The mood-induced activation of implicit alcohol cognition in enhancement and coping motivated drinkers

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Abstract

In two experiments, we investigated whether different mood states activate specific types of implicit alcohol cognition among undergraduates classified as enhancement (EM) or coping (CM) motivated drinkers. Participants completed a Stroop task in Experiment 1 (n=81), and an Extrinsic Affective Simon Task (EAST; [De Houwer, J. (2003). The Extrinsic Affective Simon Task. Experimental Psychology, 50, 77–85.]) in Experiment 2 (n=79) following random assignment to listen to positive or negative musical mood induction procedures (MMIP). Consistent with hypotheses, only EM, and not CM, drinkers displayed an activation of implicit attention to alcohol cues (Experiment 1) and reward-alcohol implicit associations (Experiment 2) following exposure to positive MMIP. Contrary to hypotheses for CM drinkers, none of the groups, in either experiment, showed an activation of implicit alcohol processing following exposure to negative MMIP. Confidence that positive mood activates implicit alcohol cognition among EM drinkers is increased since this result emerged across two studies involving quite different methodologies. This research has implications for experimental cognitive research and it highlights the potential utility of treatment matching according to drinking motives (e.g., EM) to improve clinical outcomes. © 2007 Elsevier Ltd. All rights reserved.

Keywords: Mood; Drinking motives; Alcohol; Implicit cognition

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1. Introduction

Drinking for internal or emotional reasons predicts heavy and problematic alcohol consumption, relative to drinking for external or social reasons. Within Cooper’s (1994) motivational model of alcohol consumption there are two types of internal motives: (1) enhancement motives (EM; drinking to increase positive affect), and (2) coping motives (CM; drinking to decrease negative affect). While these two emotional motives for drinking have been reliably found to be associated with unique drinking consequences, there has been little research on the highly clinically relevant question of whether there are unique antecedents associated with the two “risky” EM vs. CM patterns of alcohol consumption. The purpose of the present research was to contrast the emotional antecedents for EM vs. CM drinking-related responding.

To first specify, we use the term “emotion” interchangeably with “mood” and “affect”. While some have argued that emotional, and affective, states have a shorter duration and stronger intensity than mood states, the intensity of all of these states can presumably be altered in the laboratory (see Martin, 1990), and they are all thought to be shorter in duration (or less stable) than traits or chronic emotional conditions (e.g., depressive disorder) (Kozma et al., 1990).

Given the nature of EM and CM, one would expect that alcohol-related responding (i.e., alcohol-related cognitions as well as actual drinking behaviour) is prompted for EM drinkers in response to positive emotions, and for CM drinkers in response to negative emotions. Previous research can be interpreted to suggest how this may occur. There may, for example, be drinking motive differences in personality (Stewart & Devine, 2000), or in the operation of neural networks/motivational systems (Gray, 1972), or in sensitivity to various effects of alcohol that could account for unique responding to emotional cues among EM and CM drinkers (for a detailed review of such theories see Birch, Stewart, & Zack, 2006). Overall, there has been scant experimental research conducted to investigate how individual differences, like drinking motives moderate relations between emotions and alcohol-related responding. There has been some prior research on whether EM and CM drinkers differ in the emotions that trigger cognitive alcohol-related responding specifically (e.g., explicit and implicit alcohol cognitions).

While there is often a lack of clarity as to the respective definitions for the terms “explicit” and “implicit” cognitions, some authors, like De Houwer (2006) and Wiers et al. (2002), have synthesized disparate conceptualizations of these terms. They suggest that explicit cognitions are often measured with questionnaires and other tasks that involve conscious, intentional selection of responses. In contrast, computerized reaction time (RT) tasks are often administered to measure cognitions with functional features characteristic of implicit or automatic cognitions. Participants are likely unaware or unconscious of the nature of the hypotheses under investigation with many RT tasks, and their responding is likely unintentional. While research on implicit cognition is still in its infancy, and the psychometric merits of measures of implicit cognition are not yet well-established, this research may be less prone to confounds associated with experiments involving explicit self-reports (e.g., demand characteristics, biased self-perception). Overall, it is important to examine how both explicit and implicit alcohol cognitions vary as a result of mood and drinking motives.

There has been some prior research on how explicit alcohol cognitions vary as a function of mood states and drinking motives. In a study by Birch et al. (2004), for example, participants with extreme scores on either the EM or CM subscale of Cooper’s (1994) Drinking Motives Questionnaire (DMQ-R) were randomly assigned to listen to positive or negative musical mood induction procedures (MMIP). The self-reported strength of specific, explicit alcohol expectancy (AE) cognitions was measured with questionnaires before and after MMIP. Birch et al. (2004) found that the strength of reward AE (beliefs
that alcohol will provide emotional rewards) increased following MMIP only for EM drinkers in the positive mood group, and conversely, the strength of relief AE (beliefs that alcohol will provide emotional relief) increased following MMIP only for CM drinkers in the negative mood group.

To our knowledge, only one study conducted to date (i.e., Stewart, Hall, Wilkie, & Birch, 2002) has examined relations between affective cues, EM and CM for drinking, and implicit alcohol cognition. Stewart et al. (2002) administered a RT task, called the primed Stroop, that is intended to measure implicit attentional bias that is automatically drawn to the semantic meaning of targets (e.g., alcohol words) following priming with another class of stimuli (e.g., neutral, positive, and negative mood cues). Stewart et al. (2002) considered implicit alcohol cognition activated in memory when participants showed longer colour-naming latencies (i.e., interference) for alcohol vs. non-alcohol targets. As expected, positive (but not negative) emotional primes activated implicit alcohol cognition for EM drinkers, and negative emotional (but not neutral) primes also activated implicit alcohol cognition for CM drinkers. Unexpectedly, however, neutral primes also activated alcohol cognition for EM drinkers, and positive emotional primes also activated alcohol cognition for CM drinkers. Thus, results only partially supported hypotheses. Further research is needed, as this study did not specifically address whether drinking motives moderate relations between actual mood states and implicit alcohol processing. Indeed, exposure to lexical affective stimuli may not have any substantial influence on state affect (see Stein, Goldman, & Del Boca, 2000).

