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The moderating role of implicit alcohol-related cognitions in hazardous alcohol use

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Abstract

The present study applied the Go/No-Go Association Test (GNAT; Nosek & Banaji, 2001) to measure alcohol-related implicit cognitions. Additionally, it assessed the role of implicit cognitions as a potential moderator in the relationship between explicit predictors of alcohol use and hazardous drinking behavior. University undergraduate students ($N = 214$) completed self-report questionnaires assessing reasons for drinking and reported alcohol use. Participants also completed two GNATs assessing implicit-alcohol-related cognitions associated with attitude (good-bad) and perceived safety (safe-dangerous). As expected, participants held implicit appraisals of alcohol as “bad” and “dangerous” in the context of nonalcoholic drinks, and as “good” and “safe” in the context of licit and illicit drugs. Implicit alcohol-related cognitions moderated the relationship between drinking to cope with negative affect and hazardous drinking and drinking due to cues or craving and hazardous drinking. These findings highlight the multidimensional nature of implicit cognitions and the role of negative implicit alcohol-related associations in moderating relationships between explicit processes and subsequent alcohol use behaviors.

Keywords

Alcohol; coping; craving; drugs; implicit cognitions

Introduction

Hazardous alcohol use is an increasingly challenging social issue. It is marked by a pattern of heavy, risky drinking behavior, which may result in adverse events (e.g. physical harm or psychological distress), or which may be symptomatic of alcohol dependence but does not yet meet full DSM-V criteria for alcohol dependence. Specifically, hazardous drinking can be defined based on recommended daily limits for females (7 + drinks per week or more than three drinks per sitting) and males (14 + drinks per week or more than four drinks per sitting). On college campuses, hazardous drinking among the undergraduate community continues to affect student well-being. Nearly 83% of students report drinking at least annually, 69% in the past month (61% of which are underage), and over 43% report binge

drinking in the past 2 weeks (Core Institute, 2010). Alcohol use – a preventable public health problem – has been associated with various negative behavior outcomes, including academic performance, assault, injury, sexual violence, suicide, and future alcohol abuse and dependence (Hingson, Zha, & Weitzman, 2009; Keeling, 2000; Rehm, Gmel, Sepost, & Trevisan, 2003). Furthermore, several long-term health problems, such as liver disease, heart disease, cancer of the mouth, throat, and liver, and neurological issues have been associated with prolonged alcohol use (Baan, Straif, Grosse, & Secretan, 2007; Corrao, Bagnardi, Zambon, & La Vecchia, 2004).

Implicit alcohol-related cognitions

Implicit cognitions can play an important role in motivating alcohol-related behaviors (e.g. Stacy, 1997; Wiers, VanWoerden, Smulders, & De Jong, 2002). They may also be particularly useful in explaining situations in which observed behavior is at odds with explicit beliefs (e.g. addictive behaviors). Given the sensitive nature of alcohol use and abuse, it is a topic that may be susceptible to reporting biases, as it can threaten a person's social capital and, therefore, be affected by impression management. Implicit assessments of alcohol-related beliefs and attitudes can thus also provide a supplementary tool to measure attitudes that lend themselves to politically correct responses to avoid social criticism.

Several psychometric tools have been developed to indirectly measure alcohol-related implicit cognitions, including (but not limited to) the Extrinsic Affective Simon Task (EAST; De Houwer, 2003), the modified Stroop task, and the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). The IAT specifically has been adapted for use in bipolar formats, unipolar formats, and most recently, the single-category IAT (SC-IAT; Karpinski & Steinman, 2006).

In spite of widespread application, current measures have yielded ambivalent findings concerning alcohol-related implicit cognitions. For instance, when assessing alcohol-related attitudes (i.e. the degree of positive or negative cognitions associated with alcohol), bipolar IAT's suggest that heavy drinkers exhibit strong negative implicit associations with alcohol when compared with soda (De Houwer, Crombez, Koster, & De Beul, 2004; Wiers et al., 2002; Wiers Van De Luitgaarden, Van Den Wildenberg, & Smulders, 2005). However, assessments using unipolar and single-category IATs have indicated the presence of both positive and negative implicit attitudes toward alcohol when compared with soft drinks (Houben & Wiers, 2006, 2008). Moreover, the EAST has evidenced strong positive attitudes toward alcohol among heavy drinkers (De Houwer & De Bruycker, 2007; De Jong, Wiers, van de Braak, & Huijding, 2007). These positive associations were stronger predictors of alcohol use, whereas the negative associations were unrelated to alcohol use (Houben & Wiers, 2006). When considering implicit arousal (i.e. the degree of activity or passivity that is felt in association with alcohol cues), heavy drinkers consistently showed greater alcohol-arousal associations using both bipolar IAT's and a modified Stroop task (Kramer & Goldman, 2003; Wiers et al., 2002, 2005). However, unipolar IAT measures suggest that the level of working memory, which could hold the explicit goals and beliefs of an individual in active states, may moderate this relationship, such that implicit arousal was associated with

drinking behavior only among participants with lower working memory capacities (Thush et al., 2008).

Implicit assessments of alcohol motivation (i.e. the tendency to either approach alcohol or avoid it) have also been considered. Researchers using bipolar IAT's have not only observed stronger alcohol-approach associations but also found that these associations were related to stronger urges to drink, positive expectancies of drinking, arousal in anticipation of alcohol consumption, and higher rates of heavy drinking episodes (Ostafin & Palfai, 2006; Palfai & Ostafin, 2003). However, given the scarcity of literature in this area, and the ambivalence related to the interpretation of bipolar IATs, definitive implicit motivations related to alcohol are difficult to discern.

Ultimately, current assessment tools have yielded largely inconclusive results, often with small or no predictive capacity. Most notably, the IAT variants, the EAST, and the modified Stroop task all assess implicit attitudes as a function of response latency – where the participant is not under any time constraints – to determine the strength of implicit association between alcoholic drinks and a specific attitude or behavior. This is particularly problematic when measuring implicit cognitions because it creates the potential to override implicit processing with conscious control if cognitive resources are not actively restricted (i.e. no time limit).

