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Drinking for relief: Negative affect increases automatic alcohol motivation in coping-motivated drinkers

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Abstract Although there is increasing evidence that automatic alcohol motivation plays a role in drinking behavior, little research has examined the contexts that elicit these automatic processes. This study was designed to examine whether negative affect would increase the strength of automatic alcohol-approach associations in individuals who drink to cope with negative emotion. Participants consisted of regular drinkers who were high or low in motivation to consume alcohol to cope with negative emotion. In session 1, participants completed an Implicit Association Test (IAT; Greenwald in, J Pers Soc Psychol 74: 1464–1480, 1998) to assess automatic alcohol-approach associations. In session 2, participants were administered a personalized negative affect imagery task (Sinha in, Imagery script development procedures, version 4.1. Unpublished manuscript, Yale University School of Medicine, 2005) and completed another IAT. The results indicated that the negative affect induction increased the strength of automatic alcohol-approach associations in participants with high coping motivation but not in participants with low coping motivation. These data are the first to document that negative affect can increase the strength of automatic motivational processes related to alcohol.

Keywords Implicit · Explicit · Automatic processes · Alcohol · Motivation

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Introduction

Addiction researchers have noted that substance use behavior is often a function of nonvolitional rather than deliberative mental processes (Oei and Baldwin 1994; Tiffany 1990; Widiger and Smith 1994). The field has consequently adapted implicit measures developed in cognitive science to assess automatic processes involved in substance use (see Wiers and Stacy 2006). Although there is accumulating evidence for a role of automatic motivational processes in substance use, little is known about the contexts in which these processes are likely to be activated. The current research examined whether a negative affect induction would elicit automatic alcohol-approach associations in individuals who drink primarily to cope with negative emotion.

Cognitive-motivational models of alcohol use propose that drinking behavior is influenced by mental representations of learned positive and negative associations to alcohol (Cox and Klinger 1988; Goldman et al. 1999). These alcohol-affect associations were initially measured with self-report questionnaires. A typical approach consisted of asking participants to introspect and report their perceptions of the likelihood of positive and negative outcomes after consuming alcohol (Brown et al. 1987; Leigh and Stacy 1993). Although self-report measures of alcohol-affect associations have yielded important information about alcohol use behavior (Brown et al. 1987; Jones and McMahon 1994; Leigh and Stacy 1993), the capacity for explicit self-report measures to fully assess alcohol motivation has been questioned with the recognition that alcohol use decisions are often made automatically rather than through a deliberative introspection of the pros and cons of consumption (Goldman et al. 1991; Tiffany 1990; Wiers and Stacy 2006).

Addiction researchers have increasingly used the cognitive science constructs of automatic and controlled processes to more fully understand the role of mental representations in substance use behavior. Automatic processes are differentiated from controlled processes in that automatic processes are usually defined as being (a) unintentional, (b) efficient (i.e., effortless), (c) difficult to control, or (d) not involving awareness whereas controlled processes are defined as being (a) intentional, (b) relying upon limited attentional resources, (c) controllable, and (d) occurring within awareness (Bargh 1994). Although initial models viewed most mental processes as being entirely automatic or controlled, this perspective has not been supported. For example, the automatic attentional bias demonstrated in the Stroop task was shown to rely upon focal (controlled process) attention to the target words (Francolini and Egeth 1980). As a consequence, more recent perspectives have discarded the all-or-none assumption and replaced it with models that describe a process as involving one or more of the components of automaticity (Bargh 1994; De Houwer 2006). Although the terms automatic and implicit are often used interchangeably, we will use *automatic* to refer to properties of mental processes and *implicit* to refer to indirect measures used to assess automatic processes (see De Houwer 2006).

Dual process theories of substance use behavior propose that substance use may begin as a function of controlled processes (e.g., consciously thinking about whether one wants to have a couple of drinks) and, with continued use, becomes more a function of automatic processes (e.g., behavioral dispositions to drink are unintentionally elicited by the presence of alcohol) (Oei and Baldwin 1994; Tiffany 1990; Deutsch and Strack 2006). That is, substance use becomes less influenced by a deliberate "mental algebra" (Goldman et al. 1991) and more under the control of spontaneous, nonvolitional responses to substance use cues.

Researchers have begun using implicit cognition measures to assess the role of automatic processes in alcohol use. One approach has been to examine automatic attentional biases toward alcohol cues. This research indicates that alcohol use predicts attentional bias for alcohol-related words in both a modified Stroop task (Johnsen et al. 1994), and a dichotic listening task (Stetter et al. 1994) and also predicts worse task performance in the presence of alcohol cue distracters (Sayette et al. 1994). Recent work suggests that attentional biases toward alcohol cues may predict worse treatment outcomes (Cox et al. 2002).

