Of Two Minds about Alcohol: Specific Effects of Evaluative Conditioning on Implicit, but not Explicit, Alcohol Cognitions Among Heavy versus Light Drinkers

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Abstract

Heavy episodic drinking (HED) is a dangerous and pervasive problem in college populations. Two experiments examined the asymmetric effects of evaluative conditioning (EC) on cognitions underlying HED in a non-clinical, student sample. Based on the Associative-Propositional Evaluation (APE) model (Gawronski & Bodenhausen, 2006), we predicted that negative EC would result in stronger implicit alcohol avoidance motivation compared to neutral EC but would not impact explicit alcohol expectancies; further, we hypothesized stronger negative EC effects among students reporting HED compared to light drinkers. Experiment 1 supported these hypotheses. In Experiment 2, participants were required to focus on either feelings or knowledge about alcohol following EC. Replicating Experiment 1, negative EC was effective in promoting implicit alcohol avoidance motivation among students reporting HED compared to neutral EC, while no differences in explicit alcohol expectations or urges emerged. However, greater implicit alcohol avoidance predicted lower explicit alcohol urges among participants instructed to focus on alcohol-related feelings, but not alcohol-related knowledge, regardless of condition. Findings suggest students reporting HED, but not light drinkers, may exhibit implicit alcohol avoidance following negative EC, and that instructions to focus on alcohol-related feelings may align explicit and implicit responses. Results have implications for interventions aimed at retraining implicit alcohol cognitions among college students.

Keywords: ALCOHOL EXPECTANCIES, IMPLICIT ALOCHOL COGNTION, HEAVY EPISODIC DRINKING, COLLEGE STUDENT DRINKING.

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High-risk alcohol use among college students is a substantial public health concern in the United States. Nearly half of college drinkers report heavy episodic drinking (HED) or drinking 4 or more drinks in a row for females or 5 or more for males within the past 30 days (Hingson, Zha, & Weitzman, 2009; White & Hingson, 2013). Although many students reduce drinking after college (Jackson, Sher, Gotham, & Wood, 2001), risky alcohol use during college is associated with death, injury, sexual assault, unsafe sex, and drunk driving (National Institute on Alcohol Abuse and Alcoholism, 2013). Students reporting frequent HED are also at higher risk for developing alcohol-related problems, including alcohol use disorders (AUDs; Petit et al., 2013). Interventions and manipulations that aim to reduce HED among college students have proliferated, targeting social/normative, motivational, and cognitive underpinnings of HED (Reid & Carey, 2015).

One long-standing cognitive-motivational target for intervention has been alcohol expectancies, usually assessed as self-reported beliefs (perceived likelihood and evaluations) about positive and negative drinking outcomes, which predict alcohol use among college students (Jones, Corbin, & Fromme, 2001; Hasking, Lyvers, & Carlopio, 2011). Expectancy interventions challenge these anticipated alcohol-related outcomes to reduce drinking (Corbin, McNair, & Carter, 2001; Darkes & Goldman, 1993; Lau-Barraco & Dunn, 2008). However, reviews and meta-analyses suggest challenging explicit expectancies may not be effective in reducing alcohol consumption (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Scott-Sheldon, Terry, Carey, Garey, & Carey, 2012).

Researchers have identified other ways to conceptualize, assess, and ultimately manipulate how student drinkers respond to alcohol-related stimuli. Dual-process models of cognition suggest that relatively automatic, fast responses to alcohol-related stimuli, measured through behavioral tasks such as the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) predict unique variance in drinking behavior for youth and adults (Houben & Wiers, 2008; McCarthy & Thompsen, 2006; Noel & Thomson, 2012; Reich, Below, & Goldman, 2010). Theoretical delineation of the processes captured by the IAT and other implicit measures is ongoing in the literature (e.g., see Sherman et al., 2008; De Houwer, 2014), but regardless of the constructs that drive implicit responses, these measures allow less deliberation and control prior to response compared to self-report measures, predict many alcohol-related behaviors (e.g., see Lindgren et al., 2013), and may be less prone to social desirability concerns (Gray, LaPlante, Bannon, Ambady, & Shaffer, 2011; Greenwald, Poehlman, Uhlmann, & Banaji, 2009). Measures of implicit alcohol responses may better capture automatic impulses that likely precede behavioral actions following exposure to alcohol stimuli (Wiers et al., 2007). Thus, interventions targeting implicit responses, or that impact both explicit and implicit responses, may better facilitate cognitive and behavioral change compared to interventions that aim to change responses on explicit measures alone.

Targeting Implicit Approach-Avoidance Motivation

A variety of IATs have been developed in which drinkers sort alcohol with attributes including evaluations (i.e., positive or negative), self-relevant concepts (i.e., self-as-drinker; Lindgren et al., 2013), and words describing approach-avoidance motivation (Palfai & Ostafin, 2003). Alcohol-related cues can elicit motivational states among drinkers, driven by previous experiences of positive or negative outcomes during or following alcohol use (Bartholow, Lust,

& Tragesser, 2010; Carter & Tiffany, 1999; Powell, 1995; Stewart, de Wit, & Eikelboom, 1984). Implicit alcohol motivations, such as approach or avoidance orientations, predict drinking history (Ostafin & Palfai, 2006), risky alcohol-related behaviors (e.g., binge drinking, ability to control alcohol use; Palfai & Ostafin, 2003), acute drinking (e.g., Ostafin, Marlatt, & Greenwald, 2008), and future drinking (Farris, Ostafin, & Palfai, 2010).

Because approach-avoidance motivation is linked to experience, it is plausible that heavier compared to lighter drinkers display stronger approach motivation toward alcohol overall, but may be more susceptible to contextual cues eliciting alcohol avoidance, given the mixture of negative and positive physiological and social outcomes they encounter (Del Boca, Darkes, Goldman & Smith, 2002). In fact, alcohol-dependent individuals who are maintaining abstinence as a result of treatment exhibit alcohol-avoidance (Spruyt et al., 2013). On the other hand, current heavy drinkers actively drinking at high-risk levels exhibit stronger implicit alcohol-approach motivation compared to light drinkers (Field, Kiernan, Eastwood, & Child, 2008; Petit et al., 2013; Wiers, Rinck, Dictus, & van den Wildenberg, 2009). Interventions have targeted alcohol motivations among heavy drinkers, reducing motivational approach tendencies and subsequent drinking (Wiers, Rinck, Kordts, Houben, & Strack, 2010). However, these interventions have been tested primarily with clinical populations (e.g., AUDs) and have not been extensively examined among college students engaging in HED who are susceptible to similar alcohol-related risks (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013).

