University-affiliated Alcohol Marketing Enhances the Incentive Salience of Alcohol Cues

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Abstract

We tested whether affiliating beer brands with universities enhances the incentive salience of those brands for underage drinkers. In Study 1, 128 undergraduates viewed beer cues while event-related potentials (ERPs) were recorded. Results showed: beer cues paired with ingroup backgrounds (logos for students’ universities) evoked an enhanced P3 ERP component, a neural index of incentive salience; this effect varied according to students’ levels of identification with their university; and the amplitude of the ingroup-beer P3 response predicted change in alcohol use over one month. Study 2 (N = 104) used a naturalistic advertisement exposure to experimentally create ingroup-brand associations, and found that this manipulation caused an increase in the incentive salience of the beer brand. These data provide the first evidence that marketing beer via affiliation with their university enhances the incentive salience of the brand for underage students, and that this effect has implications for their alcohol involvement.
The need to belong to a valued social group is among the most powerful motivating forces in human life (Baumeister & Leary, 1995). Humans have evolved psychological mechanisms that bias feelings toward those with whom they share group memberships (Caporeal & Baron, 1997), producing positive ingroup evaluations (Maass, Ceccarelli, & Rudin, 1996; Pinter & Greenwald, 2011) and causing the perception of ingroup members to shift attitudes (Norton, Monin, Cooper, & Hogg, 2003), behavior (Lakin, Chartrand, & Arkin, 2008), and motivation (Loersch, Aarts, Payne, & Jefferis, 2008) toward ingroup norms.

Marketers routinely affiliate their products with social groups (e.g., Bergkvist & Bech-Larsen, 2010; Cornwell & Coote, 2005). People’s tendency to confer feelings of trust and safety to their ingroups (Brewer, 2008) provides marketers with the opportunity to implicitly convey that their products are safe and trustworthy, and endorsed by the group. In many cases this tendency is innocuous, but it can be problematic if the product is potentially dangerous. Alcohol misuse among college students causes nearly 2 million injuries each year (White & Hingson, 2013). Hence, marketing efforts that seek to affiliate alcohol brands with students’ universities have potentially dangerous consequences.

Alcohol manufacturers use various means to associate themselves with universities, including advertising during college sports broadcasts (Center on Alcohol Marketing and Youth, 2010). Current alcohol marketing efforts explicitly affiliate brands with universities via licensing agreements that permit corporations to use trademarked university symbols (e.g., The University of Missouri’s PowerTiger athletics logo and official school nickname, “Mizzou”) in their advertisements and product displays. Given that students often strongly identify with their institutions (e.g., Cialdini et al., 1976) and seemingly confer feelings of safety to university-
themed beer (Loersch & Bartholow, 2011), such efforts have the potential to encourage harmful drinking practices.

Beyond their association with trust and safety, ingroup-affiliated stimuli can rapidly capture attention (e.g., Dickter & Bartholow, 2007; Kawakami et al., 2014). Ingroup cues are inherently motivationally significant, given their ability to signal potential rewards in the form of social cohesion and shared resources (Correll & Park, 2005; Pickett, Gardner, & Knowles, 2004). This property is particularly important in the context of ingroup-alcohol affiliations given that alcohol’s motivational significance strongly determines its addictive potential (see Robinson & Berridge, 1993). In other words, the pairing of alcohol with ingroup stimuli has the potential to enhance its motivational significance, or *incentive salience*, particularly for individuals who strongly identify with the ingroup.

The purpose of the current research was to characterize the effects of ingroup (i.e., university-themed) beer marketing on the incentive salience of beer cues for underage drinkers, and to investigate the extent to which such effects can predict changes in alcohol involvement. Incentive salience was measured using the amplitude of the P3 (i.e., P300) component of the event-related potential (ERP) elicited by beverage cues. P3 amplitude varies along with the incentive value of eliciting stimuli (Beglieter, Porjesz, Chou, & Aunon, 1983; Nieuwenhuis, Aston-Jones, & Cohen, 2005), and numerous studies have shown that P3 amplitude elicited by images of alcohol signifies risk for heavy drinking (Bartholow, Henry, & Lust, 2007; Littel, Euser, Munafò, & Franken, 2012). Recent evidence links P3 amplitude to ventral striatum activation (Pfabigan et al., 2014), underscoring its significance as an index of motivational salience. Given that cues to ingroup membership are also highly salient, we predicted that an
ingroup context would exaggerate the incentive salience of beer cues, reflected in larger P3 amplitude relative to beer cues presented in a neutral outgroup context.