Implicit measures have also been used to examine automatic alcohol-affect associations. A variety of tasks have been used to assess these association networks. For example, priming tasks have demonstrated that when subjects are presented with verbal cues of desired outcome states (e.g., "feeling relaxed"), heavier drinkers are more likely to generate alcohol-related responses when asked to state the first behavior that comes to mind (Stacy 1997). Additionally, computer-based priming tasks have been used to assess the extent to which alcohol primes automatically elicit affective associations (e.g., expectancy and motivation-related words) as indexed by reaction times. This research has demonstrated that implicit measures of alcohol-affect associations predict self-reported heavy drinking episodes and alcohol-related problems as well as objective measures of alcohol consumption (i.e., drinking in the lab) (Ostafin et al. 2003; Palfai et al. 2000).

Of the variety of measures used to assess automatic stimulus-affect associations (see Fazio and Olson 2003), the one that has become most widely used is the Implicit Association Test (IAT; Greenwald et al. 1998). The IAT is assessed by having participants categorize stimuli from four categories—two target categories (the category of interest such as *alcohol* and a comparison category such as *water*) and two attribute categories (such as *positive* and *negative*)—by pressing one of two response keys. During the combination blocks, each response key is paired with one target and one attribute category. The IAT is based on the idea that stronger stimulus-affect associations will result in faster response times when one key is paired with affectively congruent categories (e.g., for someone who uniformly likes drinking, *alcohol* and *positive*) than when the key is paired with affectively incongruent categories (e.g., *alcohol* and *negative*). The IAT has good psychometric properties (see Greenwald and Nosek 2001) and has been increasingly used in experimental psychopathology research (De Houwer 2002; Teachman et al. 2001). The IAT can be said to assess automatic affective associations to the target categories for the following reasons: (a) the influence of the target's affective association on response speed is *unintentional* (i.e., the instructions are not to evaluate the valence of target stimuli, but to classify them to corresponding categories such as 'alcohol' or 'water' in the above IAT; De Houwer 2003a); (b) the IAT effects are *efficient*, as a cognitive load does not eliminate IAT effects (Cunningham et al. 2001); and (c) the IAT effects are *difficult to control*, as faking instructions have little to moderate success (Kim 2003; Steffens 2004).

Initial research found that both an alcohol-valence (*positive* and *negative* attribute categories) IAT and an alcohol-arousal (*active* and *passive* attribute categories) IAT predicted variance of self-reported alcohol use over and above that accounted for by an explicit measure of alcohol motivation (Wiers et al. 2002). Palfai and Ostafin (2003) modified the attribute categories to examine alcohol-behavior (*approach* and *avoid* attribute categories) associations because behavior dispositions are a fundamental component of affect (Lang 1995) and because approach

behavior is an essential component in a variety of motivational models of addiction (Baker et al. 1987; Robinson and Berridge 1993). The findings of this study indicated that this IAT predicted self-reported drinking behavior, urge responses to alcohol cues, and difficulty in controlling drinking behavior. Importantly, the IAT has been found to predict variance of self-reported drinking behavior over and above that accounted for by explicit measures of alcohol motivation (Wiers et al. 2002; Ostafin and Palfai 2006). Additionally, a recent study demonstrated a relation between automatic alcohol-approach associations and an objective measure of alcohol consumption (i.e., drinking in the laboratory), even when controlling for an explicit measure of alcohol motivation (Ostafin et al. 2008). Further, the findings from Ostafin et al. (2008) indicate that the IAT continued to predict laboratory consumption when controlling for typical amount of alcohol consumed per occasion. This suggests that the IAT is not simply a proxy of typical drinking behavior, but that the strength of automatic alcohol-approach associations contributes to alcohol use behavior.

Given the accumulating evidence that automatic alcohol motivation is involved in alcohol use, it would be beneficial to increase our understanding of the contexts in which automatic motivational processes are likely to be elicited. One potential context is the presence of negative affect. Starting with early models of conditioned withdrawal (Wikler 1948, 1980), alcohol researchers have noted that some individuals drink in order to relieve negative affective states (for more recent perspectives, see Baker et al. 2004; Colder 2001; Sinha 2001). From an information network perspective (Lang 1979), negative affect acts as an input that activates a drug motivation network, including verbal response elements indicating desire to use and the activation of action systems underlying drug-seeking behavior (see Baker et al. 1987). A recent study suggests that negative affect may influence automatic alcohol-approach associations (Lindgren et al. 2009). Lindgren et al. used an alcohol-behavior IAT and found that automatic alcohol-approach associations increased in participants who imagined a dating scenario that was unsuccessful, but not in participants who imagined a dating scenario that was successful. The authors suggested that the negative affect concomitant with dating failure may have increased the strength of automatic alcohol motivation, but they did not assess negative affect and could not directly examine this idea.