Another limitation of this body of literature is its limited range of application paradigms. Research has focused largely on implicit attitudes about alcohol in relation to valence (i.e. good or bad), arousal (i.e. arousal or sedation), and motivation (i.e. approach or avoid). Despite the clear connections between these implicit attitudes and drinking engagement, an overreliance on these paradigms limits understanding of the full range of implicit attitudes that influence behavior.

Indeed, there may be additional attitudes related to alcohol that can affect drinking engagement. For example, it may be beneficial to assess attitudes about alcohol's perceived safety (i.e. safe or dangerous). Since alcohol use has been associated with a wide variety of negative behavioral and health outcomes, associative networks related to perceived safety may be particularly important in influencing drinking behavior. Harm-reduction and fear-avoidance strategies have been highlighted as protective behavioral strategies in alcohol use by explicit measures (DeMartini et al., 2013). Thus, it may be equally important to investigate alcohol-related attitudes with regard to safety in implicit measures. Moreover, investigating additional attribute categories such as perceived safety will also help to expand the breadth of related associations influencing alcohol-related behavior.

Go/No-Go association task

Given the observed inconsistencies and the drawbacks of using response latency-based measures, an alternative implicit cognition tool may be helpful in clarifying these ambivalent findings. The Go/No-Go Association Task (GNAT; Nosek & Banaji, 2001) was developed in consideration of some of the methodological limitations of other measures. In contrast to other measures, the GNAT uses signal detection theory, rather than reaction time, to assess the sensitivity with which an individual appraises an object or attitude of interest.

Procedurally, the GNAT works by presenting target objects (signal) and distracter items (noise), which may or may not be qualitatively linked. “Signal” items include both the target category (e.g. alcohol) and the evaluative attribute (e.g. good) of interest. “Noise” items are any distracter items that do not belong to the target category and attribute (signal). Individuals are presented various randomly selected words and are instructed to initiate a “Go” response (e.g. pressing a key) for items that belong with either the target category or the attribute of interest. Conversely, individuals are instructed to initiate a “No-Go” response (e.g. doing nothing) when items that do not belong with either of the target stimuli are presented. Typically, a response deadline (e.g. 600 ms) is given, such that if a “go” response is warranted, participants must initiate the response before the expiration of that time frame. This time constraint facilitates the assessment of an implicit process since the participant is not given sufficient time to engage a more thoughtful explicit response to the stimuli. The strength of implicit association is a calculated score (d') derived from the sensitivity with which an individual can identify signal stimuli and distinguish noise items within the given time constraint. The accuracy and the speed with which individuals can complete these discriminations in one task (e.g. alcohol + good) can be further compared against performance in a separate task, whereby the target category is paired with a different or opposing attribute (e.g. alcohol + bad). The extent to which individuals demonstrate sensitivity in discriminating the signal stimuli (e.g. alcohol, good) from noise (e.g. soda, bad) is a reflection of the strength of the implicit association. Performance is thought to be better when jointly discriminating positively associated stimuli than when discriminating stimuli that is not associated (or negatively associated). Greater sensitivity in a given GNAT procedure, therefore, indicates a stronger implicit association between the two signal stimuli.

Methodologically, the GNAT is flexible in manipulating target comparison contexts and is capable of investigating how these varying manipulations can influence the valence of the related implicit attitude. This allows the GNAT to assess implicit attitudes without requiring a directly opposing comparison category, a quality not afforded by the bipolar IAT. Additionally, unlike many other measures, the GNAT allows for the consideration of context, which may potentially influence how the implicit appraisal is expressed. Ultimately, the GNAT has several important advantages as an assessment of alcohol-related implicit cognitions: (1) it serves as a computationally different assessment tool for understanding implicit associations in a way that utilizes response–time constraints that maximize the assessment of implicit cognitions; (2) it can assess implicit attitudes without requiring an opposing category; and (3) it can assess implicit attitudes within varying contexts that may impact the valence of the cognition. Therefore, the GNAT presents a valuable alternative for assessing implicit alcohol-related cognitions.

Interpersonal determinants of alcohol use

In spite of the promise that implicit attitudes hold for addiction research, explicit factors can also influence behavioral decision-making. According to motivational models of behavior, individual and environmental motives for drinking are a proximal pathway to alcohol use and may in turn serve different functions (Carey & Correia, 1997; Cooper, Frone, Russell, & Mudar, 1995). One’s reported reasons for drinking may thus be associated with a unique pattern of drinking behavior, which can predispose an individual for heavy drinking and

drinking-related problems. Specifically, social pressure, negative affect, and cued craving have shown to influence hazardous drinking behavior among undergraduates (Zywiack, Connors, Maisto, & Westerberg, 1996). Social pressure is marked by interpersonal contexts where drinking behaviors are encouraged, such as being offered a drink or drinking to have a good time with others. Among college students, drinking for social purposes has consistently been linked to heavy drinking (Borsari & Carey, 2001; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007). Moreover, social norm models of drinking suggest that undergraduate students tend to misperceive the intensity and frequency with which other students drink, which can further contribute to social pressures to drink excessively (Berkowitz, 2004).

Negative affect is associated with the prevalence of negative emotions such as anger, sadness, and frustration. The use of alcohol for tension reduction or internal coping as functions of negative affect can also predict heavy drinking and alcohol-related problems among undergraduates (Carey & Correia, 1997; Cooper et al., 1995). Although drinking to cope may be less prevalent among college students, as compared with drinking for social reasons, it is more likely to be related to future alcohol-related problems (Kuntsche, Knibbe, Gmel, & Engels, 2005; Neighbors et al., 2007). Therefore, a strong endorsement of drinking as a function of reducing negative affect presents an important risk factor among undergraduate hazardous drinkers.