The purpose of the two experiments described in this paper was to further investigate the impact of emotions and drinking motives on cognitions that could be considered to be implicit in nature. This research also allowed for an integration of findings on implicit cognition with previous research on explicit cognition (e.g., Birch et al., 2004), and had the potential to yield unique information about the cognitive-motivational factors underlying problematic emotionally-motivated drinking. Clinically, findings from this research may highlight the potential utility of treatment matching according to drinking motives. Such treatment matching might improve cognitive-behavioural targeting of emotional cues that commonly trigger alcoholic relapse (Marlatt & Gordon, 1985).

2. Experiment 1

Experiment 1 involved the manipulation and measurement of state positive and negative affect, and the administration of a computerized Stroop RT task to measure implicit alcohol cognition (i.e., attention to alcohol targets). In the 2×2×2 design the between-subjects factors were mood (positive and negative) and drinking motives (EM and CM), and the within-subjects factor was target type (alcohol words vs. clothing control words). As in the Stewart et al. (2002) study, implicit attention to alcohol cues was considered “activated” in memory when there were longer colour-naming latencies for alcohol vs. clothing targets. We anticipated that EM, and not CM, drinkers would take longer to colour-name alcohol vs. clothing targets following the positive mood manipulation, and in contrast, that CM, and not EM, drinkers would take longer to colour-name alcohol vs. clothing targets following the negative mood manipulation.

2.1. Method

2.1.1. Participants

To identify participants, we administered the DMQ-R (Cooper, 1994) during a mass screening of psychology undergraduates (N=809). An individual was eligible if their highest standardized DMQ-R subscale score was either an EM or CM score AND if their high EM or CM z-score was one or more (see...
Of the 160 eligible students we randomly selected 41 EM \((n=28, 68.3\% \text{ females})\), and 40 CM \((n=31, 77.5\% \text{ females})\), drinkers. Participants in each motive group were randomly assigned to either the positive or negative mood group. Participants were largely Caucasian \((93.8\%\)\), from a middle-to-upper class family background, in their first year of university \((81.5\%\)\), and were on average 19.3 \((SD=1.7)\) years old. As anticipated, this sample of EM and CM drinkers reported heavy drinking and high rates of drinking-related problems (see Birch et al., 2004). CM drinkers, relative to EM drinkers, had a higher average score on the Rutgers Alcohol Problem Index (White & Labouvie, 1989) \((M_S (SDs)=21.4 (13.8) \text{ vs. } 13.9 (9.7) \text{ respectively}, F(1,77)=8.1, p<.01)\). Only CM drinkers scored, on average, above the cut-point thought to indicate substantial alcohol problems (see Thombs & Beck, 1994).

A series of chi-square tests and 2 \((\text{motive group})\times2 \text{ (mood condition)}\) Analyses of Variance (ANOVAs) indicated that EM and CM drinkers did not differ on measured demographic variables \((\text{all } p_s>.05)\). As well, no effects involving mood condition emerged.

### 2.1.2. Materials and apparatus

#### 2.1.2.1. Demographics questionnaire

This questionnaire assessed demographic characteristics of participants such as age, year of university, gender, ethnicity, and family-of-origin annual income range. Typical alcohol use was assessed with quantity–frequency methods.

#### 2.1.2.2. Drinking Motives Questionnaire—revised

On the DMQ-R (Cooper, 1994) there are five items that comprise each of the four subscales and represent the four motives for drinking. The average of these items yields the subscale score. Respondents estimate how often they are motivated to drink for the reason specified in each item on a five-point Likert scale. The relevant items in this present research measure the frequency of drinking for EM reasons (e.g., “Because it’s exciting”) and CM reasons (e.g., “To forget about your problems”). The DMQ-R has acceptable psychometric properties (see Cooper, 1994). In the present experiment, the internal consistencies of the EM and CM subscales were .83 and .84, respectively.

#### 2.1.2.3. Rutgers Alcohol Problem Index

The RAPI (White & Labouvie, 1989) is a 23-item, well-validated, self-report measure of drinking problems commonly experienced by both clinical and community samples of adolescents and young adults. Respondents indicate on a five-point scale how many times during the last three years they have experienced specific negative consequences due to their alcohol use. Responses were summed to yield a problem frequency composite score. Cronbach’s alpha for the RAPI in the present experiment was .91.

#### 2.1.2.4. Visual analogue scales (VAS)

VAS were employed to measure fluctuations in mood intensity (Martin, 1990). Participants rated their current mood state on four positive affect (cheerful, happy, glad, and pleased), and three negative affect (sad, depressed, and blue) scales (Mongrain & Trambakoulos, 1997). The scale endpoints “very” and “not at all” were connected by 100 mm horizontal lines. Participants drew a vertical line to intersect each continuum at the position that best reflected their current mood state. A score was obtained from the measurement (in millimeters) of the horizontal distance of each vertical line from the “not at all” endpoint. For each participant, scores on all of the positive affect scales were averaged to give a positive affect score, and scores on the negative affect scales were averaged for the negative affect score.
2.1.2.5. Musical mood induction procedures (MMIP). The musical stimuli used in this experiment were developed by Mongrain and Trambakoulos (1997). These MMIP have been found to reliably induce target positive and negative mood states in university students (see Mongrain & Trambakoulos, 1997). The positive and negative MMIP are both 10-minute compilations of non-lyrical, classical, and popular musical pieces.

