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I Drink Therefore I am: Validating Alcohol-related Implicit Association Tests

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Abstract

There is an imperative to predict hazardous drinking among college students. Implicit measures have been useful in predicting unique variance in drinking and alcohol-related problems. However, they have been developed to test different theories of drinking and have rarely been directly compared to one another. Thus, their comparative utility is unclear. The current study examined five alcohol-related variants of the Implicit Association Test (IAT) in a sample of 300 undergraduates and sought to establish their predictive validity. Results indicated that the Drinking Identity IAT, which measured associations of “drinker” with “me,” was the most consistent predictor of alcohol consumption, problems, and alcohol cravings. It also had the highest internal consistency and test–retest reliability scores. The results for the Alcohol Excitement and Alcohol Approach IATs were also promising but their psychometric properties were less consistent. Although the two IATs were positively correlated with all of the drinking outcome variables, they did not consistently predict unique variance in those variables after controlling for explicit measures. They also had relatively lower internal consistencies and test–retest reliabilities. Ultimately, results suggested that implicit drinking identity may be a useful tool for predicting alcohol consumption, problems, and cravings and a potential target for prevention and intervention efforts.

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Keywords

implicit cognition; alcohol; drinking; identity; drinking motives

Hazardous drinking is a major concern at US colleges, with rates of heavy episodic drinking remaining largely unabated and with serious negative consequences experienced by some college student drinkers and those around them (see Johnston, O'Malley, Bachman, & Schulenberg, 2011; Nelson, Xuan, Lee, Weitzman, & Wechsler, 2009; Perkins 2002). National calls have been issued to identify additional mechanisms that can be targeted for prevention and intervention efforts (e.g., Malloy, Goldman, & Kington, 2002; U.S. Department of Health and Human Services, 2007). Implicit alcohol-related measures have been found to predict unique variance in measures of consumption and problems (for reviews see Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Reich, Below, & Goldman, 2010; Roefs et al., 2011; Rooke, Hine & Thorsteinsson, 2008), and they may point to promising new intervention targets (e.g., Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). Findings, however, have varied depending on study methods and samples, and implicit measures are rarely compared to one another (see Roefs et al., 2011; see Houben, Nosek & Wiers, 2010 and Van den Wildenberg et al., 2006 for exceptions outside the U.S.). Thus, it is important to investigate multiple implicit measures and determine whether they account for distinct variance in drinking behaviors in US college populations.

The present study investigated alcohol-related implicit measures in order to provide a comprehensive picture of their reliability and validity. Five alcohol-related variants of the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) were used: the Alcohol Approach, Drinking Identity, Alcohol Excitement, Alcohol Coping, and Stress Drinking IATs. These variants were developed from different theories of drinking that have support with US college samples. As other researchers have noted (e.g., Neighbors, Lee, Lewis, Fossos, & Larimer, 2007), theories are often developed and tested in relative isolation, resulting in little to no information about whether predictors from different theories account for unique variance in outcomes. Cross-study comparisons are also hampered by method differences, such as using different outcome variables or samples. The literature on alcohol-related IATs reflects both of these patterns. Consequently, there is a dearth of research examining IATs that measure different alcohol-related associations and investigating whether those IATs account for distinct variance in drinking outcomes. This study is an initial step toward bridging this gap. We begin with a description of the IAT method, followed by a brief discussion of the study IATs and the specific theories from which they were drawn.

The Implicit Association Test

The IAT is a computer-administered task that measures strengths of associations between concepts. In the IAT, participants' response latencies (reaction times) when categorizing stimuli that represent those concepts are recorded. Initially, participants classify exemplars of two contrasted concepts (e.g., pictures of *alcohol* and *water*) by pressing one of two keys (e.g., the "d" key with left hand for *alcohol* and the "k" key with right hand for *water*). Exemplars are presented individually, and participants are instructed to classify them quickly. Then, participants classify exemplars of a second pair of contrasted concepts (e.g., words representing approach or avoid) using the same keys. Next, participants complete a combined task in which exemplars from all four concepts are displayed and each concept is assigned to the same key as in the earlier blocks (e.g., "d" for alcohol and approach, "k" for water and avoid). Participants also complete a second combined block which reverses the pairing (e.g., "d" for *water* and *approach*, "k" for *alcohol* and *avoid*). In the combined tasks,