Further, we predicted that this ingroup context effect would vary according to individual differences in identification with the ingroup. Drinking is a salient part of the self-schemas of many students, for whom college attendance is stereotypically associated with drinking (Ashmore, Del Boca, & Beebe, 2002), and college students drink more than their age-matched peers (Slutske, 2005). Furthermore, the strength of group identification moderates the relationship between perceived norms for that group and its members’ drinking (Neighbors et al., 2010). Thus, we reasoned that as ingroup identification increases, so too should the incentive salience of alcohol in an ingroup context. Finally, we predicted that the P3 elicited by beer cues would uniquely predict changes in alcohol use, and that this effect would be amplified for beer cues presented in an ingroup context. (More extensive rationale for this prediction is provided in the supplementary material.) Of importance, we do not contend that exposure to ingroup-beer stimuli in the lab causes changes in alcohol use. Rather, we predict that the incentive salience of ingroup-beer cues will vary across individuals, which we view as analogous to their susceptibility to this type of alcohol marketing more generally.

Water-related cues were used as comparison stimuli. We also expected water cues to elicit larger P3s in an ingroup vs. an outgroup context because, as with the beer cues: (a) the water cues were infrequent oddballs (see Rosenfeld, Biroschak, Kleschen, & Smith, 2005); (b) water is also a consumable, appetitive commodity with incentive value; which (c) also should be amplified by ingroup context. Critically, however, the P3 elicited by water cues was not expected to be moderated by ingroup identification or to predict change in alcohol use.

**STUDY 1**
Method

Overview

The first study consisted of two experiments, run concurrently at MU and CU, which involved an initial lab session and a 30-day follow-up. Participants at both sites completed versions of the same laboratory task—the tasks differed only in the stimuli used to represent ingroup and outgroup universities—and completed identical self-report measures. The labs in both locations were identically equipped, which controlled for variability across labs that could affect data quality. Different outgroup stimuli were used at the two sites to ensure that effects of interest were not limited to a specific perceptual or group contrast; at the MU site the outgroup (University of Toronto) was represented by different colors than the ingroup, whereas at the CU site the outgroup (Appalachian State University) and ingroup were represented by a similar color scheme (see Fig. 1). These outgroups were selected because they do not typically compete for students (or in athletics) with our ingroup institutions.

Participants

Participants were recruited via introductory Psychology subject pools, and with posted flyers and email announcements that advertised the opportunity for currently enrolled, underage...
undergraduates (ages 18-20) to participate in research investigating brain responses and health behaviors. Interested students contacted the lab and a research assistant administered a brief screening interview via telephone. Individuals reporting a history of head trauma (leaving them unconscious for > 2 min), neural surgery or neurologic disorder, or who were taking psychoactive medication were disqualified, as were individuals who wore a hairstyle (e.g., dreadlocks; cornrows) that would prevent electrode placement on the scalp. Students who had not consumed alcohol in the past year, or who typically consumed more than 24 drinks per week (indicative of potential alcohol use disorder) were ineligible. The sample included 72 students at MU and 56 students at CU ($N = 128$), all of whom were 18-20 years old and roughly half (52%) of whom were women. Self-reported racial category was 82% White (including 4% Hispanic/Latino), 5% Multiracial, 4% Black, 3% Asian, and < 1% other. Participants received either $15/hour or partial course credit (if enrolled in Introductory Psychology) for the laboratory session, and an additional $20 (or additional credit) for completing the follow-up survey.

No previous studies have reported effects of ingroup (vs. outgroup) affiliation on P3 responses. Thus, sample size was estimated from power calculations based on effect sizes from prior studies using similar alcohol oddball paradigms and predicting alcohol use prospectively with alcohol cue-elicited P3 amplitude (e.g., Bartholow et al., 2007, 2010). However, because effect sizes in those prior studies (e.g., $d = .89$; $R^2_{\text{partial}} = .09$) are likely overestimated due to small sample sizes ($Ns = 46$), here we sought to more than double the sample size to help ensure more accurate estimates.

**Measuring the Incentive Salience of Beverage Cues**

**P3 responses to beverage cues.** Neural responses to beer and water presented in ingroup and outgroup university contexts were measured during a visual oddball task (adapted from
Bartholow et al., 2007). Participants saw infrequent beer and water logos superimposed on university backgrounds (i.e., the oddballs; see Figure 1) amid more frequent neutral images (the standards) drawn from the International Affective Picture System (IAPS; Lang et al., 2008). (Details concerning the specific IAPS images used can be found in the Supplementary Online Material.) Participants’ task was to categorize each image as either pleasant or neutral using one of two buttons. These stimuli were presented in five-image sequences, with the oddball always occurring in the fourth or fifth position. Each image was presented in the center of the display for 1000 ms with an inter-stimulus interval varying randomly (to reduce anticipatory processes) between 1,500 and 2,100 ms.