2.1.2.6. Stroop task. The Stroop task was presented on an IBM compatible 386 computer. Each trial consisted of the following sequence of stimuli: a .5 s appearance of a white plus sign as a fixation, a .5 s pause with a blanked screen, a 2.0 s presentation of the target word, and a 2.0 s post-trial pause with a blanked screen. Target words appeared in blue, yellow, green, pink, or red, in upper-case block letters, 11 × 14 mm in size (e.g., Stewart et al., 2002). Participants verbalized the colour of the target words into a Realistic Highball-7 microphone connected to a voice onset relay device. This relay device sent the voice signal to the computer. The computer stopped the clock on the computer timer and recorded the colour-naming latency for each word to the nearest millisecond from target onset.

Five building words (e.g., ATTIC) served as targets for the 15 practice trials presented prior to the pre-mood induction Stroop. Each experimental Stroop block was comprised of a total of 80 trials in which 20 alcohol targets (e.g., BEER) and 20 clothing (control) targets (e.g., JEANS) (see Table 1) were each presented twice. All targets appeared in a random order and the same type of target word (alcohol or clothing) never appeared more than twice in a row. Non-alcohol targets were taken from a single semantic category (i.e., clothing words). In addition, alcohol and clothing targets were matched for word length and

<table>
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<th>Table 1</th>
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<tr>
<td>Stroop task targets</td>
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<table>
<thead>
<tr>
<th>Target type</th>
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<td>Alcohol</td>
<td>Clothing</td>
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<td>Cocktails</td>
<td>Sandals</td>
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<td>Gin</td>
<td>Necktie</td>
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<td>Rum</td>
<td>Vest</td>
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<td>Shooters</td>
<td>Shirts</td>
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<td>Keg</td>
<td>Sock</td>
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<td>Beer</td>
<td>Pants</td>
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<td>Beverage</td>
<td>Scarf</td>
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<td>Wine</td>
<td>Boot</td>
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<td>Nylons</td>
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<td>Drafts</td>
<td>Shoe</td>
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<td>Whiskey</td>
<td>Bathrobe</td>
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<td>Alcohol</td>
<td>Overalls</td>
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<td>Scotch</td>
<td>Parka</td>
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<td>Vodka</td>
<td>Jeans</td>
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<td>Rye</td>
<td>Garter</td>
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<tr>
<td>Corkscrew</td>
<td>Overcoat</td>
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<tr>
<td>Cider</td>
<td>Smock</td>
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frequency of usage in the English language (Carroll, Davies, & Richman, 1971). This Stroop task was mixed or unblocked (vs. blocked) as both alcohol and control targets were randomly presented together within each experimental block (see Waters, Sayette, & Wertz, 2003).

2.1.3. Procedure

After providing informed consent, participants were tested individually during a single two-hour session. The data from some of the questionnaires in the present research were used in a separate experiment (Birch et al., 2004). The present experiment involved completing questionnaires and a Stroop task both before and after the mood induction. The pre-mood induction questionnaire included the demographics questionnaire, the RAPI, a test-day DMQ-R, and VAS. The pre-mood induction (practice) Stroop task was administered to ensure there were no baseline effects (e.g., mood × motive interaction) that could prevent us from making a valid interpretation of performance on the post-mood induction (test) Stroop task. Participants were seated 2.1 m away from the computer screen, and were asked to verbalize the colour of the targets as quickly and as accurately as possible while disregarding the word’s meaning. During testing, the experimenter was seated behind the participant to record colour-naming errors. After the first Stroop task, participants were given headphones, and left alone (see Martin, 1990) to listen to a 10-minute arrangement of musical pieces. After 10 min, participants were asked to complete a second set of questionnaires, including VAS. Next, the experimenter returned to the testing room for the post-mood induction Stroop task (same as the first). Participants were then fully debriefed and those who received the negative MMIP were given the positive MMIP.

The data were analyzed using SPSS 13.0. Missing values were very uncommon (e.g., only up to .03% of participants had a missing item on questionnaires). Mean replacement was used to estimate missing values on questionnaires (see Tabachnick & Fidell, 2001).

2.2. Results

2.2.1. Drinking motives

Results of analyses comparing screen, and test, day scores on the DMQ-R for this sample have been reported elsewhere (i.e., Birch et al., 2004). To re-iterate our conclusions, however, drinking motives remained sufficiently stable over time, and it is reasonable to believe that participants who were identified as EM or CM drinkers at our mass screening were still EM or CM drinkers respectively, at the time of their participation in this study. See below, as well, for our report of relevant Experiment 2 findings.

2.2.2. Manipulation check

We found motive group differences in baseline mood state with EM drinkers reporting significantly more positive affect, and less negative affect, than CM drinkers at baseline (both ps < .05) (Birch et al., 2004). We thus computed a 2 (mood condition) × 2 (motive group) Analysis of Covariance (ANCOVA) on mean post-induction positive affect scores on the VAS using mean baseline positive affect scores as the covariate. As expected, the covariate-adjusted mean post-induction positive affect score for participants in the positive mood group was significantly higher than that for participants in the negative mood group, $F(1,78) = 4.3$, $p < .05$ (see Table 2). A parallel $2 \times 2$ ANCOVA on mean post-induction negative affect scores indicated that participants who had been exposed to the negative MMIP had a significantly higher baseline-adjusted mean negative affect score than those exposed to the positive MMIP, $F(1,78) = 14.2$, $p < .0005$ (see Table 2). No effects of motive group were observed in either ANCOVA.
2.2.3. Stroop task performance

The dependent variable of interest was mean RT on trials with correct responses. The proportion of errors (incorrect naming, or response latencies longer than two seconds) was low (1.8%), and did not vary significantly as a function of any of the independent variables (all $p$s $>.05$). A full $2 \times 2 \times 2$ (mood condition $\times$ motive group $\times$ target type) mixed factorial ANOVA was computed to examine if there were mood or motive group differences in colour-naming latency at baseline. There was a significant main effect for motive group, $F(1,77)=4.3$, $p<.05$, such that EM drinkers were faster to colour-name both alcohol and clothing targets at baseline, relative to CM drinkers ($M$s (SDs)=692.3 (82.4) vs. 734.2 (96.4), respectively). The within-subjects target type main effect was also significant in this analysis $F(1,77)=18.5$, $p<.0005$. At baseline, all of the experimental groups tended to have delayed colour-naming of alcohol vs. clothing targets ($M$s (SDs)=721.7 (96.6) vs. 704.3 (89.7), respectively). There were no significant mood group or interaction effects in this analysis (all $p$s $>.05$) (see Fig. 1).