To our knowledge, only one study has examined whether a negative affect induction would activate automatic alcohol-affect associations (Birch et al. 2008, study 2). Birch et al. proposed that inducing negative affect should lead to stronger automatic associations between *alcohol* and *relief* (negative reinforcement motivation) than *alcohol* and *reward* (positive reinforcement motivation) in individuals who drink to cope with negative affect but not in those who drink to enhance positive affect. They examined this hypothesis by measuring the effect of a music mood induction on alcohol-relief and alcohol-reward associations assessed by the Extrinsic Affective Simon Task (De Houwer 2003b), a task similar to the IAT. Participants were categorized by their primary motivation for drinking alcohol (using the Drinking Motives Questionnaire-Revised; Cooper 1994): (a) to decrease negative affect (coping motivated; CM), or (b) to increase positive affect (enhance motivated; EM). The results did not confirm the expected effects of a negative mood induction on increasing the strength of automatic alcohol-relief associations in CM drinkers. The authors suggest that the nonfinding may be explained by recent research indicating that compared to the IAT, the Extrinsic Affective Simon Task may not be an adequate implicit measure of stimulus-affect associations (De Houwer and De Bruycker 2007). The affective attribute categories used in the study is another potential reason for the nonfinding. Birch et al. used the difference between alcohol-reward and alcohol-relief associations as their dependent variable. Given that negative affect may activate substance-related appetitive motivation (Baker et al. 2004), CM drinker experiencing negative affect may experience alcohol in the broad categories of *good* and *to be approached* instead of differentiating *good* into the more specific categories of *relief* and *reward*. Research indicating that negative affect increases positive reinforcement alcohol outcome expectancies supports this perspective (Hufford 2001).

Study overview

The current study was designed to examine whether a negative affect induction would strengthen automatic alcohol-approach associations. Participants came to the lab for two sessions. In the first session, participants completed a measure of automatic alcohol motivation (the IAT) and a negative affect imagery script, detailing a recent negative event in their lives. In the second session, participants listened to an audio recording of the negative event and again completed the IAT. We predicted that the negative affect induction would activate automatic alcohol-approach associations in participants who consume alcohol to cope with negative emotional states (high CM drinkers) but not in those who consume alcohol for reasons other than coping with negative emotional states (low CM drinkers).

Method

Participants

Sixty-five undergraduate students participated in the study for course credit. One participant did not attend the second

session, leaving a total of 64 (41 males) participants. The inclusion criteria for the study included the following: at least 18 years old, fluent in English, consumption of alcohol in the past year, and scoring in either the upper third (high CM drinkers) or lower third (low CM drinkers) of the Coping scale of the DMQ-R (Cooper 1994). The Coping scale and alcohol use questions were administered in a mass screening packet given to students in introductory psychology courses. Regular drinkers who were high CM and low CM were recruited by email. The final sample consisted of 36 (22 males) high CM and 28 (19 males) low CM drinkers. Participants were mostly Caucasian (95%) with a mean age of 20.61 years (SD = 4.9).

Measures

Typical alcohol use

Alcohol use was assessed with two items regarding average frequency of use and average amount consumed per occasion over the previous year.

Drinking motivation

Negative and positive reinforcement motivation for alcohol use were measured with the Drinking motives questionnaire-Revised (DMQ-R; Cooper 1994). The DMQ-R consists of 20 items to assess four types of drinking motivation on a Likert scale ranging from 1 (*almost never/never*) to 5 (*almost always/always*). The Coping (e.g., "to forget about your problems") and Enhancement (e.g., "because you like the feeling") scales assess motives for drinking that are related to the direct affective effects of alcohol consumption (i.e., increasing positive affect or reducing negative affect). The Coping and Enhancement scores are calculated as a mean of the five items in each scale. The other two scales assess motives for drinking related to obtaining social approval or avoiding social disapproval. Both the Coping ($\alpha = .82$) and Enhancement ($\alpha = .88$) scales demonstrated good internal consistency in this study.