The oddballs formed a 2 (Beverage type: beer vs. water) x 2 (Beverage context: ingroup vs. outgroup) within-subjects design.¹ These cells were represented by two images each and each oddball image appeared on 32 separate trials. (Note that participants saw all possible combinations of logo vs. can/bottle and ingroup vs. outgroup context images; the specific combinations shown in Figure 1 are merely examples.) On an additional 32 trials all five images were neutral (standards), to permit estimation of the oddball effect and further reduce anticipatory responses. Thus, a total of 160 5-picture trials (800 images) were presented. Trials were equally divided into four blocks and participants were given a brief break between blocks.

**Electroencephalogram (EEG) recording.** The EEG was recorded continuously from 40 standard scalp locations (American Encephalographic Society, 1994) using tin electrodes in an electrode cap (Electro-cap International, Eaton, OH). Scalp electrodes were referenced online to the right mastoid and re-referenced offline to an average of the two mastoids. Additional electrodes were placed near the eyes to record vertical and horizontal eye movements. Electrode

¹ Pretesting data from both research sites indicated that Pabst Blue Ribbon® beer and Fuji® water were evaluated neutrally by samples drawn from the same populations used here. Also, neither brand previously had been affiliated with either university in marketing campaigns.
impedances were kept below 8 KΩ. The EEG signal was amplified by NeuroScan SynAmps\textsuperscript{2} amplifiers (Compumedics, Charlotte, NC), digitized at 500 Hz and filtered online using a 0.05 – 40 Hz bandpass. Off-line, blinks were removed from the EEG using a regression-based procedure (Semlitsch, Anderer, Schuster, & Presslich, 1986), after which stimulus-locked epochs of 1100 ms (including 100ms pre-stimulus baseline) were created. Epochs were baseline corrected and then visually inspected for remaining artifacts; epochs containing significant drift or artefactual voltage deflections at all electrodes of interest for current analyses were discarded.

Averages were created for each participant at each electrode according to stimulus conditions of interest and then lowpass filtered at 12 Hz. Conditions containing fewer than 20 artifact-free trials for a given participant were discarded for that individual ($M = 29.9$ valid trials per condition). As in prior research using a similar paradigm (e.g., Bartholow et al., 2007) the P3 was most pronounced 400-600 ms post-stimulus, primarily at parietal and occipital scalp locations. Thus, P3 amplitude was quantified as the average voltage occurring during this epoch at 13 electrodes from this region (P3, P1, Pz, P2, P4, PO5, PO3, POz, PO4, PO6, O1, Oz, and O2).

**Questionnaire Measures Administered in the Lab**

**University Identification Questionnaire (UIQ).** Individual differences in the strength of identification with the university were assessed using the 9-item UIQ (Loersch & Arbuckle, 2013). Modeled after other ingroup identification measures (e.g., Tropp & Wright, 2001), the UIQ provides an index of the degree to which their university affiliation is a salient and meaningful part of respondents’ identity. Sample items include, “Knowing that I am a student at my university tells others a lot about me,” and “How important is being a student at your university to you?” Responses were made on 7-point Likert-type scales ranging from 0 (Strongly
Disagree/Not at All) to 6 (Strongly Agree/Very Much). UIQ scores were calculated as the mean response averaged over all nine items (α = .81). The full UIQ is available in the supplementary materials (Table S1).

**Alcohol-related measures.** Past-year quantity and frequency of alcohol consumption were assessed using items recommended by the NIAAA (2003). An alcohol quantity-frequency score (AlcQF), representing typical alcohol use per week over the past year, was calculated for each participant as the product of two items: (1) “During the last 12 months, how often did you usually have any kind of drink containing alcohol?”; and (2) “During the last 12 months, how many alcoholic drinks did you usually have on a typical day when you drank alcohol?”

Alcohol-related expectancies were measured using the brief form of the Comprehensive Effects of Alcohol scale (CEOA; Fromme, Stroot, & Kaplan, 1993). The brief CEOA is comprised of 15 items describing commonly experienced effects of alcohol, rated in two ways. First, respondents indicate the extent to which they expect each effect to happen to them (“If I were under the influence of alcohol . . .”) using the response options disagree, slightly disagree, slightly agree, and agree (scored -2, -1, 1, and 2, respectively). Sample items include, “I would feel calm,” “I would enjoy sex more,” and “I would feel courageous.” Second, respondents evaluate the extent to which each of these effects is bad or good, using response options bad, slightly bad, neutral, slightly good, and good (scored -2, -1, 0, 1, and 2, respectively). The expectancy scale (i.e., CEOA-exp) and evaluation scale (CEOA-eval) both showed acceptable internal consistency in this sample (αs = .67 and .73, respectively).