At-risk college student populations may be of particular interest for interventions aimed at promoting negative motivational responses to alcohol on implicit measures. Students engaging in HED may be on a trajectory which could impact their immediate and later health and well-being. Further, heavier-drinking college students' tendency to exhibit motivational approach

toward alcohol parallels non-abstaining adult clinical samples (Namkoong, Lee, Lee, Lee, & An, 2004) and these patterns of alcohol-approach and heavy alcohol use continue into adulthood for some students (Borsari, Murphy, & Barnett, 2007). Students who engage in HED also experience and report negative consequences from drinking, but discount these consequences relative to rewards and positive expectations they learn to associate with alcohol (Blume, Schmaling, & Marlatt, 2003; Wiers, van de Luitgaarden, van den Wildenberg & Smulders, 2005). If experiencing negative HED consequences along with positive drinking outcomes does in fact create alcohol-avoidance motivational tendencies, these countervailing avoidance motivations could perhaps be activated and promoted among heavy-drinking college students to alter drinking behaviors. Finally, light-drinking college students tend to already report more negative implicit alcohol responses compared to peers reporting HED, so interventions promoting implicit negativity toward alcohol are likely to be effective among heavy-, more than light-drinking students (Wiers, van Woerden, Smulders, & Jong, 2002).

Additional theory-driven research on the malleability of implicit alcohol motivations is needed to test manipulations targeting these responses and determine how effects might differ between light versus heavy drinkers, informing the development of stronger interventions for reducing student drinking. Such work, guided by dual-process models that delineate how implicit and explicit responses function separately as well as how they interact, can also increase understanding of conditions under which specific situational factors impact implicit but not explicit responses to alcohol, versus impacting both implicit and explicit responses (Baumeister & Bargh, 2014; Brunstorm & Higgs, 2002; Gawronski & LeBel, 2008). The present studies were designed to address these questions using evaluative conditioning (EC) as a means of influencing implicit alcohol avoidance among heavy drinkers with no hypothesized effect on negativity of

explicit alcohol cognitions (Experiment 1), and EC plus the manipulation of focus (i.e., introspection) as a means of influencing both implicit and explicit responses (Experiment 2).

Evaluative Conditioning of Implicit Responses to Alcohol

Grounded in classical conditioning, EC targets emotional responses to categories via repeated pairings of a Conditioned Stimulus (CS) with an affectively-valenced Unconditioned Stimulus (US; valenced vs. neutral images/words or images; Hollands, Prestwich, & Marteau, 2010; Jones, Fazio, & Olson, 2009; Wiers et al., 2013). These pairings may create new responses to the category or activate existing learned response tendencies (Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010). EC is relevant to dual-process models of cognition in that it has been observed in some studies to impact implicit, but not explicit, attitude measures (Johnsrude, Owen, Zhao, & White, 1999). This specificity of EC's impact on responses to implicit measures has been empirically supported for a variety of non-alcohol attitudes (e.g., self-esteem, health foods; Grumm, Nestler, & von Collani, 2009; Hollands et al., 2011), contrasting with earlier dual-process work demonstrating that explicit attitudes are more easily influenced than implicit responses (Gawronski & Bodenhausen, 2006). However, some studies testing EC based on dual process models report limits to EC effects when attentional constraints are introduced, suggesting EC may not solely target automatic processes (see Brunstrom & Higgs, 2002). Further, conscious awareness of EC manipulations (i.e., awareness of the US-CS contingency) seemingly boosts their effectiveness (Hofmann et al. 2010; Stahl, Unkelbach, & Corneille, 2009), suggesting EC may target explicit processes rather than implicit processes alone.

The literature is also mixed as to the specificity of EC effects on implicit versus explicit responses to alcohol. For example, Houben and colleagues (2010a) found greater implicit, but not explicit, negativity toward alcohol among college drinkers after an EC task pairing alcohol-

related stimuli with negatively valenced images compared to when alcohol was paired with neutral images. However, additional research yielded reduced positivity for both implicit and explicit alcohol attitudes following negative EC (Houben et al., 2010b). The inconsistency of findings indicates a need for guiding theory and hypothesis testing to determine when a manipulation of emotional or cognitive context will impact implicit but not explicit responses to alcohol. As these causal relationships are better understood, their implications for subsequent behavior change can be addressed more confidently. Since implicit evaluation and motivation have been observed in some research to better predict drinking behavior than self-report (Lindgren et al., 2013), manipulations specifically influencing implicit responses may provide an effective path toward behavioral change. On the other hand, to the degree that heavy drinkers are induced to experience avoidance motivation toward alcohol but maintain explicit positivity, it may be easier for them to discount the importance of the negative motivations activated or learned from EC (Blume et al, 2003).

A number of dual process models and empirical approaches describe the interaction of implicit and explicit responses and conditions under which either or both processes are impacted by manipulations such as EC (e.g., Brunstrom & Higgs, 2002). The present research aims to resolve empirical inconsistencies in EC's asymmetrical effects on responses to alcohol among college student drinkers by examining effects of EC on alcohol-related implicit and explicit measures within the theoretical and methodological framework of one of these perspectives, the Associative-Propositional Evaluation (APE) model (Gawronski & Bodenhausen, 2011). Further, the relative effectiveness of negative EC for college students who engage in HED compared to students who are lighter drinkers (Wiers et al. 2010) has not been examined. We sought to address whether these manipulations impact all non-abstaining college students (making EC a

potential component of universal preventive interventions) or only heavier drinkers (making EC a potential targeted preventive intervention).

The APE Model and the Present Experiments

According to the APE model, responses captured by implicit measures result from associative processes, or the activation and retrieval of associations in memory (Gawronski & Bodenhausen, 2011). Environmental stimuli activate these associations, creating an immediate or "gut" reaction (i.e., "alcohol + approach/want" or "alcohol + avoid/don't want"), which occurs regardless of whether an individual would explicitly endorse that response as subjectively true. For example, a person may endorse negative attitudes toward alcohol if directly asked yet experience an automatic motivation to approach alcohol when walking past a familiar bar (Deutsch & Strack, 2006). Conversely, an individual endorsing positive alcohol attitudes may walk by a bar where drinking was associated with negative feelings, creating an immediate avoidance response toward alcohol that an explicit measure may not capture. The APE model posits explicit attitudes result from *propositional* processes, described as deliberative reasoning with a goal of logical, long-term consistency. This process either confirms or rejects automatic, associative processes based on whether activated associations in memory are consistent with propositional processes (Gawronski & Bodenhausen, 2011). Therefore, the situation described above—walking past a bar associated with a bad drinking experience—may activate a negative, automatic reaction from a drinker (e.g., "I don't want a drink."), but this reaction may be discounted if the drinker is asked to think about their expectancies of alcohol (e.g., "I have fun with people when I drink."). Thus, implicit and explicit responses may or may not align in a given situation, depending on environmental and contextual cues that either prevent or promote implicit-explicit consistency. This account may provide an explanation to when EC only alters

implicit responses versus when it can alter implicit and explicit measures (Gawronski & Bodenhausen, 2011).