### Table 2

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<tr>
<th>Group</th>
<th>Positive</th>
<th>Negative</th>
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<tr>
<td></td>
<td>Experiment 1</td>
<td>Experiment 2</td>
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<tr>
<td>Positive mood</td>
<td>69.0 (21.4)$^a$</td>
<td>65.9 (15.4)$^a$</td>
</tr>
<tr>
<td>Negative mood</td>
<td>61.1 (18.8)$^b$</td>
<td>55.0 (16.7)$^b$</td>
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*Note.* Post-mood induction means have been covariate-adjusted to account for motive group differences between in baseline mood state. Comparisons are between means in the same column. Different superscripts indicate a significant difference between means ($p<.05$).

![Fig. 1. Latencies to colour-name alcohol vs. clothing targets on the pre- and post-mood induction Stroop task (Stroop tasks 1 and 2 respectively), for each mood and motive group separately.](image-url)
Mood and motive group differences in post-mood induction Stroop RTs were examined with relation to the initial hypotheses by decomposing the full $2 \times 2 \times 2$ table of means into a series of *a priori* planned comparisons (see Birch et al., 2004; Stewart et al., 2002). Planned comparisons were chosen in order to analyze the comparisons of primary interest first, using conventional alpha levels (Tabachnick & Fidell, 2001). We specifically examined latency to colour-name alcohol vs. clothing targets at the post-mood induction time, for each mood and motive group separately, with a series of directional paired-samples $t$-tests.

At the post-mood induction Stroop task, there was group specificity in the maintenance of the bias favoring the processing of alcohol vs. clothing targets, and this specificity partially supported our hypotheses (see Fig. 1). Consistent with our hypothesis, EM drinkers in the positive mood condition maintained a significantly delayed colour-naming of alcohol vs. clothing targets, $t(22) = 1.9, p < .05$. None of the other groups still showed this pattern clearly. Neither CM drinkers in the positive mood group ($t(19) = -0.8, \text{ns}$), nor EM drinkers in the negative mood group, $t(17) = 1.2, \text{ns}$, showed a significantly delayed colour-naming of alcohol vs. clothing targets. The fact that CM drinkers in the negative mood condition also did not maintain a bias favoring the processing of alcohol vs. clothing targets, however, was contrary to what we had hypothesized, $t(19) = -0.3, \text{ns}$, see Fig. 1.

### 2.3. Discussion

In Experiment 1, implicit attention to alcohol concepts was measured with a Stroop task before and after EM and CM drinkers were randomly assigned to listen to positive or negative MMIP. At baseline, EM drinkers were faster to colour-name both types of targets than CM drinkers. This may have occurred because CM drinkers tend to be more anxious than EM drinkers (e.g., Stewart & Devine, 2000), and high levels of anxiety can lead to slowed performance on various cognitive tasks (see Eysenck, 1996). At baseline, all experimental groups, on average, had delayed colour-naming of alcohol (vs. clothing) targets. Given that EM and CM drinkers report heavy, problem drinking it is not surprising that alcohol cues activated more implicit processing among this sample than clothing cues, at the first Stroop presentation.

When we next examined the impact of positive and negative affect on Stroop task performance we found results partially consistent with hypotheses. The EM-positive mood group was the only experimental group to maintain a significantly delayed colour-naming latency for alcohol vs. clothing targets. This was consistent with hypotheses that positive mood would activate implicit attention to alcohol cues (or continue to promote the salience of alcohol concepts in memory) for EM, and not CM, drinkers. Inconsistent with our hypotheses, however, negative mood did not activate (or maintain) implicit alcohol processing for CM drinkers.

There is reliability in findings from Experiment 1 and the Stewart et al. (2002) study in that positive, and not negative, mood cues activated implicit alcohol processing for EM drinkers. Only the Stewart et al. (2002) study, however, yielded evidence that negative mood cues activate alcohol cognition for CM drinkers. The differences in these findings could be due to the differences in mood cues across the two studies. One possibility is that we could have found evidence consistent with our hypotheses for CM drinkers if we had employed a blocked (vs. unblocked) version of the Stroop task. Recent research suggests that stronger Stroop effects result when the different target-types (e.g., alcohol and clothing) are each presented alone, in separate experimental blocks (Waters et al., 2003).

Overall, there was still a need for further research after Experiment 1 was conducted. We wanted to measure how another important type of implicit alcohol cognition, namely implicit AE cognitions, vary as
a function of drinking motives and mood states. This type of research would also enable us to better compare the mood triggers for specific explicit AE cognitions, tested in the Birch et al. (2004) study, with the mood triggers for specific implicit AE cognitions.