Adverse consequences from drinking were assessed using the 23-item Rutgers Alcohol Problems Index (RAPI; White & Labouvie, 1989). Participants were asked to indicate the number of times during the past year they have experienced a number of negative outcomes
while drinking or as a result of drinking. Sample items include, “Got into fights with people;” and “Caused shame or embarrassment to someone.” Responses are made using a 4-point scale with response options including 0 (None), 1 (1-2 times), 2 (3-5 times), and 3 (More than 5 times). For each participant, a total RAPI score was calculated as the sum of their responses to all 23 items ($\alpha = .84$). The RAPI has good test-retest reliability (Miller et al., 2002).

**Follow-up Assessment**

Approximately one month following the lab session ($M = 32$ [$SD = 5$] days later), participants were asked to provide data on their alcohol use and related experiences since the laboratory session. A version of the same alcohol use items given at baseline was administered, modified to refer to the past month (e.g., “Since you participated in the laboratory session about a month ago, how often did you usually have any kind of drink containing alcohol?”). A follow-up AlcQF variable was calculated from these responses.

**Procedure**

Participants provided informed consent, were fitted with the electrode cap, and then completed the self-report measures. Next, participants completed the visual oddball task while EEG was recorded. The electrode cap was then removed and an additional set of tasks and questionnaire measures not of central interest to the hypotheses investigated here were administered (see online supplementary material for details). Participants were then debriefed about this portion of the study, thanked and dismissed. One month later participants were sent a link to the online survey querying their drinking behavior since the laboratory session. Participants who did not complete the follow-up survey within three days of receiving this initial email were sent a reminder. Subsequently, all participants were sent a final email containing a full debriefing and information concerning their compensation.
Analytic Approach

Five participants were eliminated from the MU sample because of problems with EEG recording (falling asleep; data recording errors). Two additional MU participants were eliminated because they reported no alcohol use during the past year, and one withdrew from the study, leaving a final MU sample of 64 students (19 males; $M_{age} = 19.05$ years). Six participants were eliminated from the CU sample due to problems with their EEG data, leaving a final CU sample of 50 students (29 males; $M_{age} = 19.08$ years). Four additional CU and two additional MU participants failed to complete the follow-up survey. These individuals did not differ significantly from those who completed the study on any of the other dependent measures or demographic variables (all $t$s and $\chi^2$s < 1).

To account for the multilevel nature of the ERP data, quantified P3 amplitudes were analyzed using multilevel models (MLMs) with restricted maximum likelihood estimation (see Kristjannson et al., 2007). Electrode locations were nested within subjects. Following recent recommendations (see Selya, Rose, Dierker, Hedeker, & Mermelstein, 2012) estimates of local effect size were computed as $f^2$ (Cohen, 1988). Additional details concerning the MLM approach are given in the supplementary materials. Histogram distributions of alcohol use (i.e., AlcQF) measured at both baseline and follow-up indicated that these variables were positively skewed. Thus, both variables were log-transformed for analyses. UIQ and logged AlcQF scores were mean-centered to zero prior to creation of cross-product terms.

Results

Sample Characteristics

We took two steps to determining whether relevant measures were similar across the two research sites. First, mean levels of the measured variables of interest were compared across sites
(see Table 1); no significant differences were found. Next, to determine whether effects of ingroup context on motivated attention responses to beverage cues represent general phenomena that are not specific to a given set of stimuli or group of participants, a set of ancillary MLMs including data collection site as a categorical predictor of primary outcomes were tested. As described in the supplementary materials (and see Figure S1), responses to the manipulations and their interactions with measured variables of interest were similar across the two sites. Thus, data were collapsed across site in our primary analyses.

Table 1.