Hazardous drinking

Hazardous drinking was assessed with the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al. 1993). The AUDIT consists of 10 items (e.g., "How often during the last year have you failed to do what was normally expected from you because of drinking") on Likert scale ranging from 1 (*Never*) to 4 (*Daily or almost daily*) that measure problem drinking. The AUDIT is calculated as the sum of the 10 items with scores of eight or greater indicating hazardous drinking behavior. The measure demonstrated adequate internal consistency ($\alpha = .70$) in this study.

Current affect

The Self Assessment Manikin (SAM; Lang 1980) was used to assess current affect state. This scale is a non-verbal assessment of affect consisting of seven pictures of a block figure whose facial features represents feeling states ranging from *Happy* (=1) to *Unhappy* (=7). Participants were instructed to place a mark on the picture that best represents their feeling at the current time. The SAM has demonstrated good validity with other self-report measures of affect (Bradley and Lang 1994).

Automatic alcohol motivation

Each participant completed an IAT to assess automatic alcohol-action disposition associations both in the baseline session and in the second session after a negative affect induction. The IAT was presented on a personal computer with Inquisit software (Draine 2004). The IAT consisted of having participants categorize stimuli from four categories—two target categories (e.g., pictures of beer and water) and two attribute categories (e.g., approach and avoidance-related words). The IAT stimuli consisted of five pictures of beer in glasses and pitchers, five pictures of water in glasses and pitchers, five approach-related words (advance, approach, closer, forward, toward), and five avoidance-related words (avoid, away, escape, leave, withdraw). The baseline IAT was presented in seven blocks: (a) a 20-trial target discrimination block (e.g., left = *beer* and right = *water*); (b) a 20-trial attribute discrimination block (left = *approach* and right = *avoid*); (c) a 40-trial combination block (left = *beer* + *approach* and right = *water* + *avoid*); (d) another 40-trial combination block of the same combination in (c); (e) a 20-trial target discrimination block in which the target categories were reversed (left = *water* and right = *beer*); (f) a 40-trial reversed combination block (left = *water* + *approach* and right = *beer* + *avoid*); and (g) another 40-trial combination block of the same combination in (f). If participants made an error, they saw an error message and were required to make the correct response before the next trial was presented. Two IAT orders were utilized: one with the *beer* and *approach* combination first and one with the *water* and *approach* combination first. The two IAT orders were counterbalanced across participants. For each participant, the IAT order was the same across both sessions. The IAT in the second session was the same as the baseline IAT except that the number of 40-trial combination blocks was reduced from four to two (i.e., blocks 'd' and 'g' were removed). This change was made to reduce the length of the IAT so that it would be more sensitive to a potential influence from the negative affect induction.

The IAT score was calculated as a difference score between the mean response times of the beer-approach/

water-avoid block and the water-approach/beer-avoid block, with larger scores indicating stronger automatic approach motivation towards alcohol. The IAT score was calculated according to the *D*-measure algorithm (using built-in error penalties) suggested by Greenwald et al. (2003).

Negative affect induction

Negative affect was induced with a personalized guided imagery method based on the work of Lang et al. (1980) and Sinha (2005). This method consisted of two parts. First, following the script development procedure of Sinha (2005), participants were instructed in the baseline session to identify a recent negative event and provide a detailed account of the cognitions, emotions and physiological responses involved in the event. Participants were instructed to not include events in which alcohol was involved. (There was considerable variability regarding the theme of the reported negative event, though many centered around relationship stresses with family, romantic partners and friends). Second, a 5-min script was developed from this information. The editing of the script information followed the procedure outlined by Sinha (2005). This included beginning the script with the situation (time and place) of the negative event, using the present tense, interleaving body sensations with action, thoughts and feelings, and ending the script with distress-related content (thoughts, feelings, or actions). The script was then made into an audio recording that was presented to the participant in the second session. All scripts were developed and recorded by the second author.

Procedure

Participants who met the inclusion criteria and agreed to participate were assessed in private workstations in groups ranging from one to six participants. The baseline session consisted of obtaining informed consent, administering the baseline IAT, completing a series of questionnaires related to alcohol behavior (including typical alcohol use, the AUDIT and the DMQ-R), and completing the negative affect imagery script questions. The second session took place within 2 weeks of the baseline session. Participants completed a measure of their current affect and then listened to the 5-min audio recording of their negative affect script through a set of headphones. Participants were instructed to close their eyes and imagine the scene being described to them as vividly as possible, as if it were happening to them in the present moment. Participants then rated their current affect and completed another IAT, after which they were debriefed and sent home.

