item measures of urges may be useful for both holistic and item-level analysis, the insensitivity of these items suggests that dropping them may enhance the sensitivity of the AUQ in studies that use the cue reactivity paradigm. However, this is only one study and it is an empirical question. Further empirical item-level examinations of the AUQ in cue reactivity preparations are necessary to clarify the usefulness of these items.

Several limitations of this study require discussion. The absence of these findings on the variables other than self-reported urge (although positive affect and latency were significant prior to the Bonferroni correction) requires discussion. Although this pattern of findings accords with the pattern reported in Carter and Tiffany’s (1999) meta-analysis—large effect size changes in self-reported urge with small effect size changes on other dependent variables—it would have been preferable had these dynamics been evident across other dependent variables as well.

This appears to be an issue of adequate, but not ideal, statistical power. One way to address this in future studies would be through the use of a within-subjects design, which would provide approximately twice the power of the current study. This approach can be recommended only on the assumption that order effects and confusion be assessed and minimized. Alternatively, because the manipulation used in this study was simply that of instructional set, future studies

Figure 2. Interaction effect of cue type and availability information on urge to drink as measured by the Alcohol Urge Questionnaire item I crave a drink right now. The figure begins at the covariate adjusted baseline mean (3.1) to reflect increase following cue exposure; comparisons are made between alcohol unavailability and the other three conditions, not necessarily the immediately adjacent conditions. **p < .01.
might seek to increase the magnitude or salience of the availability manipulation. By way of illustration, rather than the use of only an instructional set, sociocultural boundaries could be used as a manipulation. The difference in conditioning history between individuals of the same drinking patterns who are 20 versus 21 years old would be relatively negligible, but in New York State, for example, where the drinking age is 21, their expectations that alcohol will actually be available in a study setting would be dramatically different and could be further bolstered by instructional set.

In addition, in terms of the behavioral measures of consumption and latency, it is possible that the free access to both water and beer precluded highly resolved analysis of these variables. Considerable previous literature has demonstrated that individuals will readily use psychoactive substances if provided with free access but that use is highly dependent on the presence of alternative reinforcers (Bickel, Madden, & Petry, 1998). Therefore, the influence of the cue exposure and availability manipulation may have been evident if some form of contingency were used to measure effort expended or perceived value of the substance.

Finally, it should be noted that availability information could play several different roles. For example, in this study it is not clear whether unavailability information served as further interruption of automatic processes and provoked a greater urge, or whether availability information enhanced automaticity and reduced urge reactivity. Therefore, as has already been accomplished with within-subjects designs, future between-subjects studies should also incorporate intermediate or alternative conditions to potentially illuminate the context of availability effects.

Beyond methodology, the findings in this study require discussion about their divergence from previous research. Previous nicotine cue reactivity research has relatively consistently shown that availability information will enhance cue reactivity (e.g., Carter & Tiffany, 2001; Juliano & Brandon, 1998). In relation to the present results, this suggests that availability information as a cue may play a different role across substances. One explanation for how availability information might act differently across substances may be differences in the parameters of use that lead to differing sensitivity to availability information. Regular smokers, on average, smoke 18 cigarettes per day (Schoenborn, Adams, Barnes, Vickerie, & Schiller, 2004), and each cigarette can be considered a single episode of use. Given those parameters and the numerous public societal strictures that explicitly prohibit smoking under most conditions, most smokers are accustomed to a potential interruption of smoking behavior. In turn, smokers have to navigate their environment for smoking opportunities and as a result may be more vigilantly aware of smoking availability information. Such usage parameters would be consistent with the provocation of enhanced cue reactivity by availability information.

Unlike smoking, which takes place across many contexts throughout the day, a drinking episode tends to take place under relatively circumscribed circumstances (e.g., home, bar), where a sudden prohibition or interruption is unlikely. For this reason, the interruption of drinking in a drinking context may better conform to Tiffany’s (1990) model, with unavailability information resulting in the elicitation of a greater urge. Although Tiffany’s (1990) model was proposed for all addictive drugs and a differential role for availability across substances is not intuitively obvious, the discrepancy between findings in nicotine cue reactivity and the present study suggest this may be the case.

Despite the limitations and ambiguities discussed, this study has important methodological implications. Researchers who use cue reactivity preparations should consider the explicit and implicit communications of availability and note what availability information is conveyed in research reports. The alternative is research that unwittingly incorporates a confound of undefined proportions that may suppress valid findings or amplify spurious results.

This study also provides preliminary experimental support for the unavailability information processing interruption aspect of CPM in terms of alcohol use. Although the CPM has received support in terms of its predictions that relate craving to interference with cognitive processing (e.g., Cepeda-Benito & Tiffany, 1996), the model has hitherto not been validated in terms of its predictions relating to availability information. As such, it is hoped that the present study will promote further empirical examination of this model and the potentially different role of availability information across types of substances. More generally, this study underscores the importance of examining not only the environmental conditions antecedent to substance use but the multiplicity of cues—cognitive, affective, social—that occur in an individual’s natural behavioral environment.

References


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