Means (and SDs) of Primary Study Variables as a Function of Data Collection Site

<table>
<thead>
<tr>
<th>Variables</th>
<th>Research site</th>
<th>MU</th>
<th>CU</th>
<th>Mean comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlcQF: baseline</td>
<td></td>
<td>9.37 (8.45)</td>
<td>9.46 (9.64)</td>
<td>(t(112) = 0.05)</td>
</tr>
<tr>
<td>AlcQF: follow-up</td>
<td></td>
<td>9.28 (9.22)</td>
<td>9.91 (11.54)</td>
<td>(t(109) = 0.64)</td>
</tr>
<tr>
<td>RAPI scores</td>
<td></td>
<td>9.30 (6.62)</td>
<td>7.96 (6.52)</td>
<td>(t(112) = 1.08)</td>
</tr>
<tr>
<td>UIQ scores</td>
<td></td>
<td>4.31 (0.96)</td>
<td>3.98 (0.92)</td>
<td>(t(112) = 1.83^)</td>
</tr>
<tr>
<td>P3 amplitude</td>
<td></td>
<td>9.36 (6.13)</td>
<td>9.51 (5.10)</td>
<td>(t(4289) = 0.07)</td>
</tr>
</tbody>
</table>

*Note. MU = University of Missouri; CU = University of Colorado. AlcQF = number of drinks per week in the past 12 months (baseline) or past month (follow-up); RAPI = Rutgers Alcohol Problems Index (alcohol-related negative consequences); UIQ = University Identification Questionnaire.

\(^p < .10\)

**P3 Amplitude**

**Base model.** The hypothesis that an ingroup context would enhance the motivational significance of beer cues was tested using a 2 (Beverage type: water = 0, beer = 1) x 2 (Beverage context: outgroup = 0, ingroup = 1) factorial MLM with random intercepts specified for
participants and electrodes within participants. ERP waveforms elicited in these four conditions are given in Fig. 2. This model showed a significant main effect of beverage context, $F(1, 4286) = 254.4$, $b = 1.35 (SE = 0.10)$, $p < .001$, $f^2 = .06$, indicating that beverage cues elicited larger P3 amplitude with an ingroup context ($M = 9.92 \mu V, SD = 5.05$) than with an outgroup context ($M = 8.83 \mu V, SD = 4.84$). This effect was qualified by a significant Beverage x Background interaction, $F(1, 4286) = 15.2$, $b = -0.53 (SE = 0.14), p < .001$, $R^2 = .003$.

Although there were significantly larger P3s in ingroup than outgroup contexts for both beer ($\Delta = 0.82 \mu V$) and water stimuli ($\Delta = 1.35 \mu V$) ($t$s[4286] = 8.5 and 14.1, $ps < .001$, respectively), this beverage context effect was stronger for water stimuli, $t(4286) = -3.81, p < .001$ (95% CI: -.55 to .35). The beverage main effect was not significant $F(1, 4286) = 2.24$, $p = .134$,

$\text{Fig. 2}$ Stimulus-locked ERP waveform measured at electrode Pz (midline parietal location) as a function of beverage type and beverage context. The shaded area indicates the measurement window used for P3 amplitude quantification (400 – 600 ms).

**Moderation by UIQ.** To test the prediction that the strength of participants’ identification with their universities moderates the extent to which the ingroup context enhances the incentive salience of beer cues, UIQ scores (mean-centered) were added as a predictor to the Beverage x Context MLM described previously, including all interactions involving UIQ, Beverage, and Context. This model showed a number of significant interactions involving UIQ, all of which were qualified by the predicted Beverage type x Beverage context x UIQ interaction,
$F(1, 4283) = 18.74, b = 0.61 \ (SE = 0.14), p < .001, f^2 = .0055$. We probed this interaction by examining the simple slopes of the association between UIQ scores and P3 amplitude in each of the four stimulus conditions. As depicted in Fig. 3, and as predicted, P3 responses to ingroup beer were strongly related to UIQ scores ($b = 1.69 \ [SE = 0.47], t[4287] = 3.60, p < .001$), with P3 responses to beer shown with an ingroup background increasing as a function of ingroup identity. By contrast, P3 responses to the other stimulus types were only marginally associated with this variable (outgroup beer: $b = 0.81 \ [SE = 0.47], t[4287] = 1.74, p = .082$; ingroup water: $b = 0.86 \ [SE = 0.47], t[4287] = 1.84, p = .067$; outgroup water $b = 0.58 \ [SE = 0.47], t[4287] = 1.24; p = .214$).

**Drinking Behavior during the Follow-up Interval**

As with most behaviors (see Aarts, Verplanken, & van Knippenberg, 1998), past drinking is often the best predictor of future drinking. Of greater interest theoretically is whether other variables account for unique variance in drinking behavior when variance associated with past drinking behavior is accounted for, providing some indication of processes that might
determine changes over time. Here, we were interested in whether P3 amplitude elicited by ingroup beer stimuli might represent such a process, potentially reflecting susceptibility to university-themed marketing approaches.