Finally, cued craving refers to urges to drink, the reduction of withdrawal symptoms, and any environmental cues that may initiate a craving response (Zywiak et al., 1996). Among hazardous drinkers, cravings to drink can play a central role in the transition between controlled drinking and alcohol addiction (Robinson & Berrige, 1993). Cravings to drink are enhanced among alcohol-dependent populations, so high endorsements of drinking as a function of craving among undergraduates can be particularly indicative of dangerous alcohol use (Drummond, 2000). Given the potential influence of environmental contexts on behavior, motives for drinking play a key role in prompting an individual to engage in drinking behavior. It is likely that one's implicit appraisals of alcohol can further reinforce these motives to drink. Therefore, one's likelihood to drink may be increased by the interaction of implicit attitudes and explicit contexts.

Although theoretical debate on the underlying separation of implicit and explicit systems is on-going, initial evidence suggests these are not binary systems and rather function concomitantly to influence behavior (Gawronski, LeBel, & Peters, 2007). Indeed, previous work has demonstrated a small amount of relatedness between implicit and explicit measures, suggesting that they may operate through similar networks (Reich, Below & Goldman, 2010). However, both implicit and explicit cognitions lend unique variance to alcohol use outcomes, suggesting some independent functionality as well. Explicit measures tend to demonstrate a clear advantage in predicting behavioral outcomes, although implicit measures have shown a small but significant predictive capacity as well (Reich et al., 2010). Given these premises, it follows that although explicit measures may have a more direct influence on behavioral decisions, implicit measures may influence that appraisal to some extent. As such, implicit measures may operate as a moderating factor in the relationship between explicit measures and reported alcohol use. Several studies have used implicit

primes to influence responding in explicit measures of alcohol expectancies, which further highlights how implicit attitudes may indeed influence the expression of explicit beliefs (e.g. Reich, Noll, & Goldman, 2005). Despite this potentially interactive relationship between implicit and explicit cognitions in predicting behavior, little research has been conducted to uncover the nuanced directionality of these interactions. The present study sought to clarify this relationship by implementing the use of the GNAT in alcohol research. Given the methodological advantages afforded by the GNAT, along with the ambivalent findings yielded by other implicit measures, use of the GNAT in this context is well warranted.

This study also demonstrates the applicability of the GNAT in uncovering unique relationships between alcohol-related implicit cognition and hazardous drinking behaviors, particularly in context-specific activations. The discrepant findings evidenced using other measures challenge the idea that implicit attitudes reflect highly stable and deep-rooted representations of the self. Gawronski et al. (2007) highlight the state-like nature of implicit measures, suggesting that implicit attitudes may function in accordance with contextual activation. The observed temporal instability of implicit measures further supports the notion that implicit attitudes may vary across time and space (Cunningham, Preacher, & Banaji, 2001). Therefore, it is likely that implicit attitudes may not necessarily be overwhelmingly definitive, but rather may be influenced by context. As such, this study further sought to investigate the extent to which context can affect the expression of implicit appraisals by comparing dominant implicit attitudes about alcohol in differing evaluative contexts. Given that alcohol is both a beverage and a drug, its semantic networks may be activated in both contexts. However, the implicit attitude associated with each contextual activation may be different depending on one's memory traces. Lastly, this study provides additional novelty in that it investigates alcohol-related implicit cognitions using a new paradigm, measuring the extent to which alcohol is viewed as "safe" or "dangerous".

Based on the extant literature, the purpose of this study is three-fold: (1) this study seeks to investigate implicit attitudes associated with alcohol. It is hypothesized that alcohol will be perceived as bad when presented in the context of nonalcoholic drinks. It is hypothesized that alcohol will be perceived as good when presented in the context of licit and illicit drugs. (2) This study seeks to investigate implicit cognitions associated with alcohol and perceived safety. It is hypothesized that alcohol will be perceived as dangerous when presented in the context of nonalcoholic drinks. It is also hypothesized that alcohol will be perceived as safe when presented in the context of licit and illicit drugs. (3) Finally, this study aims to investigate if alcohol-related implicit cognitions moderate the relationship between reasons for drinking (specifically as functions of negative affect, social pressure, and cued craving) and hazardous drinking behavior. Due to the scarcity of literature regarding such interactions, specific decisions about the direction of this moderation effect cannot be made.

Methods

Participants

Participants ($n = 214$) consisted of English-Speaking undergraduate students (female: $n = 135$; males: $n = 79$) enrolled at a large Southeastern university. The participants ranged in age from 18 to 25 years, with an average age of 19.26 ($SD = 1.5$). The self-reported race

included White ($n = 193$, 89.8%), Black ($n = 10$, 4.7%), Asian ($n = 4$, 1.9%), Biracial ($n = 5$, 2.3%), and other ($n = 0.9\%$). The predominant marital status of the sample was single ($n = 210$, 97.7%).

Implicit measures

Condition 1 GNAT (GNAT-AN)—The GNAT (nosek & Banaji, 2001) was modified to test implicit attitudes regarding alcohol by associating alcoholic drinks in the context of nonalcoholic drinks with two attribute categories: attitude and perceived safety. In the attitude paradigm, alcoholic drinks were associated with being perceived as either “good” or “bad”. In the perceived safety paradigm, alcoholic drinks were associated with being either “safe” or “dangerous.” As delineated by Nosek and Banaji (2001), each of the tasks consisted of multiple combination blocks, allowing the target category (alcoholic drinks) to be combined with each attribute in both of the attribute categories. Therefore, in the related attitude paradigm, “ALCOHOLIC DRINKS” (i.e. BUDWEISER, VODKA, CHAMPAGNE, GIN, etc.) was paired with “good” in one block, and with “bad” in another block. In the perceived safety paradigm, “ALCOHOLIC DRINKS” was paired with “safe” in one block, and with “dangerous” in another block. For both tasks, implicit attitudes associated with alcohol were measured using nonalcoholic drinks (i.e. CAPPUCCINO, GATORADE, MILK, PEPSI, TEA, etc.) as the distracter (noise) for the target category (alcoholic drinks). Additionally, opposing attributes served as the distracters for the target attribute in each paradigm. In the attitudes paradigm, “good” attribute words served as the distracter for “bad” attribute words, and vice versa. In the perceived safety paradigm, “safe” attribute words served as the distracter for “bad” attribute words, and vice versa.