3. Experiment 2

An associative categorization task called the Extrinsic Affective Simon Task (EAST; De Houwer, 2003) was employed in Experiment 2. For the EAST, there is a measurement of the associative strength between attribute concepts, categorized according to semantic meaning, and target concepts, categorized according to colour. We can compare the strength with which each target is associated with each attribute within each administration of the EAST by simply varying the colour of the target words (i.e., comparison of trials in which each target is categorized with different keyed-responses that correspond to the different attribute concepts). Thus, the EAST is an efficient measure of implicit cognitions relative to measures like the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). This advantage makes non-associative accounts of EAST effects (e.g., salience asymmetries, task-switching) less likely (De Houwer, 2003).

In this experiment, the attributes were concepts denoting emotional reward or relief expectancies and target were concepts denoting alcohol or non-alcohol beverage concepts. In our 2×2×4 design, the between-subjects factors were again mood (positive and negative) and drinking motives (EM and CM), whereas the within-subjects factor was attribute-target association type (reward-alcohol, relief-alcohol, reward-non-alcohol, and relief-non-alcohol). In measuring the degree to which the expectancy-beverage pairs were associated in memory (dependent variable), stronger associations were indexed by a relatively fast RT to categorize these concepts with the same keyed response. Furthermore, consistent with prior research (see Kramer & Goldman, 2003), the strength of expectancy-alcohol associations specifically, was assumed to indicate the strength or activation of reward and relief AE in implicit memory.

It was anticipated that EM, and not CM, drinkers in the positive mood condition would be faster to associate reward-alcohol, than relief-alcohol, concepts following MMIP. In contrast, it was anticipated that CM, and not EM, drinkers in the negative mood condition would be faster to associate relief-alcohol, than reward-alcohol, concepts following MMIP. Contrary to the predictions about the strength of specific expectancy-alcohol associations, the strength of specific expectancy-non-alcohol associations were not anticipated to vary between groups.

3.1. Method

3.1.1. Participants

The DMQ-R was administered to a new sample during a second mass screening (N=985) to identify EM and CM drinkers. From those eligible, we randomly selected 38 EM (n=25, 65.8% females), and 41 CM (n=29, 70.1% females) drinkers. Participants in each motive group were randomly assigned to either the positive or negative mood condition. Participants were largely Caucasian (79.7%), from a middle-to-upper class family background, in their first year of university (79.7%), and were on average 19.0 (SD=2.6) years old.

Once again, this sample of EM and CM drinkers reported heavy drinking patterns and high rates of drinking-related problems. On the RAPI (White & Labouvie, 1989), the average score for the present sample was 19.0 (SD=11.1), which is above the “cut-off” score of 15, indicating substantial alcohol problems (see
Also consistent with Experiment 1, a 2 (motive group) × 2 (mood group) between-subjects ANOVA indicated that CM drinkers had significantly higher scores on the RAPI (White & Labouvie, 1989) than EM drinkers (Ms (SDs) = 22.1 (12.2) vs. 15.7 (9.0) respectively), \( F(1,75) = 6.8, p < .05 \).

Analyses also confirmed that EM and CM drinkers did not differ on measured demographic variables (all \( ps > .05 \)). No effects involving mood condition emerged.

### 3.1.2. Materials and apparatus

#### 3.1.2.1. Questionnaires

All self-report measures used in Experiment 2 were identical to those used in Experiment 1 (i.e., demographics questionnaire, DMQ-R, RAPI, and VAS).

#### 3.1.2.2. Musical mood induction procedures (MMIP)

The positive and negative MMIP were also the same as those used in Experiment 1.

#### 3.1.2.3. Extrinsic Affective Simon Task (EAST)

In the present EAST, reward (e.g., EXCITED) and relief (e.g., RELIEVED) AE attribute words were matched for word length and frequency of usage in the English language (Carroll et al., 1971). Attributes appeared in white, and participants were asked to classify relief words with one response “P”, and reward words with another response “Q”. For classifying targets, half the participants received one colour-response assignment (press “P” for blue and “Q” for green), and the other half were given the reverse instructions. Targets were five alcohol (i.e., BEER) and five non-alcohol (i.e., SODA) beverage nouns matched for word length and frequency of usage (Carroll et al., 1971).

Stimuli were created in Adobe Photoshop, and the experiment was run on SuperLab Pro software using a Macintosh platform with a 9.0 operating system. The stimuli and trial parameters closely resembled procedures used by De Houwer (2003). Each trial consisted of the following: a white fixation asterisk for 500 ms, the presentation of the stimulus word until a response was given, a red “X” for 400 ms if the response was incorrect, and a 1000 ms post-trial pause with a blanked screen. Stimulus words were seven mm high and 5 mm wide, and appeared in Arial (bold) font. The time between word onset and response was measured using the SuperLab Pro timer and the data was saved to an Excel spreadsheet.

The EAST involved both practice and test blocks. There were three 20-trial practice blocks. During the first practice block, the attributes were each presented twice, and during the second practice block, ten clothing (control) targets were each presented once in blue and once in green. For the final practice block, the ten attributes each appeared once, and five of the clothing targets appeared once in blue and once in green, all in a random order. There were four, 30-trial test blocks. During test blocks, attributes were each presented once; and beverage targets were each presented once in green and once in blue. In randomizing, the same words could not appear on two or more consecutive trials, and the required response could not be the same on four or more consecutive trials. Cronbach’s alpha for the test EAST in this study was acceptable at .69.

### 3.1.3. Procedure

Most procedures were similar to Experiment 1 and are not re-iterated here. Again, undergraduates found eligible and recruited after a mass screening provided informed consent, and were tested individually during a single laboratory session. During the EAST, participants were seated approximately 40 cm from the computer screen and left alone to complete the task. With the computerized relief attribute classification instructions, all relief exemplars were given and participants were told that they should press the “P” or “relief” key for these words that mean “emotionally relieved” or “to provide relief from sad emotions”.