exemplars of one of the concept pairs (e.g., the alcohol and water pictures) are randomly presented on odd trials and exemplars of the other concept pair (e.g., approach and avoid words) are randomly presented on even trials. Most versions of the IAT require participants to correct errors before proceeding to the next trial. The latency or response time to make the correct response is measured. The IAT effect or measure is based on the differences in the average latency between the two combined tasks. Thus, shorter response times for the *alcohol-approach/water-avoid* task than for the *water-approach/alcohol-avoid* task would be interpreted as indicating a stronger association of *alcohol* with *approach* than with *avoid*. Ultimately, IAT effects are thought to reflect associations in memory – associations over which people may have limited control (see De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009, for detailed review and commentary on the IAT).

IATs can differ in a variety of ways. Most relevant to the present study, they can differ regarding the associations that are being measured (e.g., alcohol-approach vs. alcohol-avoidance, Palfai & Ostafin, 2003; alcohol-positive vs. alcohol-negative; or alcohol-active vs. alcohol-passive, Wiers et al., 2002). They can also differ with respect to the number of trials and mode of presentation of the four categories. For example, the recently introduced Brief IAT (BIAT) has fewer trials and only three of the four concepts are focal (explicitly labeled) during the combined tasks (e.g., Sriram & Greenwald, 2009). For example, in the first combined task, participants would press “d” for *alcohol* and *approach*, and press “k” for “anything else”. In the second combined task, they would press *d* for *alcohol* and *avoid* and press “k” for “anything else”. The present study used both traditional and Brief IAT formats, with the selection depending on whether an explicitly labeled contrast category fit effectively.

Dual Process Models of Drinking and the IAT

There are at least two main reasons for using an implicit measure, such as the IAT, to assess alcohol-related cognitions. First, they may have unique predictive value because participants may not be fully willing or able to report the relevant cognitions. A second reason is that they may assess different underlying processes than explicit measures – e.g., relatively automatic, associative or impulsive processes – that are typically contrasted with relatively controlled, propositional processes in dual process models (general: Strack & Deutsch, 2004; Smith & DeCoster, 2000; specific to addiction: Stacy & Wiers, 2010; Wiers et al., 2007). According to these models, alcohol-related stimuli may trigger impulsive, appetitive processes, resulting in an action tendency to approach, as well as reflective processes, which may in some cases (e.g., an exam the next day) result in an inhibition of the impulse to drink.

Selection of Implicit Association Test Variants

The IATs used in the present study were selected based on their previous use in the research and/or their conceptual relationship to strong explicit predictors of drinking outcomes. A control IAT (the Alcohol Control IAT) was included to provide support for claims that alcohol-related IATs must be conceptually meaningful if they are to predict drinking-related variables. Relevant literature for each selected IAT is briefly described, including the theoretical perspective from which it is drawn.

Alcohol Approach IAT

The Alcohol Approach IAT was developed by Palfai and Ostafin (2003) and has since been used in multiple studies, including internationally (e.g., Van den Wildenberg et al., 2006). It was developed from theoretical models of addiction that propose that substance use cues may automatically trigger a motivational state focused on acquiring or consuming the

substance – i.e., activate an alcohol-approach state (see Baker, Morse, & Sherman, 1987; Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Thus, the Alcohol Approach IAT measures whether one is faster at associating alcohol-related stimuli with words representing approach versus words representing avoidance – in essence, capturing whether one's general motivation toward alcohol is more appetitive versus more inhibitory. Scores on this IAT have been demonstrated to predict unique variance in college students' hazardous drinking prospectively (Farris, Ostafin, & Palfai, 2010), retrospectively (Ostafin & Palfai, 2006), and in the laboratory (Ostafin et al., 2008). There is also preliminary evidence that alcohol-approach associations can be targeted for clinical interventions (Wiers et al., 2010, 2011).