Stimuli (i.e. presented words) for all signal (target category and attribute) consisted of written English words. Each task used 96 stimulus words: 24 types of alcoholic drinks, 24 types of nonalcoholic drinks, 24 positive attributes (i.e. good or safe), and 24 negative attributes (i.e. bad or dangerous). The words used to represent alcoholic drinks, nonalcoholic drinks, “safe” attributes, and “dangerous” attributes were developed by the Hwemudua Addictions and Health Disparities Laboratory (HAHDL) for the purpose of this study, in consideration of length and familiarity. The 24 words used to represent the “good” and “bad” attributes were selected from previous research (Bellezza, Greenwald, & Banaji, 1986; Nosek & Banaji, 2001). Labels for the signal category and attribute for each block were continuously presented on the upper left and right quadrants of the computer screen to remind participants of the targets of interest for each task. Randomly selected stimuli were presented in the middle of the computer screen. Participants were instructed to (1) press the “green button” (“Go” response) on a Cedrus RB-834 response pad as quickly as possible for stimuli belonging to either the identified signal or attribute for the block, (2) refrain from pressing the “green button” (“No-go” response) for stimuli that do not belong to either the identified signal or attribute for the block. Trials where signal items were correctly responded as signal (i.e. correct “Go” response) or where noise items were correctly ignored (i.e. correct “Nogo” response) were reinforced by presenting a green “O” below the stimulus word for 100 ms. Conversely, error responses (e.g. incorrectly categorizing a

noise item as signal, failing to categorize signal items) were reinforced by presenting a red “X” below the stimulus word for 100 ms. See Figure 1 for example.

Each task consisted of four practice blocks and two experimental blocks. The practice blocks allow participants to acquaint themselves with the task by detecting signal (target = “ALCOHOLIC DRINKS”) from noise (distracter = “NONALCHOLIC DRINKS”) for each target and attribute (e.g. alcoholic drinks, good, bad, safe, dangerous) independently. Each practice block consisted of 20 trials with a 1000 ms response deadline. Afterward, each participant completed two experimental blocks, each of which consisted of 76 trials, where the first 16 trials were considered practice trials. During each experimental block, the target was combined with an attribute (i.e. “ALCOHOLIC DRINK” and “good”; “ALCOHOLIC DRINK” and “bad”; “ALCOHOLIC DRINK” and “safe”; “ALCOHOLIC DRINK” and “dangerous”) with a 600 ms response deadline. This response deadline is slow enough to allow for accurate responses to be made, but fast enough that ceiling effects are effectively minimized (nosek & Banaji, 2001). Each task was administered using Inquisit 3.0.

Calculation of d' proceeded according the conventional algorithm designed for the GNAT by Nosek and Banaji (2001). The proportion of “Hits” or correct responses (i.e. Press “Go” for signal items) was first calculated for each paired task (e.g. alcohol + good, alcohol + bad). The proportion of “False alarms” or incorrect responses (i.e. Press “Go” for noise items) was also calculated for each paired task. Next, both the calculated proportions were converted to a z-score. Then, a difference between the z-score values for the correct and incorrect responses was calculated to yield a d' for each paired task. Therefore, $z(\text{Hit}) - z(\text{False Alarm}) = d'$. Any d' values of 0 or below indicate excessive error performance, or the participant’s inability to detect signal from noise, and were thus removed from the analysis. Ultimately, each GNAT resulted in two d' scores, such that Alcohol + Good yields one d' and Alcohol + Bad yields a separate d' . Since d' captures the sensitivity with which individuals were able to discriminate signal stimuli from noise, the difference between the two d' values is a reflection of the pervasive implicit attitude.

Condition 2 GNAT (GNAT-AD)—The GNAT-AD is identical to the GNAT-AN with the exception of one major difference: implicit cognitions associated with alcohol were measured in the context of licit and illicit drugs (i.e. drugs as the distracter), rather than nonalcoholic drinks. The 24 words used to represent licit and illicit drugs (e.g. TOBACCO, MARIJUANA, COCAINE, PCP, etc.) were developed by the Hwemudua Addictions and Health Disparities Laboratory (HAHDL) for the purpose of this study, in consideration of word length and familiarity.

Explicit measures

Problem drinking—The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993) is a ten-item Likert-type instrument used to measure an individual’s engagement in hazardous drinking behavior. Items in this instrument assess frequency of alcohol use (e.g. “How often do you have a drink containing alcohol?”), problems caused by alcohol use (e.g. “How often during the last year have you

been unable to remember what happened the night before because of your drinking?’’), and symptoms of alcohol dependence (e.g. ‘‘How often during the last year have you found that you were not able to stop drinking once you had started?’’). Higher scores on the AUDIT are associated with problem drinking. A score above 8 indicates hazardous drinking (Kokotailo et al., 2004). The average score among this sample was 8.26 ($SD = 6.15$). The AUDIT has been widely validated in several different countries, and its psychometric properties have been tested in a college sample. Specifically, it has demonstrated high sensitivity (0.91) and moderate specificity (0.60) in the detection of high-risk college drinkers (Kokotailo et al., 2004). The AUDIT produced scores with adequate reliability in this study ($Cronbach's\ a = 0.83$)

Reasons for drinking—The Reasons for Drinking Questionnaire (RFD; Zywiack et al., 1996) is a 16-item survey instrument designed to measure positive and negative motives for drinking behavior. Clients rate the importance of different reasons for their engagement in drinking on an 11-point scale, which ranges from zero (‘‘not at all important’’) to ten (‘‘very important’’). Sample statements include, ‘‘I felt sad’’ or ‘‘I saw others drinking.’’ The RFD yields three subscales – negative emotions, direct or indirect social pressure, and craving and cues. Scores are calculated for each subscale with higher scores representing stronger endorsement of the corresponding reason. Test–retest reliability for the RFD is modest (0.63) and its three-factor scale has been confirmed (Zywiak, Westerberg, Connors, & Maisto, 2003; Zywiak et al., 2006). The negative affect scale (RFD-NA; $Cronbach's\ a = 0.91$), social pressure scale (RFD-SP; $Cronbach's\ a = 0.80$), and cued craving scale (RFD-CC; $Cronbach's\ a = 0.70$) of the RFD all produced scores with adequate reliability in this study.