Based on the APE model, a manipulation that simply associates image categories through repeated presentation (i.e., EC) should only influence associative processes, impacting responses on implicit but not explicit measures. However, if a situation provides an opportunity or demand for participants to deliberate on their experience following these repeated pairings, propositional thinking may validate learned or activated associations from EC, such that both implicit and explicit alcohol cognitions are impacted and consistent. In other words, propositional, or explicit, processes may be influenced by manipulations which primarily target associative, or implicit, associations in certain contexts. For example, having participants focus, or introspect, on their emotions following manipulations like EC have been found to make explicit attitudes align more strongly with implicit attitudes (Gawronski & LeBel, 2008). To test hypotheses regarding the malleability of college students' responses to alcohol based on the APE model, we conducted two experiments following methodological sequences described by Gawronski and LeBel (2008). In addition to testing the impact of negative versus neutral EC on college students' implicit alcohol motivations and explicit expectancies (Experiment 1), we manipulated participants' focus on either feelings or knowledge about alcohol immediately after EC procedures (Experiment 2).

Experiment 1

We sought to partially replicate and extend past research using EC on alcohol attitudes (Houben et al., 2010a; 2010b) within a broad sample of college student drinkers, including those reporting recent HED. Specifically, the first experiment tested for asymmetric effects of EC on responses to implicit versus explicit measures using the framework outlined in the APE model.

Since the APE model posits that implicit measures are largely automatic, and may be reflective of recently acquired associations, we expected that (H1) negative EC would impact implicit alcohol motivations among college student drinkers, demonstrating greater implicit alcohol avoidance motivation compared to neutral EC. However, since the APE model suggests explicit attitudes may be more resilient to immediate change due to previous experiences and effortful validation of attitudes, (H2) no difference was anticipated for explicit expectancies between EC conditions. Consistent with past research (Field et al., 2008; Wiers et al., 2009), we expected (H3) participants reporting recent HED to exhibit lower implicit alcohol avoidance motivation compared to non-HEDs (i.e., across experimental conditions). However, it was hypothesized (H4) HED status would interact with EC, demonstrating negative EC is particularly effective in promoting implicit alcohol avoidance motivation among HEDs compared to non-HEDs.

To extend findings reported by Houben and colleagues (2010a; 2010b) and broaden understanding of EC's impact on automatic processes, we measured implicit alcohol approach/avoidance motivation. Approach/avoidance motivations seem strongly related to the gut response used by Gawronski & Bodenhausen (2006) to characterize associative, or automatic, processes, increasing our confidence that hypothesized effects would be detected. Implicit alcohol motivation captures anticipatory responses toward alcohol, measuring an individual's orientation to approach or avoid alcohol, therefore providing an associative parallel to explicit expectancies. Further, in addition to explicit expectations of alcohol, we also assessed affective evaluations of these expectations, since these may be more analogous to implicit motivations than previously learned expectations.

Method

Research Ethics Committee Review. All recruitment procedures and research protocols for Experiment 1 were reviewed and approved by our campus Institutional Review Board under Protocol Number 307555, reviewed under the title "Changing Students' Alcohol Cognitions: Distinct Techniques for Influencing Implicit versus Explicit Cognitions."

Participants. Undergraduate students (N = 95) at a large, urban public university received course credit for participating in the study. Abstainers (no lifetime drinking *or* no alcohol in the 3 months prior to the experiment, n = 9) were excluded from experimental manipulations, leaving a final sample of 86 participants (72.1% female; M_{age} = 24.50, SD_{age} = 7.29). Participants identified as Caucasian (53.5%), African American (34.9%), or as another race (11.6%). Only 5.8% (n = 5) reported belonging to a fraternity or sorority. A sensitivity power analysis indicated an approximately medium effect size (η^2 = .08) would provide 80% power to detect significant interaction effects with the recruited sample.

Measures and procedure. After informed consent, participants answered a demographic survey (i.e., race, gender, age, fraternity/sorority membership), and a measure of self-reported drinking behavior (i.e., whether they have ever drank, whether they drank in the past 3 months). Next, they were randomly assigned an EC procedure and then completed measures of implicit alcohol motivation and explicit alcohol expectancies, with order of measures counterbalanced between subjects. There were no mean differences among any measures between counterbalanced orders, all ps > .293. Finally, contingency awareness was assessed by asking participants to write down whether they noticed anything about the presentation of images during EC. Responses were categorized as contingency aware or not aware by 2 independent raters (Cohen's kappa = .92) and disagreements were resolved by discussion.

Alcohol use and experiences questionnaire (AUEQ). The AUEQ (adapted from Bartholow et al., 2010) defines a standard drink (e.g., 12-ounce can or bottle of beer) and includes items about alcohol consumption within various time intervals (e.g., the past 2 weeks, 30 days, etc.). Participants were classified as engaging in recent HED if they indicated that they have consumed 5 or more (for males) or 4 or more (for females) alcoholic drinks in a single setting within the past 30 days on at least one occasion (Hingson et al., 2009).

Evaluative conditioning. Participants were randomly assigned an EC procedure adapted from Hollands et al. (2011) showing a series of 5 alcohol images (e.g., glass of beer and wine together, wine alone, beer alone, shot of tequila, mixed drinks) interspersed with either 5 neutral pictures (keychain, electrical socket, unlit lightbulb, nondescript office building, friction slide for file drawer) or negative pictures (man aiming a gun at the viewer, burning house, roach on a piece of pie, befouled toilet, landfill) pictures depending on assignment at the beginning of the session to the negative or neutral condition. Eight of the images were normed photos (four negative, four neutral) selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1997) and two were public-domain web images (one negative, one neutral); images were rated by an independent sample prior to recruitment for Experiment 1 to ensure they were equally valenced. The use of images reflecting general negative emotion was in line with prior work using EC to influence alcohol-related outcomes (Houben et al., 2010a; 2010b). Using E-Prime software (Schneider, Eschman, & Zuccolotto, 2002), images were presented as a slide show featuring 100 trials. Trials consisted of an alcohol image (1s), followed by a negative or neutral image depending on experimental condition (1s), and then a 500ms intertrial interval. The specific order in which alcohol and valanced images were presented across trials was random. To ensure that participants were paying attention during the task, they were instructed to

hit the space bar when an image of a white circle appeared on the screen; like the other EC images, the white circle appeared at random points during the task.