Alcohol Excitement IAT

The Alcohol Excitement IAT was developed by Lindgren et al. (2011) and has some similarities to Wiers et al.'s arousal IAT (Wiers et al., 2002). It was developed from theories of drinking that suggest that individuals vary in their reasons for drinking and that such motives are important, proximal predictors of drinking (e.g., Cox & Klinger, 1988). Drinking for enhancement of positive mood or for fun or enjoyment are among the motives most commonly endorsed by adolescents and young adults and most predictive of their drinking (Cooper, 1994; Cooper, Frone, Russell, & Mudar, 1995; Kuntsche, Knibbe, Gmel, & Engels, 2005). Lindgren et al. (2011) reasoned that enhancement motives may also have an implicit analogue because of findings that (a) drinking generally becomes more automatic over time (e.g., Oei & Baldwin, 1994), and (b) people can drink in anticipation of celebration without being aware of doing so (e.g., Mohr et al., 2001). Thus, the Alcohol Excitement IAT measured whether one is faster at associating alcohol-related stimuli with words representing excitement versus words representing diminish. Scores on that IAT predicted unique variance in drinking after controlling for explicit enhancement motives (Lindgren et al., 2011). In the present study, the Alcohol Excitement IAT used a different contrast category – “diminish” was changed to “depress”. This change was made to ensure that both excitement and its contrast category specifically referred to alcohol's effects, which may improve the predictability of the IAT (see Houben et al., 2010).

Alcohol Cope IAT

The Alcohol Cope IAT was also developed by Lindgren et al. (2011) and was also drawn from motivational models of addiction. There is a substantial body of research indicating that drinking in order to cope with negative affect is a strong and consistent predictor of alcohol outcomes, especially of hazardous drinking (Cooper et al., 2005; Littlefield, Sher, & Wood, 2010; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007). Lindgren et al. again reasoned that these motivations may be reflected implicitly and created an IAT that measured whether one is faster at associating alcohol-related stimuli with words representing cope versus ignore. Alcohol Cope IAT scores predicted unique variance in drinking after controlling for explicit coping motives. The present study retained the stimuli used by Lindgren et al., but used the BIAT format in order to reduce the salience of the contrast category for cope (i.e., ignore). This change stemmed from concerns regarding the potential for multiple interpretations for ignore as a category label.

Stress Drinking IAT

Because of the importance of coping motives for predicting hazardous drinking and the difficulty in identifying a contrast category for “coping,” another IAT was developed with the intention of assessing coping-related drinking more functionally. That is, to the degree that people drink to cope with distress, one would expect that stress would be associated with drinking versus some other form of coping. Therefore, an IAT was constructed that measured whether one is faster at associating stress-related stimuli with words representing drinking versus reaching out.

Drinking Identity IAT

The Drinking Identity IAT was constructed for this study. It was drawn from recent additions to the theory of planned behavior. As originally formulated, the theory of planned behavior states that attitudes, norms, and perceived control collectively determine one's intentions, which in turn, determine one's behaviors (Ajzen, 1991). More recently, it has been demonstrated that incorporating measures of how strongly one identifies with the behavior (e.g., identifying with drinking) improves the predictability of the model (e.g., Fekadu & Kraft, 2001). Aspects of the self, including self-esteem and self-concept, have a long tradition of being measured using the IAT (e.g., Greenwald & Farnham, 2000). Thus, it was expected that identification with drinking could be captured using an IAT and the resulting IAT scores would predict unique variance in drinking. Thus, an IAT was developed for this study that measured whether one was faster at associating alcohol-related stimuli with words representing the self versus others. Preliminary evidence supports this claim, with a related IAT predicting unique variance in alcohol-related risky behaviors after controlling for previous drinking behavior (e.g., Gray, LaPlante, Bannon, Ambady, & Shaffer, 2011).

Alcohol Control IAT

Finally, an Alcohol Control IAT was included (cf. Van den Wildenberg et al., 2006). Note that all of the above IATs were designed to compare alcohol with conceptually meaningful psychological dimensions (e.g., approach versus avoid; excite versus depress). If all IATs were found to be equally associated with drinking, one might argue that implicitly pairing alcohol with anything (e.g., coping, excitement, ninjas, or ice cream) would result in an association with drinking. Thus, the inclusion of an IAT pairing alcohol with a dimension that, at face value, should be unrelated to problem drinking was deemed important to establish discriminant validity of the IATs. In this case, dessert was chosen as a comparison category to alcohol and its associations with food or beverage were assessed. This IAT was hypothesized to be unrelated to drinking outcomes.

Overview and Hypotheses

The current study sought to establish and evaluate the validity of five IAT variants that have been developed from different theories of drinking and addiction and have resided in relatively different research lines. Because alcohol-related IATs have potential application for identifying and intervening in hazardous drinking among college students, it is important to investigate whether these IATs account for distinct variance in critical drinking outcomes. The five IAT variants (Alcohol Approach, Alcohol Excitement, Alcohol Cope, Stress Drinking, and Drinking Identity) and a control IAT were investigated.