Demographic questionnaire—A demographic questionnaire was administered to assess sample characteristics. The questionnaire asked participants to self-report their race, age, sex, marital status, occupational status, and history with psychotherapy.

Procedures

Participants in this study were randomly assigned to either a ‘‘nonalcoholic drinks context’’ treatment group (Condition 1), or a ‘‘licit and illicit drugs context’’ treatment group (Condition 2). The separate treatment groups account for variability in appraisal of implicit attitudes due to relative context, while still controlling for issues of fatigue, practice, and familiarity. Participants in Condition 1 ($n = 113$; 52.6%) were read a script by a research assistant, informing them that the present study involved the investigation of reaction times. After informed consent was established, each participant completed the GNAT-AN. Next, the participants completed all the self-report measures in a randomized order. Finally, the participants were debriefed only on the general nature of the study, to preserve the integrity of the experiment for future participants. Participants in Condition 2 ($n = 101$; 47.0%) underwent the same procedures as participants in Condition 1, with the exception of completing the GNAT-AD instead of the GNAT-AN.

Analytic strategy

To assess the applicability of the GNAT in the measurement of implicit appraisals of alcohol and its perceived attitude, d' scores were computed as previously described for each pairing task (i.e. d' Good and d' Bad) in both condition groups (GNAT-AD and GNAT-AN). Paired samples t-tests were then conducted to assess if significant differences existed between the two attitude valences (i.e. Good, Bad) as a function of implicit appraisal. The difference between the two valences is indicative of the dominant attitude (i.e. d' Good– d' Bad). The same process was used to assess the applicability of the GNAT in the measurement of implicit appraisals of alcohol and its perceived safety (i.e. d' Safe and d' Dangerous). The sample size of this study is sufficient to detect a moderate effect size with an alpha level of 0.05 and a power of 0.90 (Cohen, 1992).

To examine moderator effects of implicit cognitions, a hierarchical multiple regression (HMR) was used. The sample size of this study is sufficient to detect a moderate effect size with an alpha level of 0.05 and a power of 0.80 (Cohen, 1992). Prior to conducting the main analyses, data were first screened for any missing or error values and assumptions of normality were checked. Additionally, all predictor and moderator scores were centered to reduce multicollinearity between main and interaction effects (Cohen & Cohen, 1983).

A total of four HRMS were conducted: two HMRs were conducted for Condition 1 (HMR1-2) and two HMRs were conducted for Condition 2 (HMR3-4). Variables were entered in a step-wise format (Frazier, Tix & Barron, 2004). Step 1 entered potential confounding variables of age and gender. Step 2 entered explicit predictors of drinking, including the negative affect, cued craving, and social pressure subscales of the RFD. Step 3 entered the respective implicit alcohol-related cognition measure, as deemed by each GNAT score. For HMR1, this was the GNAT-AN (attitude) measure, which was derived by the difference of the two d' scores (i.e. d' Good– d' Bad). For HMR2, step 3 included the GNAT-AN (Safety) measure, which was derived the same way (i.e. d' Safe– d' Dangerous). The same processes were used for HMR 3 and 4, respectively, with the exception that implicit measures were derived from condition two participants instead (i.e. GNAT-AD (attitude) and GNAT-AD (safety), respectively). Finally, at step 4, an interaction effect reflecting the product of both RFD subscales and respective GNAT score was entered.

Based on the significant interactions observed in the omnibus analyses, each significant interaction effect was followed up in an independent hierarchical multiple regression to ensure accuracy. Variables were re-centered as previously described according to the individual variables being considered. Age and sex were not included as control variables in these regressions as they were previously insignificant. Additionally, interactions that were no longer significant under these conditions were not further pursued. The regression slopes of the significant interactions were plotted in the graph at one standard deviation above the mean, at the mean, and one standard deviation below the mean.

Results

When assessing the applicability of the GNAT in the measurement of implicit appraisals of alcohol and its perceived attitude among Condition 1 (i.e. non-alcoholic drinks were used as noise), participants showed greater sensitivity when ALCOHOLIC DRINKS and BAD ($d' = 2.06$) were signal, than when ALCOHOLIC DRINKS and GOOD were signal ($d' = 1.38$; $t(85) = -7.77, p < 0.001$, *Cohen's d* = 0.8). This large effect size suggests that individuals associated alcohol with bad when appraised in the context of nonalcoholic drinks (Figure 2). Furthermore, among Condition 2 (i.e. licit and illicit drugs were used as noise), participants showed greater sensitivity when ALCOHOLIC DRINKS and GOOD ($d' = 2.13$) were signal than when ALCOHOLIC DRINKS and BAD were signal ($d' = 1.81$; $t(85) = 4.01, p < 0.001$, *Cohen's d* = 0.4). This medium effect size suggests that individuals associated alcohol with good when appraised in the context of licit and illicit drugs (Figure 1).

When assessing the applicability of the GNAT in the measurement of alcohol and its perceived safety, participants in Condition 1 showed greater sensitivity when ALCOHOLIC DRINKS and DANGEROUS ($d' = 1.98$) were signal than when ALCOHOLIC DRINKS and SAFE were signal ($d' = 1.00$; $t(85) = -12.73, p < 0.001$, *Cohen's d* = 1.4). This large effect size suggests that individuals associated alcohol with dangerous when appraised in the context of nonalcoholic drinks (Figure 2). Participants in Condition 2 showed greater sensitivity when ALCOHOLIC DRINKS and SAFE ($d' = 1.76$) were signal than when ALCOHOLIC DRINKS and DANGEROUS were signal ($d' = 1.40$; $t(87) = 4.63, p < 0.001$, *Cohen's d* = 0.5). This medium effect size suggests that individuals associated alcohol with safe when appraised in the context of licit and illicit drugs (Figure 2).