To address this question, AlcQF at Time 2 (log-transformed, zero-centered) was submitted to a stepwise regression procedure using forward selection and alpha-to-enter set to .15. Predictor variables included sex, baseline AlcQF (zero-centered), CEOA-exp and CEOA-eval scores, RAPI scores, and P3 amplitudes elicited by ingroup beer, ingroup water, outgroup beer and outgroup water. Tolerances for retained predictors were > .88 and variance inflation factors were < 1.14, indicating limited collinearity. Three predictors were retained above the threshold of $p = .15$ (see Table 2). Step 1 established, unsurprisingly, that baseline AlcQF was the strongest predictor of AlcQF at Time 2. Step 2 retained the RAPI scores, suggesting that while controlling for prior alcohol use the number of past-year alcohol-related negative consequences also positively predicted Time 2 alcohol use. Finally, Step 3 retained P3 elicited by ingroup beer cues, which predicted additional variance in follow-up drinking beyond that accounted for in the first two steps. No other predictors accounted for significant additional variance (all $ps > .15$). To determine the specificity of the prediction by ingroup beer P3, a number of additional models were tested in which all possible combinations of the P3 variables were included. In each model where ingroup beer P3 was included it emerged as a significant predictor; in every model that did not include ingroup beer P3, no P3 variables emerged as significant predictors.

Discussion

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$N=100$ participants (38 from CU, 62 from MU) were included in this analysis. Six participants failed to complete the follow-up assessment; 8 others had missing values on one or more predictor variables. Rationale for the stepwise modeling approach is provided in the supplementary materials.
These findings suggest that pairing beverages with their university’s logos enhances their incentive salience for underage students. As predicted, the P3 response to beer was larger when paired with symbols of students’ (ingroup) universities than when paired with other (outgroup) universities. Although the ingroup context also increased the P3 to water, that pairing has fewer implications for encouraging harmful behavior. Here, for example, variability in the magnitude of the ingroup-beer P3 effect—but not the ingroup-water P3 effect—predicted changes in alcohol use, over and above previous drinking. Considered in the context of previous studies showing that alcohol cue-elicited P3 predicts alcohol involvement (Littel et al., 2012), these results suggest that marketing beer by paring it with universities increases students’ risk for heavy drinking.

Table 2

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>Model $R^2$</th>
<th>$R_p^2$</th>
<th>$b$ (SE)</th>
<th>95% CI</th>
<th>t(96)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baseline AlcQF</td>
<td>.333</td>
<td>.333</td>
<td>0.539 (0.091)</td>
<td>.721-.357</td>
<td>5.95***</td>
</tr>
<tr>
<td>2</td>
<td>Baseline RAPI</td>
<td>.363</td>
<td>.029</td>
<td>0.031 (0.014)</td>
<td>.059-.003</td>
<td>2.24**</td>
</tr>
<tr>
<td>3</td>
<td>Ingroup beer P3</td>
<td>.388</td>
<td>.025</td>
<td>0.031 (0.015)</td>
<td>.061-.001</td>
<td>1.99*</td>
</tr>
</tbody>
</table>

*Note.* Baseline AlcQF = average number of drinks per week in the 12 months prior to the lab session; RAPI (Rutgers Alcohol Problems Index) = number of alcohol-related negative consequences experienced during the 12 months prior to the lab session.

***p < .001; **p = .027; *p = .049.

Further, the salience of ingroup beer cues varied as according to participants’ identification with their university. This effect was specific to ingroup beer: UIQ scores correlated with ingroup-beer P3 amplitude but not that elicited by other targets. This finding suggests that underage students with the strongest psychological attachment to their universities
might be the most susceptible to marketing approaches aimed at associating alcohol brands with universities.

**STUDY 2**

**Overview**

Study 1 was limited by its correlational nature; we cannot assume that exposure to ingroup-university-embedded alcohol cues causes increased P3 responses to those cues. Study 2 addressed this limitation by experimentally manipulating the context in which beer advertisements were presented, and used a more naturalistic means of placing beer ads in a university context. Participants were randomly assigned to watch basketball game footage featuring either their university’s team or another university’s team, during which ads for either beer or water were shown. They then completed a picture-viewing oddball task in which brand logos for beer and water were infrequent targets. We predicted that P3 responses to beer logos would be largest for participants who had seen beer ads (vs. water ads) in the context of their own university team’s game (vs. an outgroup team’s game).

**Method**

**Participants**

One hundred four CU undergraduates (ages 18-20; 46% female) participated in exchange for partial credit in an Introductory Psychology course (if enrolled) or for payment of $15/hr. The eligibility criteria and methods used to recruit and screen participants were similar to those used for Study 1, with one exception. Given that effects of our manipulations in Study 1 were most evident among students who more strongly identified with their university, for Study 2 we administered the UIQ as part of a pre-testing battery early in the semester and recruited only individuals who responded with a “2” or higher on the 0-6 response scale for each of the UIQ’s
items (indicating moderate to high university identification). Individuals not enrolled in Intro Psychology completed the UIQ as part of their eligibility screening protocol. Approximately 82% self-identified as White (including 12% as Hispanic or Latino); 9.4% indicated more than one race; 2% were Asian; 1% were Black; and 5.6% did not indicate a racial or ethnic category.