Results

Alcohol behavior

Over the previous year, participants reported drinking alcohol an average of 2.0 (SD = 0.87) days per week and 4.98 (SD = 2.64) drinks per occasion. Both alcohol variables demonstrated non-normal distributions and were log-transformed for the analyses. The mean AUDIT score was 8.69 (SD = 4.62), with 61% of the participants reporting hazardous drinking (AUDIT of 8+). The high CM and low CM drinkers did not differ in frequency of use, t (1, 62) = −0.46, $p = .65$, average amount consumed, t (1, 62) = 1.39, $p = .17$, or hazardous drinking, t (1, 62) = 1.14, $p = .26$.

IAT reliability and validity

Both internal and test–retest reliability were assessed. An IAT score from each of the two combination blocks was created to assess internal consistency of the baseline IAT. The correlation between the two partial measures demonstrated an internal consistency (r [64] = .55, $p = 3 \times 10^{-6}$) similar to other IAT research (Nosek et al. 2005). The baseline IAT and second-session IAT demonstrated good test–retest reliability (r [64] = .65, $p = 7 \times 10^{-9}$; see Table 1 for zero-order correlations among the variables).

Partial correlations between the IAT and alcohol use variables, covarying gender and age, were conducted in order to examine the validity of the IAT as a measure of automatic alcohol motivation. Analyses included the baseline IAT, session 2 IAT and an aggregate of the two IATs ($\alpha = .78$). The results indicated a relation between the IAT

Table 1 Zero-order correlations among the motivation and alcohol consumption variables ($N = 64$)

Measure	1	2	3	4	5	6	Mean (SD)
1. IAT session 1	–						−0.13 (.37)
2. IAT session 2	.65**	–					−0.11 (.45)
3. Coping motivation	.01	.02	–				1.73 (.75)
4. Enhance motivation	.05	−.06	.45**	–			2.81 (1.04)
5. Alcohol frequency	.03	.07	.46**	.27*	–		2.0 (.87)
6. Alcohol quantity	.27*	.32*	.16	.43**	.05	–	4.98 (2.64)

IAT larger scores = stronger appetitive motivation; Coping motivation = negative reinforcement drinking from the Drinking Motives Questionnaire-Revised (DMQ-R); Enhance motivation = positive reinforcement drinking from DMQ-R; Alcohol frequency = drinking days per week over past year; Alcohol quantity = drinks per occasion over past year

* $p < .05$

** $p < .001$

and quantity consumed per occasion for the session 2 IAT pr (60) = .26, p = .04 and aggregate IAT pr (60) = .24, p = .06, but not baseline IAT baseline IAT pr (60) = .17, p = .19. The IAT was not related with frequency of consumption per week, $ps > .40$, which is consistent with previous research (Palfai and Ostafin 2003; Ostafin and Palfai 2006). Incremental validity was examined with a hierarchical regression analysis of quantity of alcohol consumed per occasion on gender, age and the DMQ-R coping and enhancement scales entered as Step 1 and the IAT as Step 2. The results indicated that when controlling for explicit measures of alcohol motivation, alcohol consumption was predicted by both the session 2 IAT ($\beta = .31, p = .009$) and aggregate IAT ($\beta = .27, p = .03$).

We examined whether the relation between the IAT and quantity consumed per occasion differed between the high CM and low CM groups with a hierarchical regression analysis of quantity consumed per occasion on gender, age, condition (high versus low CM) and baseline IAT entered as Step 1 and a product of the standardized values of the condition and baseline IAT score as Step 2. The same analysis was conducted with the session 2 IAT and then again with the aggregate IAT. The results of all three analyses indicated a nonsignificant interaction between condition and IAT (all $ps > .83$), demonstrating that the strength of relation between the IAT and quantity consumed per occasion did not differ between the groups.

Manipulation check

A repeated measures analysis was conducted to determine if the negative affect induction was successful in increasing negative affect across groups. Seven low CM and four high CM participants did not complete the post-affect induction SAM. The results indicated a main effect of the induction on negative affect across groups, increasing from baseline ($M = 3.11$; SE = 0.19) to post-negative affect induction ($M = 4.98$; SE = 0.25), F (1, 52) = 44.50, $p = 2 \times 10^{-8}$). This increase in negative affect represents a large effect size (Cohen's $d = 1.17$). The induction influenced the negative affect similarly across both groups, as there was a non-significant group (high CM and low CM) by time (pre- and post- induction negative affect) interaction, F (1, 51) = 0.14, p = .71 (high CM and low CM, respectively: pre-induction $M = 3.25$; SD = 1.39 and $M = 2.90$; SD = 1.41 and post-induction, $M = 5.03$; SD = 1.93 and $M = 4.91$; SD = 1.64).