Exemplars were also given with instructions for classifying reward attributes, and participants were told to press the “Q” or “reward” key for all of the words that mean “emotionally rewarded” or “to increase rewarding happy emotions”. With the target word classification instructions, exemplars were not given, and participants were told that only the colour of the words was important (instructions varied according to each participant’s randomly-assigned colour-response assignment).

The EAST took about 15 min to complete, and participants were asked to respond as quickly and accurately as possible. After the first EAST, participants completed questionnaires (i.e., demographics, RAPI, DMQ-R, and VAS), then listened to the MMIP. Last they completed the final EAST (same as baseline EAST), as well as a final mood rating scale prior to debriefing.

3.2. Results

3.2.1. Drinking motives

We computed a $2 \times 2 \times 2 \times 2$ mixed factorial Analysis of Variance (ANOVA) on the standardized average DMQ-R EM and CM scores (see Birch et al., 2004). Between-subjects factors were motive group (EM vs. CM) and mood condition (positive vs. negative). Within-subjects factors were test time (screen day vs. test-day administration of the DMQ-R), and DMQ-R subscale (CM subscale vs. EM subscale). Significant main effects for motive group, $F(1,75)=4.8, p < .05$, were qualified by significant motive group×subscale, $F(1,75)=134.3, p < .0005$, and motive group×subscale×test time, $F(1,75)=11.5, p < .001$ interactions.

There was also a significant mood×motive group effect, $F(1,75)=5.1, p < .05$. Simple effect analyses exploring this interaction indicated that CM drinkers in the negative vs. positive mood group had significantly higher CM scores collapsed across test times (screen day vs. test day). Notably, however, CM scores among the two groups of CM drinkers are not significantly different when these are examined separately at each test time. Thus it is reasonable to conclude that the CM scores among the two groups of CM drinkers are sufficiently homogenous.

We conducted simple effect analyses to further explore the three-way interaction involving test time. Only one significant effect emerged when we examined the effects of test time for each subscale and motive group separately, collapsed across mood condition. Initial standardized EM scores reported by CM drinkers increased significantly from screen day to test day ($M$s (SDs)=$.5 (.6)$ vs. $.9 (.6)$ respectively), $F(1,40)=19.6, p < .0005$, but still remained relatively low at test time as compared to EM subscale norms for EM drinkers. In contrast, standardized CM scores reported by CM drinkers, and the EM and CM scores reported by EM drinkers, remained stable. Overall, individuals identified as EM or CM drinkers at the time of our mass screening were still identifiable as EM or CM drinkers when participating in our experiment (the latter generally occurred weeks to a few months after the mass screening).

To confirm motive group differences in drinking motive scores, we then examined the motive group×subscale interaction. We analyzed the simple effects of motive group for each subscale, and of subscale for each motive group, both collapsed across mood condition and test times. For the motive group effects, EM drinkers scored significantly higher than CM drinkers on the EM subscale, $F(1,77)=39.9, p < .0005$, ($M$s (SDs)=$1.4 (.4)$ vs. $.7 (.6)$ respectively). Conversely, CM drinkers scored significantly higher than EM drinkers on the CM subscale, $F(1,77)=68.6, p < .0005$, ($M$s (SDs)=$1.5 (.5)$ vs. $.5 (.6)$ respectively). For the within-subjects subscale effects collapsed across mood condition and test times, the EM drinkers scored significantly higher on the EM than the CM subscale, $F(1,37)=72.9, p < .0005$. Conversely, CM drinkers scored significantly higher on the CM than the EM subscale, $F(1,40)=62.5, p < .0005$. As in Experiment 1,
these analyses overall, provide evidence for a good separation of the different motive groups and for the validity of our method for selecting EM and CM drinkers.

3.2.2. Manipulation check

As in Experiment 1, we analyzed post-mood induction VAS data with between-subjects ANCOVAs in order to take motive group differences in baseline mood ratings into account. A 2 × 2 (mood × motive) ANCOVA on mean post-induction positive affect VAS scores, using mean baseline positive affect scores as the covariate, indicated, as expected, that the covariate-adjusted mean post-induction positive affect score was significantly higher for participants in the positive vs. negative mood condition, F(1,76) = 15.3, p < .0005 (see Table 2). Similarly, a parallel 2 × 2 ANCOVA on mean post-induction negative affect scores, indicated, as expected, that participants who had been exposed to the negative MMIP had a significantly higher baseline-adjusted mean negative affect score than those exposed to the positive MMIP, F(1,76) = 19.5, p < .0005 (see Table 2). No effects of motive group were observed in either ANCOVA.

Similar to Experiment 1, we also found evidence that the MMIP can significantly change levels of positive and negative affect as expected. Again we computed paired-samples t-tests on baseline and post-mood induction positive and negative affect VAS scores for both mood groups separately. From baseline, participants in the positive mood group had significantly increased levels of positive affect and decreased levels of negative affect. Also consistent with expectations and with findings from Experiment 1, participants in the negative mood group had significantly increased levels of negative affect (all ps < .05).

3.2.3. EAST performance

In line with previous research (see De Houwer, 2003), RTs below 300 ms or above 3000 ms (only .3% of trials in which there was a correct response) were recoded to 300 ms and 3000 ms respectively. Only RTs for correctly categorized responses were analyzed. Overall, errors were quite rare, occurring on 5.1% of trials. A series of repeated measures ANOVAs were computed to compare errors rates for making reward-alcohol vs. relief-alcohol associations for each EAST, and for each mood and motive group separately. These indicate that none of the experimental groups differed in their accuracy of making reward-alcohol, vs. relief-alcohol, associations (i.e., all ps > .05). Of note, it is inconsistent with De Houwer’s (2003) prior research that we did not find results consistent with our hypotheses in the error data.