Implicit alcohol motivation. The alcohol motivation IAT was modeled after Palfai and Ostafin (2003). Participants sorted pictures (i.e., soft drinks or alcoholic beverages) and words (i.e., approach-related or avoidance-related) on a computer screen. In one set of critical trials, the participant was instructed to sort alcohol images with avoidance-related words and soft drinks with approach-related words. In another set of critical trials, these pairings were switched. Order of critical trial blocks (alcohol-avoid or alcohol-approach first) was counterbalanced. Reaction time-based D scores were calculated using the improved IAT scoring algorithm (Greenwald, Nosek, & Banaji, 2003), such that positive D scores indicated stronger alcohol-avoidance motivations and negative D scores suggested stronger alcohol-approach motivations. Correlation of D scores calculated from practice trial blocks with D scores calculated from test trial blocks (Greenwald et al., 2003) indicated that the IAT had good internal consistency, $r(84) = .477$, $p < .001$.

Explicit alcohol expectations. The comprehensive effects of alcohol (CEOA; Fromme, Stroot, & Kaplan, 1993) consists of 38 items that make up 4 positive subscales, including sociability ($\alpha = .858$-$.909$; e.g., “It would be easier to talk to people.”), tension reduction ($\alpha = .707$-$.793$; e.g., “I would feel calm.”), liquid courage ($\alpha = .719$-$.832$; e.g., “I would feel courageous.”), and sexuality ($\alpha = .727$-$.748$; e.g., “I would feel sexy.”), and 3 negative subscales, including cognitive and behavioral impairment ($\alpha = .749$-$.864$; e.g., “I would feel dizzy.”), risk-aggression ($\alpha = .638$-$.712$; e.g., “I would take risks.”), and self-perception ($\alpha = .638$-$.685$; e.g., “I would feel guilty.”). Participants rated the likelihood that they would experience the outcome

described when drinking alcohol using a scale from 1 (*Disagree*) to 4 (*Agree*). Participants also reported the valence (positive or negative) of that outcome, rated from 1 (*Bad*) to 5 (*Good*).

Results

Implicit alcohol motivation. Implicit alcohol motivation was analyzed using a 2 (EC condition: negative, neutral) X 2 (drinker status: non-HED, HED) analysis of variance (ANOVA). Results indicated a significant main effect of EC condition on implicit alcohol motivation, $F(1,82) = 6.33$, $p = .014$, $\eta_p^2 = .072$, such that participants in the negative EC condition exhibited greater alcohol *avoidance* ($n = 42$; $M = 0.38$, $SD = 0.31$) compared to those in the neutral EC ($n = 44$; $M = 0.21$, $SD = 0.41$), supporting hypothesis 1. There was also a significant main effect of drinker status on implicit alcohol avoidance motivation, $F(1,82) = 10.59$, $p = .002$, $\eta_p^2 = .114$, suggesting HEDs demonstrated less alcohol avoidance ($n = 44$; $M = 0.18$, $SD = 0.35$) compared to non-HEDs ($n = 42$; $M = 0.41$, $SD = 0.37$), supporting hypothesis 3. These main effects were qualified by a significant interaction of EC condition and drinker status, $F(1,82) = 4.07$, $p = .047$, $\eta_p^2 = .047$, supporting hypothesis 4 (see Figure 1). Among non-HEDs, simple effects indicated no differences in implicit alcohol avoidance motivation between negative ($n = 19$; $M = 0.43$, $SD = 0.37$) and neutral ($n = 23$; $M = 0.39$, $SD = 0.38$) EC conditions, $F(1,82) = 0.12$, $p = .730$, $\eta_p^2 = .001$. Among HEDs, those in the negative EC condition exhibited greater implicit alcohol avoidance motivation ($n = 23$; $M = 0.34$, $SD = 0.25$) compared to HEDs in the neutral EC condition ($n = 21$; $M = 0.003$, $SD = 0.35$), $F(1,82) = 10.56$, $p = .002$, $\eta_p^2 = .114$, suggesting negative EC may have promoted alcohol avoidance among heavier drinkers.

INSERT FIGURE 1 HERE

Explicit alcohol expectancies. A 2 (EC condition: negative, neutral) X 2 (drinker status: non-HED, HED) multivariate analyses of variance (MANOVA) was performed individually on

valence and expectancy estimates of the 7 subscales of the CEOA. Results indicated no factors significantly affected valence estimates, all *p*s > .110. However, results indicated drinker status significantly affected expectancy estimates, Wilks' $\lambda = .813$, $F(7, 76) = 2.50$, $p = .023$, $\eta_p^2 = .187$. Supporting hypothesis 2, no other factors or interactions were significant, all *p*s > .182, indicating explicit expectations did not differ between EC conditions. Subsequent univariate ANOVAs indicated HEDs reported greater expectancies of alcohol-related sociability ($M = 3.42$, $SD = 0.43$) compared to non-HEDs ($M = 3.08$, $SD = 0.73$), $F(1,82) = 6.72$, $p = .011$, $\eta_p^2 = .076$. Similarly, HEDs reported greater expectancies for alcohol-related courage ($M = 2.91$, $SD = 0.60$) compared to non-HEDs ($M = 2.47$, $SD = 0.76$), $F(1,82) = 8.69$, $p = .004$, $\eta_p^2 = .096$. All other subscales did not significantly differ between HEDs and non-HEDs, all *p*s > .086.

Contingency awareness. On the contingency awareness question, fourteen participants indicated they noticed a pattern in which alcohol-related images were paired with valenced images during the EC task. A 2 (EC condition: negative, neutral) X 2 (drinker status: non-HED, HED) X 2 (contingency awareness: aware, unaware) ANOVA examined implicit alcohol motivation and alcohol expectancies (sociability and liquid courage). The analyses indicated no significant main effects of contingency awareness, all *p*s > .742 and no factors significantly interacted with contingency awareness, suggesting prior results were unaffected by contingency awareness, all *p*s > .363.

Discussion

Experiment 1 provided support for the hypothesized asymmetric effect of EC on implicit alcohol motivation but not on explicit alcohol expectancies. Participants assigned to negative EC demonstrated greater implicit alcohol avoidance motivation compared to neutral EC. However, no main effect of EC was found among any explicit alcohol expectations, supporting past

research (Houben et al., 2010a). HEDs also exhibited less implicit alcohol avoidance motivation and reported significantly higher alcohol-related expectancy scores compared to non-HEDs. However, drinking status significantly interacted with EC for implicit, but not explicit, responses to alcohol. HEDs assigned to negative EC had significantly greater implicit alcohol avoidance motivation compared to HEDs assigned to neutral EC, while no significant differences emerged among non-HEDs. This finding suggests negative EC may only impact implicit alcohol avoidance motivation among heavy drinkers, while lighter drinkers show greater avoidance than approach motivation toward alcohol regardless of associations primed in the immediate situation.