Influence of negative affect induction on automatic alcohol-approach associations

We hypothesized that a negative affect induction would increase the strength of automatic alcohol-approach associations in high CM drinkers but not low CM drinkers. This hypothesis was examined with a between group (high CM and low CM) by within group (pre- and post-negative affect induction IAT) repeated measures analysis, covarying gender and age. The results indicated a significant interaction, F (1, 60) = 6.89, p = .01, partial η^2 = .10 (see Fig. 1). In order to assist the interpretation of the interaction effect, we conducted repeated measures analyses on the pre- and post-negative affect induction IAT separately for the high CM and low CM groups. The results indicate that the high CM group demonstrated a significant increase of automatic alcohol-approach associations from baseline ($M = -.14$, SE = .07), to post-negative affect induction ($M = -.02$, SE = .08), F (1, 35) = 4.49, p = .04. This increase in automatic alcohol-approach associations represents a small to medium effect size (Cohen's $d = 0.28$). Further, the results indicate that the low CM group did not demonstrate a significant increase of automatic alcohol-approach associations from baseline ($M = -.12$, SE = .06), to post-negative affect induction ($M = -.23$, SE = .08), F (1, 27) = 2.64, p = .12.

These findings support the hypothesis that negative affect influences automatic alcohol motivation differently in these two groups. That is, negative affect appears to strengthen automatic alcohol-approach associations in drinkers whose alcohol consumption is a function of motivation to cope with negative emotion but not in those who are low in coping motivation.

We additionally examined whether an increase in negative affect after the induction was related to an increase in alcohol-approach associations in the high CM group. Difference scores (post-induction minus pre-induction) were calculated for both the negative affect and IAT measures. A correlation analysis indicated that increased negative

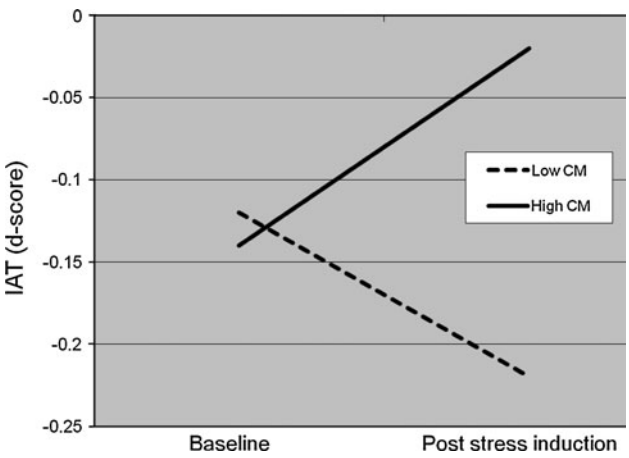

Fig. 1 Influence of negative affect induction on strength of automatic alcohol motivation in drinkers high (high CM) and low (low CM) in motivation to consume alcohol to cope with negative emotion. Larger IAT scores indicate stronger automatic alcohol-approach associations

affect was not related to increased strength of alcohol-approach associations, r (32) = −.10, p = .58.

Discussion

This study examined whether individuals who drink alcohol to regulate their negative emotions would demonstrate strengthened automatic alcohol-approach associations when in a negative affective state. This hypothesis was supported by the findings that a negative affect induction increased the strength of automatic alcohol-approach associations in drinkers who consume alcohol to cope with negative affect but not in those who consume for reasons other than coping with negative affect. A number of potential alternative interpretations of the results were ruled out, as the high CM and low CM groups did not exhibit significant differences in problematic drinking behavior (frequency of use, typical amount of alcohol consumed, or hazardous drinking patterns) or mood change after the negative affect induction.