Hierarchical multiple regressions

In HMR1, reported reasons for drinking (RFD) were found to be significantly associated with hazardous drinking behavior ($F(3, 88) = 16.628, p < 0.001, R^2 = 0.350$). More specifically, the social pressure subscale of the RFD predicted hazardous drinking scores ($\beta = 0.442, t(88) = 4.26, p < 0.001$) after controlling for age and gender. Additionally, there was a significant interaction effect between RFD and implicit attitudes associated with alcohol in the context of nonalcoholic drinks (GNAT-AN attitude; $F(3, 84) = 4.405, p = 0.006, R^2 = 0.084$). More specifically, hazardous drinking behavior (AUDIT) was significantly predicted by the interaction of GNAT-AN (attitude) and the negative affect ($\beta = -0.368, t(84) = -3.21, p = 0.002$) and cued craving ($\beta = 0.279, t(84) = 2.48, p = 0.015$) scales of the RFD. This significant interaction is presented in Table 1.

In HMR2, reported reasons for drinking were found to be significantly associated with hazardous drinking behavior ($F(3, 90) = 17.304, p < 0.001, R^2 = 0.353$). More specifically, the social pressure subscale of the RFD predicted hazardous drinking scores ($\beta = 0.429, t(90) = 4.08, p < 0.001$) after controlling for age and gender. No significant interaction effects were observed.

For HMR 3, which tested moderating effects of implicit alcohol-related cognitions in the relationship between RFD and alcohol use among Condition 2, RFD were found to be significantly associated with hazardous drinking behavior ($F(3, 83) = 14.151, p < 0.001, R^2$

= 0.331). More specifically, the social pressure ($\beta = 0.344$, $t(83) = 2.85$, $p = 0.005$) and cued craving ($\beta = 0.282$, $t(83) = 2.05$, $p = 0.043$) subscales of the RFD predicted hazardous drinking scores after controlling for age and gender. No significant interaction effects were observed.

For HMR 4, RFD were significantly associated with hazardous drinking behavior ($F(3, 84) = 13.783$, $p < 0.001$, $R^2 = 0.322$). More specifically, the social pressure ($\beta = 0.326$, $t(84) = 2.71$, $p = 0.008$) and cued craving ($\beta = 0.299$, $t(84) = 2.17$, $p = 0.033$) subscales of the RFD predicted hazardous drinking scores after controlling for age and gender. Additionally, an interaction trend was found between reported RFD and implicit perceived safety of alcohol in the context of drugs (GNAT-AD safety; $F(3, 80) = 2.485$, $p = 0.067$, $R^2 = 0.410$). More specifically, the cued craving subscale of the RFD interacted significantly with the safety paradigm of the GNAT-AD ($\beta = -0.286$, $t(80) = -2.25$, $p = 0.027$). This interaction is presented in Table 1.

Follow-up HMRs for significant interactions indicated that there was a significant interaction between reported reasons for drinking as a function of relief of negative affect (RFD-NA) and implicit alcohol-related attitudes appraised in the context of non-alcoholic drinks (GNAT-AN attitude; $\beta = -0.220$, $p = 0.022$, $R^2 = 0.048$). This significant interaction is presented in Figure 3. The slope of the line one standard deviation below the mean ($\beta = 0.591$, $t(90) = 4.462$, $p < 0.001$) and at the mean ($\beta = 0.373$, $t(92) = 3.851$, $p < 0.001$) was statistically different from zero. Therefore, scores on the RFD-NA more strongly predicted scores on the AUDIT for participants with moderate to high implicit appraisals of alcohol as bad in the context of non-alcoholic drinks. Furthermore, the relationship was insignificant among participants with implicit appraisals of alcohol as good in the context of non-alcoholic drinks.

There was also a significant interaction between reported reasons for drinking as a function of cued craving (RFD-CC) and the implicit perceived safety of alcohol in the context of licit and illicit drugs (GNAT-AD safety; $\beta = -0.208$, $p = 0.026$, $R^2 = 0.040$). This significant interaction is presented in Figure 3. The slope of the line was significantly different from zero at one standard deviation below the mean ($\beta = -0.342$, $t(86) = 2.927$, $p = 0.004$), at the mean ($\beta = 0.483$, $t(92) = 5.285$, $p = 0.000$), and at one standard deviation above the mean ($\beta = -0.792$, $t(86) = 5.198$, $p < 0.001$). Analysis of the plot shows that scores on the RFD-CC more strongly predicted scores on the AUDIT for participants with moderate to high implicit appraisals of alcohol as dangerous in the context of licit and illicit drugs. More specifically, participants who endorsed drinking as a function of cued craving tended to show more hazardous drinking behavior if they held implicit views of alcohol as dangerous. Furthermore, participants whose implicit views of alcohol were safe in this context exhibited a weaker positive relationship between drinking as a function of cued craving and hazardous drinking behavior.

Discussion

Contextual effects in alcohol-related implicit cognition

The present study examined the assessment of alcohol-related implicit cognition using the Go/No-Go Association task. The GNAT is a novel approach to assessing implicit cognitions related to alcohol and provides a valid supplemental test with which to measure implicit attitudes. The study also provided novelty in the application of a new paradigm in this field of research by assessing implicit measures of the perceived safety of alcohol. Given the vast negative behavior and health outcomes associated with alcohol, studying the implicit perceived safety of alcohol among college students highlights a key attribute in the implicit appraisals of alcohol.

In applying the GNAT, this study demonstrated that implicit appraisals of alcohol differed according to the context. Specifically, our first two hypotheses were confirmed in that participants showed an implicit attitude of alcohol as bad in the context of nonalcoholic drinks (Hypothesis 1) and as good in the context of licit and illicit drugs (Hypothesis 2). Additionally, our third and fourth hypotheses were also confirmed in that participants showed an implicit perception of alcohol as dangerous in the context of nonalcoholic drinks (Hypothesis 3) and as safe in the context of licit and illicit drugs (Hypothesis 4). These findings are in line with some of the previous findings in the literature using bipolar IATs, which report negative attitudes toward alcohol when compared to nonalcoholic drinks (De Houwer et al., 2004; Houben & Wiers, 2007; Wiers et al., 2002). However, the observed shift in attitude toward alcohol when the context changes calls into question the static nature of alcohol-related cognitions. Indeed, this study suggests that implicit alcohol-related cognitions may not operate independent of context, but instead are multidimensional constructs, whose expressions are influenced by the context in which the appraisal is made. These findings have been replicated in our laboratory.