One limitation of this experiment is uncertain conceptual overlap between our explicit and implicit dependent measures. We selected expectancies as our explicit measure because of its pervasiveness in alcohol research literature, prior use in alcohol-related EC (Houben et al., 2010a), and because expectancies, like implicit alcohol motivations, are conceptualized as anticipatory responses to alcohol (Goldman, 2002). To enhance our ability to detect EC effects on explicit responses, we determined that a self-report measure that more closely parallels alcohol motivations would be useful to add in subsequent studies (Keren & Schul, 2009). Notwithstanding these limitations, results are in line with empirical findings reported by Houben et al. (2010a) but using a different implicit alcohol assessment and support the APE model, suggesting implicit responses may be influenced by recently acquired associations (i.e., EC), while explicit assessments rely on prior beliefs which may be more difficult to change in acute settings (Gawronski & LeBel, 2006). However, the APE model also predicts that responses on implicit and explicit measures are not always asymmetric. Specifically, explicit and implicit consistency can be manipulated through instructing participants to focus on feelings (i.e., “gut” response) versus knowledge (i.e., prior memories and expectations; Gawronski & LeBel, 2008).

Experiment 2

Experiment 2 was designed as a replication and extension of Experiment 1, with the addition of an explicit drinking urge measure, more closely paralleling our implicit measure of alcohol motivation and strengthening our test of dual process hypotheses (Bohn, Krahn, & Staehler, 1995). Experiment 2 examined conditions under which implicit and explicit alcohol cognitions may align by having participants focus, or introspect, on either their *feelings* or their *knowledge* about alcohol (Gawronski & LeBel, 2008). In addition to previous hypotheses, we hypothesized (H5) significantly more negative explicit alcohol cognitions following negative EC compared to neutral EC among participants instructed to focus on their feelings toward alcohol, since focusing on alcohol-related feelings would make participants rely primarily on their gut, or automatic, reaction toward alcohol when self-reporting (Gawronski & LeBel, 2008). Finally, it was expected that explicit or propositional thinking should validate the automatic, implicit response when participants are asked to reflect on their feelings about alcohol, regardless of EC procedure. Thus, it was expected (H6) self-reported alcohol cognitions would be related to implicit alcohol motivations for participants focusing on alcohol-related feelings, but not knowledge.

Method

Research Ethics Committee Review. As with Experiment 1, all recruitment procedures and research protocols for Experiment 2 were reviewed and approved by our campus Institutional Review Board under Protocol Number 307555, reviewed under the title “Changing Students’ Alcohol Cognitions: Distinct Techniques for Influencing Implicit versus Explicit Cognitions.”

Participants. Undergraduate students (N = 100) at a large, urban public university received course credit for participating in the study. Abstainers (n = 24) were excluded from experimental manipulations, leaving a final sample of 76 participants (56.6% female; M_{age} = 24.84, SD_{age} = 5.85). Participants identified as Caucasian (59.2%), African American (23.7%), Asian American (3.9%), or as another race (13.2%). Only 10.5% (n = 8) reported belonging to a fraternity or sorority. A sensitivity power analysis indicated an approximately medium effect size (η^2 = .09) would provide 80% power to detect significant interaction effects with the recruited sample for Experiment 2.

Measures and procedure. The measures used for Experiment 2 were identical to Experiment 1 (alcohol motivation IAT and CEOA), except for the addition of an explicit alcohol urge measure and introspective focus manipulation. The procedure of Experiment 2 was identical to Experiment 1, with the inclusion of introspective focus immediately following EC and explicit alcohol motivation being assessed after the CEOA. Similar to Experiment 1, order of implicit and explicit measures was counterbalanced between participants and no differences among any measures were present between counterbalanced order, all ps > .312. Contingency awareness was assessed at the end of the study, asking participants to write down whether they noticed anything about the presentation of images during EC. Responses were categorized as contingency aware or not aware by 2 independent raters (Cohen's kappa = .89) and disagreements were resolved by discussion.

Introspective focus. Focus related to alcohol was manipulated using a task adapted from Gawronski and LeBel (2008). Following completion of the EC task, participants were told to take a moment to either think about their feelings of drinking alcohol or about their knowledge of drinking alcohol. All participants were required to write down their responses on paper.

Explicit alcohol motivation. Explicit alcohol motivation was assessed using the Alcohol Urge Questionnaire adapted from Bohn et al. (1995). Nine items ($\alpha = .864$) were rated on a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*). Example items include, "All I want to do now is have a drink," and, "Nothing would be better than a drink right now" An additional negatively-worded item, "I have no urge to drink now," was added to the original 8-item scale. Items were averaged such that higher values indicated greater urge or approach motivation toward alcohol.

Results

Implicit alcohol motivation. A 2 (EC condition: negative, neutral) X 2 (drinker status: non-HED, HED) X 2 (introspective focus: feelings, knowledge) ANOVA yielded a significant main effect of drinker status on implicit alcohol avoidance motivation, $F(1,67) = 4.27$, $p = .043$, $\eta_p^2 = .060$, with HEDs exhibiting lower avoidance motivation ($n = 39$; $M = 0.07$, $SD = 0.45$) than non-HEDs ($n = 36$; $M = 0.26$, $SD = 0.43$), further supporting hypothesis 3. A main effect of introspective focus also emerged, $F(1,67) = 8.68$, $p = .004$, $\eta_p^2 = .115$, indicating participants focusing on alcohol-related knowledge had greater implicit avoidance ($n = 38$; $M = 0.32$, $SD = 0.42$) compared to focusing on alcohol-related feelings ($n = 37$; $M = 0.04$, $SD = 0.44$). Inconsistent with hypothesis 1, no significant main-effect differences on implicit alcohol motivations between negative EC ($n = 41$) and neutral EC ($n = 34$) conditions emerged, $F(1,67) = 0.44$, $p = .512$, $\eta_p^2 = .006$. However, EC condition interacted with drinker status, $F(1,67) = 4.38$, $p = .040$, $\eta_p^2 = .061$, further supporting hypothesis 4 (see Figure 2). Simple effects indicated no differences in implicit alcohol avoidance motivation between negative ($n = 23$; $M = 0.24$, $SD = 0.40$) and neutral ($n = 13$; $M = 0.29$, $SD = 0.48$) EC conditions among non-HEDs, $F(1,67) = 0.95$, $p = .332$, $\eta_p^2 = .014$. Among HEDs, negative EC demonstrated greater implicit

alcohol avoidance (n = 18; M = 0.22, SD = 0.45) compared to neutral EC (n = 21; M = -0.05, SD = 0.42), $F(1,67) = 4.11$, $p = .047$, $\eta_p^2 = .058$.