The current positive findings are discrepant from the negative findings of Birch et al. (2008). The two studies differed on a number of variables that could account for the different results. Whereas the negative affect induction in Birch et al. consisted of listening to dysphoric music, the induction in the current study consisted of participants listening to an audio description of a negative event from their own lives, with instructions to imagine as though the event was occurring in the present. From an information processing perspective, the more an input matches a prototype (i.e., a typical sort of experience), the more likely the motivational network will be activated (Baker et al. 1987; Lang 1979). It seems plausible that the affect script would more closely match the sort of event (and negative affect) that has preceded coping-related drinking than would the music induction. This idea is supported by findings that drug craving is more strongly elicited by personalized negative affect imagery than by a non-personalized negative affect induction (Sinha et al. 1999). It should be noted, however, that past research has found greater automatic responding toward alcohol in CM drinkers compared to drinkers who consume alcohol primarily to enhance positive affect (Grant et al. 2007). In this research, a non-personalized (music) anxiety induction led to greater attentional biases toward alcohol on an alcohol Stroop task. A second difference is that Birch et al. measured automatic alcohol motivation as the strength of alcohol-relief associations relative to alcohol-reward associations whereas the current study measured it as the strength of alcohol-approach relative to alcohol-avoid. It may be that the use of two appetitive attribute categories masked the influence of negative affect induction on automatic alcohol motivation in Birch et al. That is, at an implicit level of measurement, individuals may be unable to discriminate between the positive and negative reinforcing elements of appetitive motivation. In this case, a broader category such as *good* (vs. *bad*) or *approach* (vs. *avoid*) may be more sensitive to changes in automatic alcohol motivation. A third difference between the studies is that Birch et al. used the Extrinsic Affective Simon Task whereas the current study used the IAT. Birch et al. noted that the IAT may be the more preferable implicit measure, as it has stronger construct and predictive validity (De Houwer and De Bruycker 2007). The greater construct validity of the IAT would suggest that it will be more sensitive to variables involved in alcohol motivation.

In addition to the main finding that a negative affect induction elicits increases automatic alcohol motivation only in high CM drinkers, follow-up analyses raise several interesting questions to be examined in future research. First, the result that increases in self-reported negative affect were not related to increases in alcohol-approach associations in the high CM group was somewhat unexpected. This nonfinding may be a result of using a single-item measure to assess affect state. The purpose of using this brief measure was to provide a fast manipulation check of the negative affect induction. However, the use of a single-item may not allow a full assessment of affect state, obscuring a potential relation between negative affect and the IAT. Although single-item measures have been found to be valid measures of affect (Bradley and Lang 1994), including more items (perhaps involving specific emotions rather than simple valence) would increase the reliability and thus sensitivity of the measure. Future research would also benefit from using multiple measures of affect, including biological measures. Second, we were intrigued by the direction of change demonstrated in the low CM drinkers. As can be seen in Fig. 1, the negative affect induction led to a decrease in the strength of automatic alcohol-approach associations in the low CM drinkers. Although this change was statistically nonsignificant, it may be of some theoretical interest. Working from the bioinformational model of affect (Lang 1979), Baker et al. (1987) proposed two substance-seeking motivation networks, one involving negative affect and one involving positive affect. In this model, affective states act as inputs that can trigger the motivation networks—negative affect activates the negative affect network and positive affect activates the positive affect network. This model further proposes an inhibitory effect for the opposite affect states such that positive affect inhibits the negative affect network and negative affect inhibits the positive affect network. Evidence for the inhibiting effects of an affect state on the opposite affect motivation network has been found in smokers (Zinser et al. 1992). Further analyses in the

current study indicated that the low CM group was significantly higher ($p < .001$) than the high CM group in positive reinforcement motivation for consuming alcohol (assessed with the Enhancement scale of the DMQ-R). This suggests that the positive affect motivation network is more closely linked to the drinking behavior in the low CM group. If so, the negative affect induction may have inhibited their motivation to consume.

There are several limitations to the study that bear upon the interpretation of the results. One limitation regards the fact that the IAT score is a summary score that incorporates both approach and avoidance dispositions. A consequence of this is that it may be difficult to determine whether the increase in the IAT score in the high CM drinkers reflects strengthening of approach associations or weakening of avoid associations. Given that the IAT scores were consistently below zero, it is possible that the primary consequence of increased negative affect was to weaken alcohol-avoid associations rather than strengthen alcohol-approach associations (i.e., increase motivational dispositions toward alcohol). Although this possibility cannot be ruled out, we believe that there are several reasons to interpret the results as indicating greater appetitive motivation toward alcohol (rather than decreased aversive motivation). First, the results support previous data and theory that negative affect increases the appetitive motivation toward alcohol for individuals who drink to cope with negative affect (Colder 2001; Wikler 1948). Second, this alcohol-behavior IAT has been found to predict drinking behavior in a number of studies (Ostafin et al. 2008; Ostafin and Palfai 2006; Palfai and Ostafin 2003), suggesting that it reflects appetitive motivation toward alcohol. That this IAT involves appetitive motivation is additionally supported by evidence that it is related to individual differences in appetitive responses to cues of reward but not aversive responses to cues of punishment (Palfai and Ostafin 2003). Last, an IAT score below zero does not necessarily reflect stronger alcohol-avoid associations relative to alcohol-approach associations because of the fact that the IAT score also incorporates associations to the contrast category of water. A number of researchers (Fazio et al. 1986; Jonides and Mack 1984) have noted that unless a neutral category (in this case, the contrast target category of water) is completely neutral, a facilitation of reaction time can only be interpreted as being relative (i.e., not as absolute). That is, although the IAT may be reliable and valid, its metric is arbitrary (Blanton and Jaccard 2006). That the value of the IAT score is arbitrary can be seen by the effects of changing contrast categories. For example, one can show that a smoking-valence IAT score of nonsmokers is "negative" when using a contrast category of 'nonsmoking', but "positive" when changing that category to 'stealing' (Robinson et al. 2005). Thus, in the absence of a truly neutral contrast category, it is difficult to ascribe meaning to the IAT score in relation to a zero point. In sum, we believe that the results indicate that negative affect increases the strength of appetitive motivation toward alcohol for the high CM drinkers, but the relative nature of the IAT score makes it difficult to infer this with certainty. Future research may benefit from the use of single category IATs (Karpinski and Steinman 2006) to parse out the individual contribution of approach and avoid associations.