**Materials and Procedure**

Electrophysiological recording parameters were identical to Study 1. The primary tasks were different, as explained next.

**Manipulating the incentive salience of beer cues.** Following electrode placement, participants were told that the first part of the experiment involved watching television footage from a basketball game. They were told to simply watch the game, and that they would be asked to respond to some questions about the video content at the conclusion of the experiment. Participants were randomly assigned to one of four between-subjects conditions, which determined the specific combination of game footage and television ads they viewed. During the 2009-10 NCAA men’s basketball season, both MU and CU played games against the University of California (Cal). Both games were telecast by ESPN. We obtained both telecasts and edited them to show 4 min of first-half game action during which the home team (MU or CU) was leading. These video segments included three transitions to commercial breaks, the first occurring after approximately 2 min of game action and the others after approximately 1 min each, after which we inserted three 30-sec video advertisements as they typically appear during sports telecasts. In all four experimental conditions and in each set of commercials, one ad varied according to condition—either one of three ads for Dasani® water (water condition) or one of three ads for Pabst Blue Ribbon® beer (beer condition). The other two ads featured products not relevant to the manipulation (e.g., pizza; luxury car; tablet). The manipulated ad was presented
immediately after the first basketball segment, last after the second basketball segment, and immediately after the final basketball segment. The combination of game (CU [ingroup] or MU [outgroup]) and ad content (beer or water) constituted our primary experimental manipulations, resulting in a 2 (Game; ingroup, outgroup) x 2 (Beverage; beer, water) between-subjects design (ns ranged from 25 to 27 per condition).

**P3 responses to beverage cues.** Following the third video ad, participants were informed that the second part of the study would involve a picture-rating task in which pictures would be shown roughly once per second, and that they should attend to and categorize each image as pleasant or neutral using one of two response buttons. The task used to elicit P3 responses to beer and water cues was structured exactly like the one used in Experiment 1, except that the oddballs (Pabst Blue Ribbon and Dasani logos) were shown without any background imagery (i.e., not super-imposed over ingroup and outgroup logos).

As in Experiment 1, averages were created for each participant and electrode according to stimulus conditions and then lowpass filtered at 12 Hz. Conditions containing fewer than 20 artifact-free trials for a given participant were discarded for that individual (M = 29.9 valid trials per condition). Visual inspection of the grand average waveforms indicated that the P3 was most pronounced 400-700 ms post-stimulus, primarily at parietal and occipital scalp locations. Thus, P3 amplitude was quantified as the average voltage occurring during this epoch at the same set of 13 electrodes used in Experiment 1.

**Results**

Data from three participants were unusable due to a high proportion of EEG artifacts, leaving a final sample of 101 participants. The primary prediction advanced for this study was for a 3-way interaction, such that P3 amplitude elicited by beer logos (vs. water logos) would be
largest among participants who had seen video ads for beer (vs. water) viewed in the context of their own university team’s game (vs. an outgroup team’s game). This prediction was tested with a 2 (Game; ingroup, outgroup) x 2 (Ad type; beer, water) x 2 (Target; beer logo, water logo) MLM with restricted maximum likelihood estimation. Electrode locations were nested within subjects. The predicted Game x Ad type x Target interaction was significant, $F(1, 1310) = 40.58, p < .0001, f^2 = .033$ (see Fig. 4).

To unpack this complex interaction, we computed separate Ad type x Target interactions for each game condition. Among participants who watched an outgroup team game, the Ad x Target type interaction was not significant, $F(1, 622) = 0.50, p = .480, f^2 = .001$. For participants who watched an ingroup team game the Ad x Target type interaction was significant, $F(1, 688) = 73.20, p < .0001, f^2 = .104$. Follow-up contrasts showed that the P3 elicited by the beer logo was larger among participants who had seen the beer ad ($M = 12.05 \mu V$) compared to the water ad ($M = 8.98 \mu V$), $t(134.8) = 2.78, p = .006$. In contrast, the P3s elicited by water logos were unaffected by which ad was seen during the game ($Ms = 9.05$ and $8.43 \mu V$ for beer and water ads, respectively), $t(134.8) = 0.57, p = .573$. 