As in Experiment 1, we first examined if there were mood or motive group differences in baseline performance on the RT task. For Experiment 2, this involved computing two separate 2 × 2 × 2 mixed factorial ANOVAs. In both ANOVAs, the two between-subjects factors were mood group (positive or negative) and drinking motive group (EM or CM). In the first ANOVA the within-subjects factor was attribute-alcohol association type (reward-alcohol vs. relief-alcohol), whereas in the second ANOVA the within-subjects factor was attribute-non-alcohol association type (reward-non-alcohol vs. relief-non-alcohol). While we confirmed there were no significant mood, motive, or interaction effects in either of these analyses (all ps > .05), we did identify that the within-subjects attribute-alcohol association type main effect was significant for the first ANOVA, F(1,75) = 4.4, p < .05. At baseline, all of the experimental groups on average were faster to associate reward-alcohol than relief-alcohol concepts (Ms (SDs) = 755.1 (150.7) vs. 778.6 (159.0), respectively) (see Fig. 2).

We analyzed mood and motive group differences in post-mood induction EAST performance with relation to the initial hypotheses by decomposing the full 2 × 2 × 4 (mood condition × motive group × association type) table of means into a series of a priori planned comparisons. Again, planned comparisons were used in order to analyze the comparisons of primary interest first, using conventional alpha levels (Tabachnick & Fidell,
We specifically used a series of directional paired-samples $t$-tests to compare RTs to press the relief (“P”) vs. reward (“Q”) key to categorize both beverage targets, at the post-mood induction time, for each mood and motive group separately.

At the post-mood induction EAST task, there was clearly a group specificity in the maintenance of the baseline effect for faster reward-alcohol vs. relief-alcohol associations, and this specificity supported our hypotheses (see Fig. 2). Consistent with our hypothesis, EM drinkers in the positive mood condition maintained significantly faster reward-alcohol, than relief-alcohol, associations, $t(18) = -3.4, p < .005$. None of the other groups continued to show this pattern clearly. Both CM drinkers in the positive mood group, $t(20) = -1.6$, ns, and EM drinkers in the negative mood group, $t(18) = .5$, ns, failed to show significantly faster reward-alcohol vs. relief-alcohol associations after the MMIP.

None of the experimental groups had significantly faster relief-alcohol, than reward-alcohol, associations (all $p s > .05$) after the MMIP (see Fig. 2). The fact that CM drinkers in the negative mood condition, specifically, did not show a facilitated RT to associate relief-alcohol vs. reward-alcohol concepts was contrary to what we hypothesized, $t(19) = .0$, ns.

As anticipated, all of the experimental groups were just as fast to make reward-non-alcohol, as relief-non-alcohol, associations following the MMIP (all $p s > .05$). Thus only the strength of specific attribute-alcohol, and not specific attribute-non-alcohol, associations varied between experimental groups following the MMIP.

**3.3. Discussion**

In Experiment 2, the EAST enabled us to compare the strength of the implicit association between specific types of alcohol cognitions (i.e., reward and relief AE), and beverage concepts (i.e., alcohol and non-alcohol). Consistent with hypotheses, there were no mood or motive group differences at baseline. On average, however, all the experimental groups had stronger reward-alcohol than relief-alcohol associations at baseline. This could be because reward AE are more normative than relief AE for young, undergraduate drinkers.
Partially consistent with hypotheses for post-mood induction EAST task performance, the EM-positive mood group was the only experimental group to maintain a significantly stronger reward-alcohol vs. relief-alcohol association. This positive mood activation of a reward-alcohol vs. relief-alcohol association, for EM, and not CM, drinkers was found even when none of the experimental groups showed a greater activation of a reward-non-alcohol vs. relief-non-alcohol association. Thus, positive mood activated (or continued to promote the salience of) reward AE in memory for EM drinkers. In contrast, no evidence was found in support of our hypothesis that negative mood would activate implicit relief AE for CM drinkers. This pattern of findings consistent with hypotheses for EM drinkers in the positive mood group, but not for CM drinkers in the negative mood group, is similar to the pattern of findings in Experiment 1.

There are some methodological concerns associated with Experiment 2. Participants in this experiment may have had an activation of implicit AE only if they actually held idiographic reward or relief AE in memory that were consistent with the AE exemplars that were chosen for this experiment. Contrary to the original design for the EAST (De Houwer, 2003), it may have been best to counterbalance both the attribute and target response assignments. Also of concern, there has been some research, since the present study was conducted, indicating that the IAT may provide a more reliable measurement of various individual differences in attitudes than the EAST (i.e., De Houwer & De Bruycker, 2007; Schmukle & Egloff, 2006; Teige, Schnabel, Banse, & Asendorpf, 2004). Of note, however, Schmukle and Egloff conclude that, even for modified versions of the EAST, the moderate internal consistencies are still higher than those observed for many other indirect measures. Overall, it seems the EAST may still prove to be a good option particularly when (as in the present study) there is a measurement of differences in attitudes between groups of people, at the supra-individual level (De Houwer & De Bruycker, 2007), and when a very efficient measurement of associations between multiple different concepts is needed (e.g., with MMIP). Indeed, results from the present research, and previous similar research (e.g., de Jong, Wiers, van de Braak, & Huijding, 2007), suggest that the EAST, employed in these types of contexts, has acceptable psychometric merits.