The first part of the investigation focused on psychometric properties of the IATs, including their internal consistency and test-retest reliability. The second part of the investigation focused on the extent to which each IAT predicted unique variance in drinking outcomes (consumption, problems, and cravings) after controlling for explicit predictors. For each IAT, the explicit predictor used was a self-report measure that was an established, reliable predictor of the drinking outcomes and one that was conceptually related to the associations measured in the specific IAT. Based on previous findings, all of the IATs other than the Alcohol Control IAT were expected to be positively and uniquely associated with the drinking-related outcomes after accounting for explicit predictors (see Greenwald et al., 2009; Houben et al., 2010; Lindgren et al., 2011; Ostafin, Marlatt, & Greenwald; Ostafin & Palfai, 2006). The two-way interactions between the IATs and related explicit predictors were also investigated. One might expect synergistic results, with high values on implicit and explicit measures being particularly predictive of related alcohol behavioral outcomes.

Alternatively, one might expect implicit measures to be stronger predictors at lower levels of explicit measures, possibly due to a lack of awareness of one's alcohol associations and/or due to self-presentation concerns. Finally, exploratory analyses were conducted to test how the IATs accounted for distinct variance in drinking outcomes when included in the same model.

Method

Participants

Participants consisted of 300 undergraduates (136 men, 164 women) between the ages of 18–25 ($M = 20.47$, $SD = 1.52$) at a large public university in the Pacific Northwest. Fifty-seven percent of participants identified as White/Caucasian, 30% as Asian, nine percent as multiracial, and the remaining four percent as either Black/African American, American Indian/Alaska Native, Native Hawaiian/other Pacific Islander, unknown, or declined to answer. All participants were compensated \$30. A subset of the participants (22 men, 19 women) was invited for a second session to assess test–retest reliability of the IATs. They were compensated \$25.

Measures

Implicit Association Test (IAT)—The Implicit Association Test (IAT; Greenwald et al., 1998) is a reaction time measure designed to assess the relative strength of associations between two pairs of concepts or two sets of target and attribute categories. The IATs were computer-administered (programmed with Inquisit, 2010). The IATs used the traditional 7-block structure. Blocks 1, 2 and 5 provide the participant with practice classifying stimuli as belonging to one of two target categories (e.g., categorize a picture of beer as either “alcohol” or “water”) or one of two attribute categories (e.g., categorize words as fitting in either the “approach” or “avoid” categories) using a left (“d”) and right key (“k”) on the keyboard. There are also two critical category pairing conditions in the IAT. In the first category pairing condition (blocks 3 and 4), items representing the category “alcohol” were categorized with the same response key as items representing the category “approach,” while items representing “water” were categorized with the same response key as items representing “avoid.” In the second category pairing condition (blocks 6 and 7), “alcohol” and “avoid” items were categorized with one response key, and “water” and “approach” items were categorized with the other. The difference in average categorization latency across the two critical category pairing conditions is taken as an implicit indicator of relative preference for approaching versus avoiding alcohol. To minimize order effects, target–attribute pairings were counterbalanced across participants, and the order of IAT administration was randomized. Also, to reduce fatigue, IATs were evenly spaced throughout the session interspersed among the self-report measures. Scores were calculated using the D score algorithm (Greenwald, Nosek, & Banaji, 2003).

We assessed six different alcohol-related associations: alcohol approach, drinking identity, alcohol excitement, alcohol beverage (control), alcohol cope, and stress drinking (the latter two were assessed using a BIAT; see below). A complete list of the stimuli used for each IAT can be found in Table 1. Each IAT was scored such that higher scores indicated stronger associations with the concepts in the IAT's name. For example, the Alcohol Approach IAT was scored such that higher scores indicate stronger associations of alcohol–approach (and water–avoid) than alcohol–avoid (and water–approach).

Idiographic IATs: Three of the IAT variants (Alcohol Approach, Alcohol Excitement IAT, and Alcohol Cope) used individualized alcohol stimuli. Specifically, participants were instructed to select images depicting the four types of alcoholic beverages they consumed

most often (non-drinkers were instructed to select the alcoholic beverages they had been offered most often). Each picture included three examples of a single category of alcohol (such as three premium domestic beers, three red wines, etc.). Stimuli representing the water construct were standardized. They consisted of four images, each of which featured three examples of water (e.g., three domestic bottled waters, three sparkling waters, etc.).