INSERT FIGURE 2 HERE

Explicit alcohol expectancies. A 2 (EC condition: negative, neutral) X 2 (drinker status: non-HED, HED) X 2 (introspective focus: feelings, knowledge) MANOVA was performed individually on valence and expectancy estimates of the 7 subscales of the CEOA. Results indicated no factors significantly affected valence estimates, all ps > .065. Drinker status was significantly predictive of expectancy estimates, Wilks' $\lambda = .785$, $F(7, 60) = 2.35$, $p = .035$, $\eta_p^2 = .215$. No other factors or interactions were significant, all ps > .192, inconsistent with hypothesis 6. Subsequent univariate ANOVAs indicated HEDs reported greater expectancies of alcohol-related sociability (M = 3.34, SD = 0.46) compared to non-HEDs (M = 3.05, SD = 0.51), $F(1,66) = 9.24$, $p = .003$, $\eta_p^2 = .123$. Similarly, HEDs reported greater expectancies for alcohol-related courage (M = 2.89, SD = 0.58) compared to non-HEDs (M = 2.44, SD = 0.69), $F(1,66) = 10.44$, $p = .002$, $\eta_p^2 = .137$. HEDs also reported greater risk and aggression expectancies (M = 2.61, SD = 0.67) compared to non-HEDs (M = 2.12, SD = 0.68), $F(1,66) = 8.00$, $p = .006$, $\eta_p^2 = .108$. All other subscales did not significantly differ between HEDs and non-HEDs, all ps > .109. To examine whether the relation between explicit alcohol expectations and implicit alcohol motivations differed between introspective focus conditions, 2 MANOVAs tested the interaction of implicit alcohol motivation and introspection conditions individually predicting expectancy and valence estimates of the 7 subscales of the CEOA. Results indicated expectancy and valence estimates did not differ in their relation with implicit alcohol motivations between introspection conditions, both ps > .312.

Explicit alcohol motivations. A 2 (EC condition: negative, neutral) X 2 (drinker status: non-HED, HED) X 2 (introspective focus: feelings, knowledge) ANOVA indicated no main effects or interactions on explicit motivation to drink alcohol, all *p*s > .437, inconsistent with hypothesis 5. Hierarchical regression was used to assess differences in the relations between implicit and explicit alcohol motivations among conditions using the PROCESS macro for SPSS 24 (version 3; Hayes, 2012). Results indicated the relation between implicit and explicit alcohol motivation measures differed across introspection conditions, $F(1,72) = 5.77$, $p = .019$, $\Delta R^2 = .071$, supporting hypothesis 6. Among participants assigned to introspect on alcohol-related feelings, greater implicit alcohol avoidance motivation was related to lower explicit motivation to drink alcohol, $t(72) = -3.07$, $p = .003$, $b = -0.95$. Those assigned to focus on alcohol-related knowledge demonstrated a non-significant relation between measures in the opposite direction, $t(72) = 0.18$, $p = .859$, $b = 0.05$ (see Figure 3).

INSERT FIGURE 3 HERE

Contingency awareness. Eight participants indicated they noticed a pattern in which alcohol-related images were paired with valenced images during the EC task. A 2 (EC condition: negative, neutral) X 2 (drinker status: non-HED, HED) X 2 (introspective focus: feelings, knowledge) X 2 (contingency awareness: aware, unaware) ANOVA was conducted on implicit alcohol motivation and alcohol expectancies (sociability, liquid courage, and risk/aggression). No significant main effects of contingency awareness emerged, all *p*s > .245, and no factors significantly interacted with contingency awareness, all *p*s > .333.

Discussion

Unlike Experiment 1, no main effect of EC condition was found on implicit alcohol motivations. Replicating Experiment 1, HEDs exhibited significantly lower implicit avoidance

toward alcohol compared to non-HEDs and drinker status significantly interacted with EC with HEDs assigned to negative EC demonstrating greater implicit alcohol avoidance motivation compared to neutral EC. No main effect of EC was found for explicit alcohol expectations or motivations, but HEDs reported significantly greater alcohol-related expectations of sociability and courage, in addition to greater risk and aggression, than non-HEDs. Regarding introspection conditions, individuals instructed to focus on alcohol-related knowledge exhibited greater implicit alcohol avoidance motivation compared to those instructed to focus on alcohol-related feelings. This main effect was not hypothesized, but is in line with some previous research, suggesting that knowledge of the effects of alcohol may reduce risky alcohol use (Jander, Crutzen, Mercken, & De Vries, 2015), thus shifting motivation away from alcohol. No main effects or interactions on levels of explicit alcohol motivation emerged, suggesting explicit alcohol cognitions were unaffected by EC, drinker status, or introspection. However, among those instructed to focus on alcohol-related feelings, implicit alcohol motivations were significantly related to explicit urge, suggesting these attitudes were consistent regardless of EC or drinker status. In contrast, implicit and explicit alcohol motivations were unrelated among those instructed to focus on alcohol-related knowledge. These findings are consistent with the APE model (Gawronski & LeBel, 2008) and support hypotheses, suggesting explicit assessments may be influenced by implicit responses when drinkers are instructed to focus on alcohol-related feelings.

Experiment 2 addressed limitations of Experiment 1, adding an explicit measure of alcohol motivations (i.e., urge) and extending the use of the APE model to test hypotheses about conditions under which implicit and explicit responses are aligned. While results provide partial support for Experiment 1 and past research (Houben et al., 2010a; 2010b), some findings are

inconclusive (i.e., no main effect of EC). One limitation of Experiment 2 was the limited sample size, given the inclusion of an additional factor (introspective focus) in the model, although power analysis indicated adequacy to test hypotheses. Nonetheless, results extend the application of the APE model in manipulations targeting alcohol cognition.

General Discussion

The findings reported here provide evidence for an asymmetric effect of EC on implicit versus explicit responses to alcohol. With respect to EC, across 2 experiments, the manipulation impacted implicit, but not explicit measures, using a variety of established/validated and internally consistent explicit self-report assessments. However experiment 2 also provided preliminary evidence that brief introspection may align implicit and explicit alcohol cognitions.