4. General discussion

In this present research, two experiments were conducted to determine if specific types of implicit alcohol cognition vary as a function of both drinking motives (EM and CM) and mood state (positive and negative). Consistent with what was hypothesized, there is evidence from the first and second experiment, respectively, that positive mood activates or maintains implicit attention to alcohol (vs. non-alcohol) cues, and implicit associations between reward-alcohol (vs. relief-alcohol) concepts, only for EM (and not CM) drinkers. There was no evidence from Experiment 1 or 2 that negative mood activates or maintains implicit alcohol cognition (i.e., implicit attention to alcohol cues or implicit relief-alcohol associations). This was contrary to what was predicted for the CM drinkers in the negative mood condition. Confidence in these findings is increased as similar results emerged across two studies that measured different types of implicit alcohol cognition with different RT tasks. Even the Stewart et al. (2002) study involved different methods again, and found similar evidence. This converging of evidence attests to the criterion validity of these different methods (i.e., Stroop, EAST), and has implications for experimental cognitive research. As well, this evidence is consistent with the Birch et al. (2004) finding that positive, and not negative, mood increases the strength of explicit reward AE among EM drinkers. This suggests there are similar positive mood triggers for both implicit, and explicit, alcohol cognitions among EM drinkers.
As mentioned earlier, there may be underlying reasons why drinking motives (like EM) influence mood triggers for alcohol cognition or consumption. Briefly, EM drinkers may have sensitivity to euphoric effects of alcohol, or an overactive Behavioural Activation System (Gray, 1972), motivating them to drink in response to rewarding, positive (rather than punishing, negative) affect cues (see Birch et al., 2006). Further research is needed in this area.

It is unclear why, contrary to hypotheses, negative mood cues did not activate implicit alcohol cognition among CM drinkers in the present pair of experiments. This finding seems inconsistent with findings reported by Stewart et al. (2002); although this discrepancy in results may be due to differences in affective cues (i.e., lexical affective cues used by Stewart et al. vs. MMIP herein). Our findings contrary to hypotheses in the present research also seem at odds with the Birch et al. (2004) finding that negative mood increased the strength of explicit relief AE among CM drinkers. While there may be different triggers for implicit, vs. explicit, alcohol processing among CM drinkers, it is unclear why positive affect triggers both explicit and implicit cognitions among EM drinkers, but negative affect only triggers explicit cognition among CM drinkers. It is possible that for undergraduates, relatively early in their drinking careers, there have been fewer exposures to pairing of negative mood with drinking and relief outcomes among CM drinkers, relative to the extent of pairing between positive mood, drinking, and reward outcomes among EM drinkers. Thus, negative mood triggering of alcohol cognitions may not have become fully automatized yet in undergraduate CM drinkers.

Overall, further research is needed to compare mood triggers for explicit vs. implicit alcohol cognitions among CM drinkers, and to see if findings generalize to an older sample of drinkers. As well, future research could examine how drinking motives influence the effects of qualitatively different affective states (sad vs. anxious or happy vs. excited) on alcohol cognition or drinking behaviour. In fact, recent research conducted in our laboratory suggests that MMIP designed to induce anxious rather than depressive states can indeed activate implicit attention to alcohol cues uniquely among a subtype of CM drinkers who self-report drinking to reduce anxious affect (Grant, Stewart, & Birch, 2007).

All of the recent research on implicit cognition in this area highlights the need for additional related research. Research is needed to confirm that the RT tasks administered in this study are indeed measuring cognitions that could be characterized as “implicit”, rather than explicit, in nature (De Houwer, 2006). Similarly, further research is needed to characterize the nature of the relative different types of implicit cognition (e.g., attention vs. associations) measured in these task. Future research is also needed to investigate the relative influence of mood, drinking motives, as well as explicit and implicit alcohol cognitions, in predicting actual drinking behaviour (see Birch, Stewart, Girling, & Berish, 2006, for initial work in this area).

Further limitations are noteworthy. As we did not control for reports of higher alcohol problems among CM (vs. EM) drinkers, results may have been influenced by group differences in problem drinking. However, evidence from our previous relevant studies (e.g., Birch et al., 2004) and other similar research (Cooney, Litt, Morse, Bauer, & Gaupp, 1997), suggests that individual differences, like drinking motives, are more likely to account for mood-induced cognitive reactivity than problem drinking severity per se. Further limitations include a lack of a neutral mood control group, not examining gender differences, and having an imbalanced female to male ratio among participants (due to the imbalanced sex ratio among psychology undergraduates) which may limit generalizability to males. Additionally, exposure to alcohol-related stimuli in questionnaires and in the baseline RT tasks in both experiments may have influenced priming of implicit alcohol cognition during the (test) post-mood induction RT tasks. Further research should minimize participant’s exposure to alcohol cues prior to the test RT task.
There are clinical implications associated with our major finding that positive mood states activate implicit alcohol cognition among EM drinkers. Consistent with a study by Conrod et al. (2000), favorable outcomes in treatments for substance misuse are likely when cognitive-behavioural therapy is tailored to unique client needs and targets maladaptive emotional reasons (e.g., EM) for substance misuse. Thus, clients receiving treatment for alcohol misuse could be identified as EM drinkers and given feedback about their extreme EM for drinking (see Conrod et al., 2000). They could be taught to recognize the positive mood triggers that may increase their likelihood of alcohol misuse, and the cognitive processes through which this might occur. To help target cognition specifically, attentional retraining (AR) and AE challenge procedures could be adapted for EM drinkers specifically. AR can increase awareness of (and coping responses to) automatic, cognitive determinants of drinking (e.g., positive mood) (see Wiers et al., 2006). AE challenge procedures undermine associations between drinking and expected outcomes, and they typically involve psychoeducation about how the effects of alcohol (e.g., euphoria) are strongly influenced by expectations rather than pharmacology. There is preliminary evidence indicating that AE challenge procedures may reduce the strength of implicit AE, although such procedures may be particularly effective in reducing the strength of explicit AE (see Wiers, van de Luitgaarden, van den Wildenberg, & Smulders, 2005). Overall, cognitive-behavioural treatment may reduce the positive mood triggering of implicit (and also explicit) alcohol cognitions among EM drinkers. To the extent that alcohol cognition predicts alcohol consumption, interventions that reduce these cognitions should promote a reciprocal reduction in drinking to modulate positive emotions among “risky” EM drinkers.

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