Explicit predictors of hazardous drinking

In addition to assessing implicit appraisals of alcohol, the study also provided evidence for several explicit predictors of hazardous drinking. First, the endorsement of drinking as a function of social pressure was significantly related to hazardous drinking behavior. Consistent with previous research, participants who reported drinking due to concerns about social pressure were more likely to drink hazardously (Borsari & Carey, 2001; Neighbors et al., 2007). The endorsement of drinking for social reasons is corroborated by motivational models of drinking, which cite that drinking for social enhancement or conformity are particularly predictive of hazardous drinking (Kuntsche et al., 2005).

Drinking as a function of cued craving was also shown to be a significant predictor of hazardous drinking behavior. High endorsements of drinking due to urges to drink or withdrawal symptoms were related to higher drinking behavior. Previous research corroborates this finding, such that cravings for alcohol are positively related to drinking behavior and can act a precursor to future alcohol abuse (Drummond, 2000). Given the observed relationship between cue reactivity and alcohol-dependence, endorsements of

drinking to satiate cravings may act as an important and reliable indicator for identifying at-risk drinkers.

Implicit and explicit interactions in behavioral decision-making

Another goal of this study was to test whether implicit cognitions related to alcohol moderate the relationship between reported reasons for drinking and alcohol use. Two key interaction effects between implicit and explicit processes were observed in this respect. First, implicit attitudes toward alcohol in the context of nonalcoholic drinks moderated the relationship between reported reasons for drinking and drinking behavior. Individuals who strongly endorsed drinking in order to relieve negative affect tended to exhibit higher drinking behavior, particularly if they held strong implicit appraisals of alcohol as bad. In contrast, implicit appraisals of alcohol as good did not significantly influence participants' drinking behavior as a function of relief of negative affect. These results indicate that implicit appraisals of alcohol as bad are related to one's likelihood to drink if the explicit endorsement of alcohol to relieve negative feelings is already present. Although this finding may seem counterintuitive, it may be interpreted that individuals who drink more to relieve negative affect have had more negative experiences with alcohol, and, therefore, report negative implicit appraisals. As past experiences with alcohol can influence the memory constructs that make up implicit cognitions, these implicit appraisals of alcohol as bad may therefore be indicative of previous heavy drinking behavior, and thereby make it more likely that the participant will report more hazardous drinking behavior.

It was also observed that implicit appraisals of alcohol as dangerous in the context of licit and illicit drugs moderated the relationship between reported reasons for drinking as a function of cued craving and drinking behavior. Specifically, individuals who experienced strong desires to drink as a result of a physical urge or withdrawal symptom tended to experience higher drinking habits, particularly if they held implicit perceptions of alcohol as dangerous in the context of licit and illicit drugs. Individuals who strongly endorsed drinking as a result of cues or craving but who also held implicit perceptions of alcohol as safe in this context did not exhibit such high hazardous drinking behavior. Therefore, this evidence suggests that individuals who experience cravings to drink may be more likely to fulfill those cravings if they hold implicit views of alcohol as dangerous when compared with other drugs. Again, these findings may be related to one's past experiences. It may be interpreted that, within this context, participants have had many negative experiences with alcohol in the past but have also had very limited experiences with other drugs. In this way, participants who hold these implicit attitudes may have more experience with hazardous drinking and little to no experience with other licit and illicit drugs, resulting in an appraisal of alcohol as dangerous in the context of drugs. Therefore, it may be the case that this particular group of participants exhibit higher hazardous drinking as a function of craving and cues because they implicitly view alcohol as dangerous as a result of both previous negative experiences with alcohol and a lack of overall experience with other drugs. Since alcohol use and abuse often acts as a gateway to other drug use later on, it may be one of the first substances with which these young adults are experimenting and, therefore, have not yet obtained experience with other drugs (see Kandel, 2002 for review). Future research may

attempt to replicate and confirm these notions, however, by assessing explicit measures of alcohol expectancies in addition to implicit appraisal.

Collectively, these two findings highlight the role of negative implicit appraisals as a moderating factor in strengthening the relationship between explicit reasons for drinking and hazardous alcohol use. The findings suggest that negative implicit appraisals of alcohol, regardless of the context in which the appraisal is made, may act as an additional risk factor for heavy alcohol use and abuse. This finding is in line with previous research yielded by the bipolar IAT, which suggests that negative implicit appraisals can predict heavy drinking behavior (Wiers et al., 2002). Moreover, these results provide some preliminary evidence for the idea that implicit and explicit processes may not necessarily function separately from each other, but rather are co-occurring and can influence each other when making cognitive decisions about a behavior. While the reflective system may inhibit automatic impulses to a degree, the cognitions generated by the impulsive system may lend influence to these decisions. Therefore, although hazardous drinking behavior has been shown to be largely predicted by explicit motives, the degree to which these explicit factors can predict drinking may vary according to individual differences in implicit appraisal.

Despite some of the contributions this study offers, it is not without some limitations. While the use of the GNAT paradigms to assess implicit attitudes regarding alcoholic drinks helps to reduce concerns of social desirability biases, this does not account for any impression management that might have affected responses on the explicit measures of self-reported alcohol use, and reasons for drinking. Additionally, it may be argued that using different samples for each GNAT condition can negatively impact the validity of findings. For example, how can you investigate the nature of contextual influences on implicit cognitions if the same participant did not undergo each condition? However, using different samples of participants helps eliminate additional issues of fatigue or practice that may arise with multiple trials of the test. As a precaution, participants were randomly assigned to both conditions in order to minimize the possibility of sampling differences. Furthermore, we utilized a bipolar view of implicit cognitions in order to investigate its moderating effects on the relationship between reasons for drinking and hazardous drinking behaviors. While this conceptualization is consistent with the extant literature utilizing the GNAT and other related implicit paradigms, an alternative approach could be to investigate bivalent effects of these implicit cognitions where attribute (i.e. attitudes, perceived safety, etc.) evaluative processes are appraised separately (Cacioppo & Bernston, 1994). Finally, since the sample was limited to undergraduate students at a Southwestern university, generalizing the findings from this study beyond these sample characteristics should be done with caution.