Asymmetric Effects of EC on Implicit Motivation among Heavy Drinkers

While these findings contrast with studies in the general EC literature showing stronger effects on explicit than implicit measures or enhancement of EC effects when conscious processing is not restricted (e.g., Brunstrom & Higgs, 2002), they are largely consistent with prior research examining EC on alcohol-related attitudes (Houben et al., 2010a). The authors of one meta-analysis of EC effects concluded that a single-process, propositional account for the impact of EC provides a parsimonious explanation of most published results included in their analysis, but also that some findings may fit a dual-process account and that additional, clarifying research focusing on moderators of EC effects is needed (Hofmann et al., 2010). Our research was not designed to address these overall theoretical issues, but aimed to clarify conditions under which EC effects would appear on implicit and explicit alcohol assessments among college student drinkers. While our findings were in line with asymmetric EC effects on implicit alcohol responses (Houben et al., 2010a), we extend this literature by providing evidence

for recent drinking habits as an individual difference in response to negative EC. Responsiveness to alcohol cues and experiences of negative and positive drinking outcomes suggest that college students engaging in heavy drinking may respond more strongly to manipulations linking alcohol to negative emotion compared to lighter drinkers, but little research has tested this hypothesis. The present research demonstrates that negative EC may be particularly effective in promoting alcohol avoidance among heavy drinkers compared to light drinkers.

Further, light drinkers did not show significant differences between EC conditions in either experiment, exhibiting equivalent implicit alcohol avoidance motivation regardless of EC condition. On the other hand, heavier-drinking participants in the neutral EC condition had average implicit alcohol approach-avoid scores near 0 across experiments, but were alcohol-avoidant if exposed to negative EC, suggesting negative emotional contexts may primarily impact heavy drinkers' motivation in college student populations. Future research should examine positive, in addition to neutral and negative EC procedures, to determine whether heavy drinkers are particularly susceptible to either immediate approach or avoidance orientations toward alcohol depending on the salience of emotional contextual cues associated with alcohol.

Integrating Implicit and Explicit Processes

The APE model framework guiding the present research describes unique functions for implicit (associational, as defined by the theory) and explicit (propositional) processes, positing that these processes can operate separately or together, and may reflect consistent or inconsistent evaluations, depending on context. We aimed to examine whether effects observed in other alcohol research could be understood in terms of this model and whether some empirical inconsistencies could be accounted for (Houben et al., 2010a; 2010b). The asymmetric impact on implicit response suggests that faster, less controlled responses to alcohol may be susceptible to

change using acute interventions such as EC (Gawronski & LeBel, 2008). However, our attempt to manipulate explicit expectancies and motivations by altering participants' focus in Experiment 2 was only partially supported. While participants focusing on alcohol-related feelings exhibited consistency between implicit and explicit alcohol cognitions, there were no significant differences in *levels* of explicit alcohol cognitions between EC conditions. Nevertheless, findings suggest focusing on alcohol-related feelings may shift explicit attitudes toward agreement with implicit attitudes. Many of our participants were not aware of the CS-US contingency in the EC task. It is possible that an alternative EC design with more obvious connection between negative or positive emotions portrayed and alcohol could create more contingency awareness and increase the likelihood of effect on explicit measures.

Limitations & Future Research

Design limitations include lack of follow-up data on drinking behavior subsequent to the experiments, in addition to the uncertainty about the conceptual congruence between our explicit and implicit measures of alcohol cognition in Experiment 1. While the present study only examined immediate effects following EC, similar alcohol-related EC procedures are established to have effects lasting up to a week (see Houben et al., 2010b) and up to a year when the procedures are administered over a few days (see Wiers et al., 2011). An additional limitation is the IAT used in these experiments utilized alcohol and soft-drink categories. Contrasting alcohol with non-alcoholic drinks is consistent with prior research (Houben et al., 2010a; 2010b; Lindgren et al., 2013), but future research may enhance interpretability of findings by using single category IATs that do not require a contrast category (Karpinksi & Steinman, 2006). Further, while contingency awareness is known to be the strongest moderator of EC (Hofmann et al., 2010), no effects of contingency awareness were found in the present experiments. This

finding may be due to low proportions of contingency aware participants across experiments (11-16%) hindering statistical power to detect these effects. An alternative EC design with more obvious connection between negative or positive emotions portrayed and alcohol (e.g., drunk driving) may create more contingency awareness and increase the likelihood of effect on explicit measures. While the lack of effects regarding contingency awareness is inconsistent with the broader EC literature (Hofmann et al., 2010), our findings are consistent with prior work which found no effects of contingency awareness on alcohol-based EC (Houben et al., 2010a; 2010b). Finally, in addition to these design limitations our sample included relatively few males (< 28% in Experiment 1), restricting the generalizability of results.

Notwithstanding these limitations, results are in line with and extend empirical findings reported by Houben and colleagues (2010a, 2010b) and generally in line with our hypotheses. Pairing valenced images with alcohol stimuli impacted implicit alcohol motivations when those images were negative compared to neutral, specifically among college students reporting HED. Although the meaning of IAT scores and whether alternative approaches to assessing implicit responses are debated in the literature (e.g., Karpinksi & Steinman, 2006; Payne, Cheng, Govurn, & Stewart, 2005), the IAT's predictive validity is well-established, particularly within alcohol research (Farris et al., 2010; Palfai & Ostafin, 2003; Ostafin et al., 2008). Thus, these uncertainties do not confound the consistent HED x EC condition interaction we observed across two experiments. The interaction of EC condition with recent drinking behavior is a novel contribution to the literature, suggesting participants reporting recent heavy drinking may have been more susceptible to negative conditioning in both studies than those reporting no heavy drinking episodes in the past 30 days. The finding of an implicit-explicit motivation relationship only for those instructed to focus on feelings about alcohol was also in line with the APE

framework and also contributes to the literature. Next steps include using both positive and negative EC and other manipulations of emotional context to determine whether heavier-drinking college students are more susceptible to such contexts regardless of valence. In addition, further work on the conditions under which contextual manipulations impact both implicit and explicit responses is important, both from the perspective of theory-testing and that of application to prevention and harm reduction efforts. Using the APE model, testing conditions under which associations between alcohol and emotions are validated by explicitly reported propositions, and then in turn investigating the impact of such effects on later drinking behavior, could enhance the utility of cognitive bias interventions.

Although cognitive bias interventions that target implicit responses to alcohol are implemented with increasing frequency (e.g., Wiers et al., 2011; Wiers et al., 2013), data do not fully support their long-term effectiveness for prevention and treatment (see Cristea, Kok, & Cuijpers, 2016). The emergence of meta-analyses questioning the extent of behavioral impact from such interventions is similar to earlier critiques of interventions targeting explicit alcohol cognitions (Scott-Sheldon et al., 2006). Further pre-intervention research is critical to understand when interventions may be effective in reducing risky drinking via impact on both implicit and explicit responses. Ultimately, understanding how past experience and present context interact to shape fast responses on implicit measures and more deliberative responses on explicit measures may inform future interventions. Specifically, linking such changes to behavior and determining what motivational and cognitive changes impact longer-term behavior change, and translating this understanding into intervention techniques, may maximize the success of prevention and harm reduction programs.