Brief IAT (BIAT): Two of the IAT variants (Alcohol Cope and Stress Drinking) used the BIAT block format as described in Menatti et al. (in press), and the number of trials as described by Sriram and Greenwald (2009). The BIAT has fewer than 50% of the trials used in most standard IATs. The BIAT uses stimuli from four categories but leaves one of the categories unlabeled in the task. For example, in the Alcohol Cope BIAT, the four categories were *alcohol*, *water*, *cope* and *ignore*. In one of the two critical blocks that use the four categories, the participant is asked to give a right key response when items representing *alcohol* and *cope* are presented, and a left key response when “anything else” is presented. In the other critical block, the participant is instead instructed to respond with the right key for *water* and *cope* items, and the left key for “anything else.”

The BIATs had seven-blocks and approximated the structure of a full IAT – e.g., Blocks 1, 2, and 5 were practice blocks intending to teach participants the task and stimuli and Blocks 3, 4, and 6, 7 had the critical target-attribute pairings (e.g., “Cope” + “alcohol” or “Cope” + “water”). Like the traditional IAT, the order of the target-attribute pairings was counterbalanced across participants. BIATs were also scored using the D method recommended by Greenwald et al. (2003), and each BIAT was again scored such that higher scores indicated stronger associations with the concepts in the BIAT’s name.

The use of the BIAT format (as opposed to the regular IAT) was driven by the difficulty of identifying a natural contrast category for the “coping” construct. Lindgren et al. (2011) used “ignore” as a contrast, arguing that those who drink to cope view alcohol as a means to solve their problems or deal with their distress. Thus, ignoring a problem may provide a useful counterpoint to coping. However, the use of ignore as a category label could have multiple interpretations (e.g., to ignore worries and to positively distance oneself, to ignore the steps needed to actively solve the problem, and/or to ignore alcohol). The BIAT format was used so that the ignore stimuli could be used but not be explicitly labeled as a category, thereby potentially reducing the potential for multiple interpretations. For consistency, the Stress Drinking IAT, which was developed as an alternate way to measure coping-related drinking, also used the BIAT format.

Data Reduction: All IAT data were screened for possible exclusion using the procedures described in Nosek, Greenwald, and Banaji (2007). Specifically, if participants responded to 10% or more of the trials faster than 300 milliseconds, the score for that IAT was discarded. Exclusion rates were as follows: eight scores for the Drinking Identity IAT, 13 scores for the Alcohol Approach IAT, 14 scores for the Alcohol Excitement IAT, 16 scores for the Alcohol Beverage IAT, five scores for the Alcohol Cope BIAT, and five for the Stress Drinking BIAT. Data were also screened for overly slow responders (e.g., more than 10% of trials above 3000 milliseconds); no participants met that criterion. Thus, less than five percent of the scores for each IAT were discarded.

Explicit Predictors

Coping and Enhancement Drinking Motives: The Drinking Motives Questionnaire (DMQ; Cooper, 1994) is a 20-item assessment of drinking motives. It has four subscales, two of which were used in this study (e.g., coping motives and enhancement motives). The former was used to assess drinking to cope with distress (e.g., “Because it helps you when

you feel depressed or nervous”) and was the counterpart to the Alcohol Cope and Stress Drinking BIATs. The latter assessed drinking to increase positive affect (e.g., “Because it gives you a pleasant feeling”) and was the counterpart to the Alcohol Excitement IAT. Participants responded using a five-point scale ranging from one (“Never/almost never”) to five (“Almost always/always”). Alphas were .84 for the coping subscale and .91 for the enhancement subscale.

Drinking Identity: Adapted from the Smoker Self-Concept Scale (Shadel & Mermelstein, 1996), the Alcohol Self-Concept Scale (ASCS) is a five-item measure of drinking identity and was the counterpart to the Drinking Identity IAT. Participants rate their agreement (from -3 = strongly disagree to 3 = strongly agree) with statements on how much drinking plays a part in the individual’s life and personality, and others’ perceptions of the role of alcohol in one’s life (e.g., “Drinking is a part of ‘who I am’”). Alpha was .94.