Overall, the results from this study contribute to an emerging body of literature addressing both the assessment of implicit cognitions and the impact of implicit cognitions related to alcohol and related drinking behavior. Although there were several novel findings reported, it should be noted that these findings are largely exploratory. Therefore, replication of findings will be necessary. Additionally, more work is needed in this area of research to clarify and expand upon these findings. For example, although there is some evidence for the moderating role of implicit cognitions related to alcohol, the assessment of implicit cognitions may be expanded to include different paradigms and/or superordinate contexts. It

may be the case that alternative paradigms, such as arousal or familiarity, may have a differential effect on the relationship between explicit factors and subsequent drinking behavior. Also, future research may attempt to further discern the nuanced relationships between implicit and explicit processes related to drinking by investigating the moderating role of implicit cognitions in relation to other explicit predictors of drinking behavior. For instance, measures related to mental health may be useful to assess, taking into consideration the additional risk posed by negative implicit appraisals of alcohol. Lastly, it may be possible that these observed moderation effects are not really the result of interactions between implicit and explicit processes, but are rather explained by some alternative third variable related to executive function. Previous studies have argued that variables related to executive function, such as working memory capacity or response inhibition, can have a significant effect in determining the predictive ability of implicit cognitions in drinking behavior (Houben & Wiers, 2009; Thush et al., 2008). Therefore, future studies could attempt to identify and clarify the possible mediating role of such variables.

In conclusion, this study offers preliminary evidence that individual differences and implicit appraisals may function collectively as endophenotypes for alcohol use. It also demonstrates a novel assessment of implication cognitions associated with the perceived safety of alcoholic drinks. Future studies might examine the predictive utility of using these models to identify which individuals are at risk for alcohol use and abuse and accordingly determine the extent of that risk. To advance this area of research, it may be imperative to utilize factor analytic methods that integrate data from a diverse range of methodological approaches. Having well-characterized endophenotypes could facilitate neuroimaging studies seeking to identify these biological processes in the brain. Additionally, future research might examine the clinical implications of these findings by exploring the extent to which mental health providers, particularly in addiction settings, could better serve clients by considering how context can shape attitudes about alcohol and how these attitudes may affect drinking behavior.

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Figure 1.
Alcohol-related Go-No Go Association Task (GNAT) screen examples.

Figure 2.

Implicit attitudes associated with alcoholic beverages. AN-G, “Good” paradigm of Condition 1 GNAT; AN-B, “Bad” paradigm of Condition 1 GNAT; AN-S, “Safe” paradigm of Condition 1 GNAT; AN-D, “Dangerous” paradigm of Condition 1 GNAT; AD-G, “Good” paradigm of Condition 2 GNAT; AD-B, “Bad” paradigm of Condition 2 GNAT; AD-S, “Safe” paradigm of Condition 2 GNAT; AD-D, “Dangerous” paradigm of Condition 2 GNAT.

Figure 3.

Measurement of implicit attitudes about alcohol interacting with reported reasons for drinking to predict alcohol use. AUDIT, Alcohol Use and Disorders Identification Test; RFD-NA, Negative Affect subscale of Reasons for Drinking Questionnaire; RFD-CC, Cued Craving subscale of Reasons for Drinking Questionnaire; GNAT-AN (attitude), attitude paradigm of Go/No-Go Association Task for Condition 1.

Table 1

Significant hierarchical multiple regression analyses predicting hazardous drinking behavior.

Dependent variable=AUDIT	R^2	R^2	β	t	df	p
HMR 1						
Step 1: control variables	0.033	0.033				0.212
Age			0.066	0.638	91	0.525
Sex			0.161	1.551	91	0.124
Step 2: RFD	0.383	0.350				0.000
RFD-NA			0.021	0.175	88	0.861
RFD-SP			0.442	4.257	88	0.000
RFD-CC			0.208	1.648	88	0.103
Step 3: GNAT-AN (attitude)	0.384	0.001	0.025	0.279	87	0.781
Step 4: RFDxGNAT-AN (attitude)	0.467	0.084				0.006
RFD-NAxGNAT-AN (attitude)			-0.368	-3.205	84	0.002
RFD-SPxGNAT-AN (attitude)			0.002	0.014	84	0.989
RFD-CCxGNAT-AN (attitude)			0.278	2.483	84	0.015
HMR 4						
Step 1: Control variables	0.025	0.025				0.334
Age			0.148	1.390	87	0.168
Sex			0.045	0.421	87	0.675
Step 2: RFD	0.347	0.322				0.000
RFD-NA			0.002	0.019	84	0.985
RFD-SP			0.326	2.713	84	0.008
RFD-CC			0.299	2.171	84	0.033
Step 3: GNAT-AD (safety)	0.355	0.009	-0.096	-1.048	83	0.298
Step 4: RFDxGNAT-AD (safety)	0.410	0.055				0.067
RFD-NAxGNAT-AD (safety)			-0.004	-0.035	80	0.973
RFD-SPxGNAT-AD (safety)			0.146	1.317	80	0.191
RFD-CCxGNAT-AD (safety)			-0.282	-2.250	80	0.027

AUDIT, Alcohol Use and Disorders Identification Test; RFD-NA, Reasons for Drinking Questionnaire Negative Affect Subscale; RFD-CC, Reasons for Drinking Questionnaire Cued Craving Subscale; RFD-SP, Reasons for Drinking Questionnaire Social Pressure Subscale; GNAT-AN, Condition 1 GNAT; GNAT-AD, Condition 2 GNAT. Paradigms are represented in parentheses.