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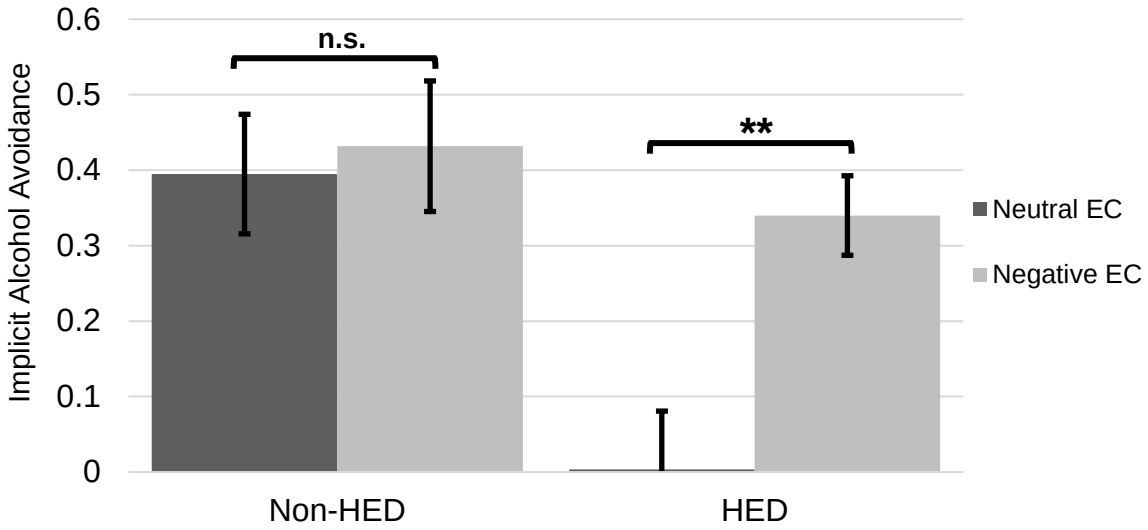

Figure 1. Implicit alcohol avoidance motivation as a function of the EC condition (neutral, negative) and drinker status (non-HED, HED). $^{**}p < .01$

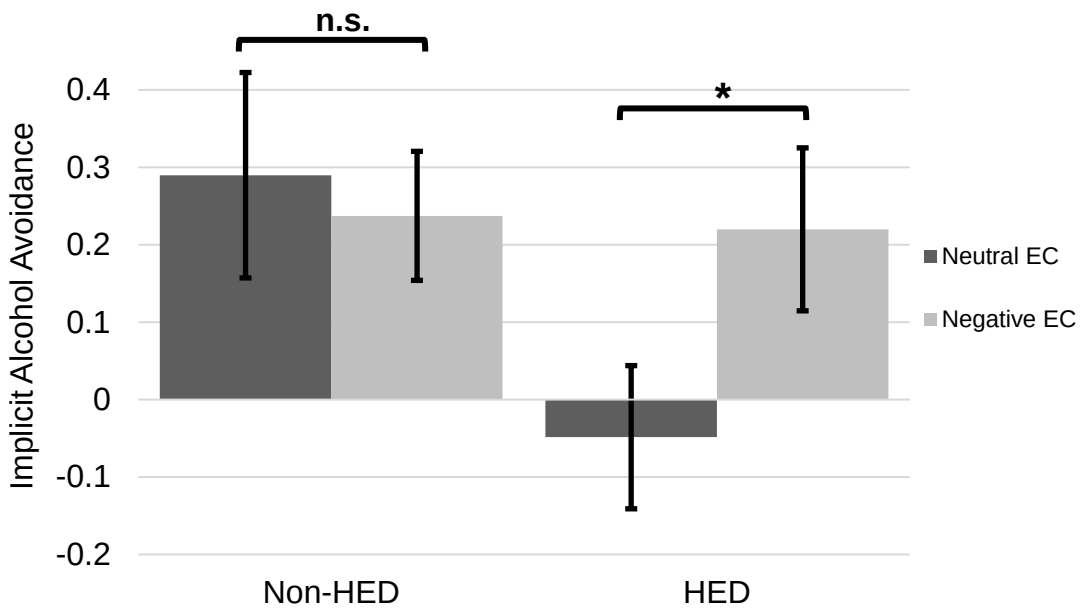

Figure 2. Implicit alcohol avoidance motivation as a function of the EC condition (neutral, negative) and drinker status (non-HED, HED). *$p < .05$

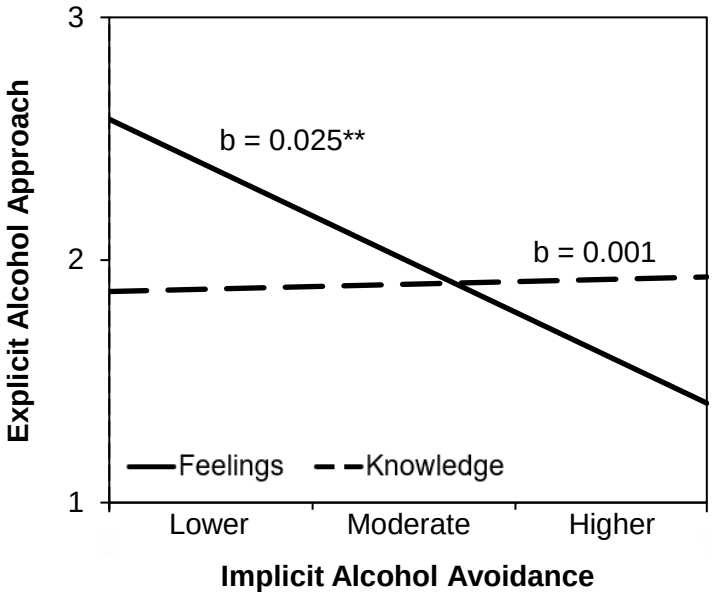

Figure 3. Interaction between introspection condition (feelings, knowledge) and implicit alcohol motivation predicting explicit alcohol motivations. Higher values on the y-axis indicate greater approach motivation toward alcohol. Higher values on the x-axis indicate greater avoidance motivation toward alcohol. Implicit alcohol motivation is graphed at -1 SD (lower), at the mean (moderate), and +1 SD (higher). **p < .01.