Fig 4 Mean P3 amplitude as a function of game viewed (ingroup [IG] or outgroup [OG]), ad viewed (beer or water), and oddball target type (beer logo vs. water logo) in Experiment 2. Capped vertical bars represent standard error of the mean.
An additional contrast compared the P3 elicited by beer logos among participants who had viewed a beer ad during an ingroup team game ($M = 12.05 \mu V$) versus and outgroup team game ($M = 10.51 \mu V$); this contrast was significant, $t(134.8) = 2.08, p = .046$.

**Discussion**

Through its experimental design, Study 2 showed that exposure to beer ads in an ingroup context causes increases in the incentive salience of alcohol cues, providing the first evidence that neural reactivity to alcohol cues can be manipulated via implied associations with a valued ingroup. These results provide compelling evidence for the effects of realistic advertising exposure on the incentive salience of a beer brand. To the extent that college students are routinely exposed to ads for particular brands on campus or during university-related telecasts, these findings suggest those brands will be imbued with incentive value, potentially increasing alcohol seeking and consumption.

**General Discussion**

Universities work hard to reduce alcohol involvement and its related harms among students (see Wolfson et al., 2012); they also strive to increase students’ identification with their schools. The current findings suggest that, when university units (e.g., athletics departments) license the use of university-related images to market beer, these efforts might be at cross-purposes. Here, presenting beer in an ingroup context—in either an abstract, laboratory-derived way or in a realistic television advertising setting—enhanced its motivational significance for underage drinkers, and this effect had implications for their alcohol involvement. Moreover, these effects appear largest among the very students universities hope to cultivate—those most strongly identified with their schools—suggesting these individuals might be more susceptible than their less strongly identified peers to the appeal of university-themed alcohol marketing.
Beyond their implications for understanding this marketing approach, the current findings make a number of other contributions. First, the research deepens understanding of cue-reactivity as a marker for addiction risk by highlighting the importance of contextual factors and individual differences. Most cue-reactivity paradigms present cues in isolation from any meaningful context, which fails to represent the ways in which drinking and alcohol marketing actually occur. Using both simple background images implying an association and actual television ads as they typically appear, the current work demonstrates the importance of context for shaping incentive salience. This context-dependent neural response afforded unique prediction of alcohol involvement prospectively. Future research could investigate the extent to which context-dependent P3 reactivity predicts alcohol use in situations specifically related to that context, such as football tailgating.

Previous attempts to identify moderators of alcohol cue-elicited P3 response have focused on characteristics of the sample, such abstinence duration among recovering addicts (Littel et al., 2012). The current research identified characteristics of both the cues (their context) and the participants (ingroup identification) that are not directly tied to alcohol use but nonetheless were important moderators, suggesting that broadening the scope of cue-reactivity paradigms can greatly enhance their utility for understanding the neurobiology of risk.

Finally, the present work represents a response to recent calls for understanding problematic drinking by investigating domains of functioning that can be tied to endophenotypes with identifiable neurobiological circuits (see Sher, 2015). A recent review (Litten et al., 2015) listed incentive salience and social processes as two promising candidate domains that should be investigated. The current work addresses this call by testing the importance of social processes on a neurophysiological response linked to incentive salience.
This work also was limited in several respects. Two of the primary hypotheses were correlational in nature, leaving uncertainty as to the existence of causal relationships between ingroup identification, cue salience and changes in drinking. Also, although generally consistent with previous reports (e.g., Bartholow et al., 2007) the prediction of drinking behavior by ingroup-beer P3 amplitude was modest; confidence should be tempered until this effect is replicated. We are encouraged by ongoing work in our laboratories (Loersch, Ito, Volpert, & Bartholow, 2016) showing a highly similar result using a different cue-exposure paradigm.

In conclusion, this research contributes to understanding of the neurobiological mechanisms underlying both susceptibility to alcohol marketing and risk for underage alcohol use, and underscores the importance of social context and social motives in determining the incentive salience of alcohol-related cues. Research of this kind holds promise to translate neurobiologically based theories of motivated behavior to a human laboratory model, ultimately promoting efforts to specify the biological bases of behavior.
Author Contributions

B.D. Bartholow, C. Loersch, P. Bolls and T.A. Ito developed the study concept and study design. Data were collected by H.I. Volpert, M.P. Johnson, K.A. Fleming and B. Carter. Data analyses were performed by C. Loersch, M.P. Johnson and K.A. Fleming, and findings were interpreted by B.D. Bartholow, T.A. Ito, M.P. Johnson, and C. Loersch. B.D. Bartholow and C. Loersch drafted the manuscript, and T.A. Ito provided critical revisions. All authors approved the final version of the manuscript for submission.

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