The nature of the sample comprises a second limitation of the study. The participants were young and demonstrated relatively moderate levels of drinking behavior. As a consequence, the results cannot be generalized to older drinkers who drink more heavily. Given that this latter group may be more likely to consume alcohol to cope with negative affect (Baker et al. 2004), future research would benefit from examining whether similar results occur in more experienced drinkers.

As evidence for a role of automatic alcohol-affect associations in drinking behavior accumulates, determining the contexts that activate these automatic processes will help researchers and clinicians to understand and treat problematic alcohol use. A number of studies have demonstrated that implicit and explicit measures of alcohol-affect associations account for unique variance in drinking behavior (Ostafin and Palfai 2006; Wiers et al. 2002). Further, it appears that implicit measures of stimulus-affect associations may be better able to predict behavior that is more difficult to control, such as when self-control resources are depleted (Hofmann et al. 2007; Ostafin et al. 2008; also see Fazio et al. 1995; Perugini 2005). These findings suggest the importance of automatic stimulus-affect associations in predicting behavior. A more sophisticated understanding of the role of automatic alcohol motivation in drinking behavior will be advanced by increasing our knowledge of the contexts that are likely to elicit these associations. These contexts may represent what has been termed *high-risk situations* for dyscontrolled alcohol use (Marlatt 1996). For example, a recent study found that initial alcohol consumption activates automatic alcohol-approach associations (Farris and Ostafin 2008; though alcohol preload did not activate approach behavior using a stimulus response compatibility task in Schoenmakers et al. 2008). It has been proposed that negative emotion may be an especially important high-risk situation (Marlatt 1996). The current study supports this proposition in that it represents the first research to find that negative emotion may serve as a context in activating automatic alcohol-affect associations.

There are a number of applied science implications for the current study and similar research of automatic motivational processes in substance use. The current findings that negative affect elicits automatic alcohol motivation in

high but not low CM drinkers suggests that it may be beneficial to match treatment strategies with the personality of the treatment-seeking individual (for evidence on the utility of treatment matching, see Conrod et al. 2000). The results suggest that emphasizing negative emotion regulation strategies would be particularly beneficial for high CM drinkers but less useful for low CM drinkers. To the extent that automatic alcohol motivation is found to play a role in alcohol behavior, it will become increasingly important to develop intervention strategies that can modulate this influence. The relatively poor long-term efficacy of traditional cognitive-behavioral treatments for alcohol use (McKay et al. 2006) may be explained in part by findings that these treatments may influence controlled but not automatic processes related to alcohol motivation (Wiers et al. 2005). Intervention strategies may benefit from theoretical advances that suggest that automatic stimulus-affect associations may be more influenced by nonverbal strategies such as evaluative conditioning than by logical reasoning (Gawronski and Bodenhausen 2006). The influence of automatic stimulus-affect associations on behavior may also benefit from novel approaches that emphasize changing the relation to one's internal experience rather than changing the content of the experience (i.e., associative networks; Hayes 2004). Marlatt and Ostafin (2006) proposed that mindfulness (i.e., developing an awareness of and attitude of acceptance toward one's internal experience; Bishop et al. 2004; Kabat-Zinn 2003) may have utility in modulating the effect of automatic motivational and attentional processes on substance use behavior. This perspective is supported by recent findings that mindfulness may decouple the relation between automatic alcohol motivation and problem drinking (Ostafin and Marlatt 2008).

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