Behavioral Activation Scale – Fun-seeking: (BAS-fun; Carver & White, 1994). This 4-item subscale is a measure of the Behavioral Activation System (BAS), which as formulated by Gray (1975) refers to the motivational system that is highly sensitive to cues that signal potential rewards. Because it measures the extent to which a person is motivated by the desire to seek out or approach fun activities (e.g., “I will often do things for no other reason than they might be fun”) and is predictive of hazardous drinking (e.g., O’Connor, Stewart, & Watt, 2009), the BAS-fun was included as an explicit measure related to the Alcohol Approach IAT. Participants rate their agreement (from 1 “Strongly disagree” to 4 “Strongly agree”). Alpha was .71.

Self-reported Alcohol Outcomes¹

Typical Drinking: The Daily Drinking Questionnaire (DDQ; Collins, Parks & Marlatt, 1985) assesses average alcohol consumption within the past three months. Participants are asked to report how many standard drinks they consumed on each day of a typical week. Participants were provided with a card with common standard drink equivalencies.

Alcohol Problems: The *Rutgers Alcohol Problem Index* (RAPI; White & Labouvie, 1989) asks participants to report how many times in the past three months (from 0 “never” to 4 “More than 10 times”) they experienced 23 symptoms of problem drinking and negative consequences as a result of drinking, ranging from mild (“Had a bad time”) to serious (“Suddenly found yourself in a place that you could not remember getting to”). Two additional items were added asking participants how often they had driven shortly after consuming 2 and 4 drinks, respectively. Alpha was .90.

Alcohol Cravings: Cravings were assessed using the Alcohol Craving Questionnaire Short Form-Revised (ACQ; Singleton, Tiffany & Henningfield, 1995). Twelve items measured current alcohol craving (e.g., “If I had some alcohol I would probably drink it”), including alcohol use intentions, anticipation of positive benefits of drinking, anticipation of relief from withdrawal and negative moods, and lack of control over alcohol use. Each response was measured on a seven-point scale ranging from negative three (“Strongly Disagree”) to three (“Strongly Agree”). Alpha was .72.

¹We also collected participants’ responses to the Alcohol Use Disorders Identification Test (AUDIT, Babor, Higgins-Biddle, Saunders & Monteiro, 2001) and a measure of future drinking intentions based on the DDQ. Those measures were not included due to space constraints and overlap with the reported drinking outcomes (e.g., the drinking intentions measure was correlated with the DDQ at .86) and the AUDIT contains questions about quantity and frequency of drinking as well as about problems. Analyses of those measures are available from the first author upon request.

Procedure

All procedures were approved by the university's institutional review board. Participants were initially recruited via a list of current undergraduates provided by the university registrar. They were invited via email to participate in the study and were provided with a link to a website with more information about the study. If willing to participate, they could schedule an appointment for a 90-minute lab session via the website. During the lab session, participants were guided through the informed consent process. Study measures were completed individually on laptop computers in a large room, in which up to four participants were present at a time. Spaced seating, privacy screens, and partitions ensured the privacy of participants' responses. The session consisted of a randomly presented series of IATs, the explicit predictors, and the self-reported alcohol outcomes. Participants were compensated \$30.

A subsample of participants was invited to return to the lab one week later to repeat the IATs and the self-report measures. Half of the participants who scored an average of 2.0 or higher on the coping subscale of the DMQ ($n = 25$) and a random sample of all other participants ($n = 14$) were invited to return for a second session. All invited participants accepted the invitation. Participants were compensated \$25 for the second visit.

Results

Psychometric Properties of the Study IATs

Descriptive Statistics—Means, standard deviations, ranges and Pearson r 's are reported in Table 2a. Mean IAT D scores for the Drinking Identity and Alcohol Excitement IAT were close to zero, indicating that participants were no more likely to associate “drinking” with “me” than with “not me”, and no more likely to associate “alcohol” with “excite” than with “depress.” Alcohol Approach and Alcohol Cope scores were, on average, negative, indicating that participants were faster at pairing “alcohol” with “avoid” than with “approach,” and “coping” with “water” than with “alcohol.” Means for the Stress Drinking BIAT and Alcohol Control IAT were positive, indicating that participants were faster at pairing “stress” with “drinking” versus with “reaching out,” and “alcohol” with “beverage” than with “food.” Finally, the IAT scores were, at most, modestly correlated with one another, with the strongest correlation between the Drinking Identity and Alcohol Excitement IAT, $r = .44$.

Internal Consistency—Internal consistencies were examined by calculating the correlation between a D score using data from the practice blocks (3 and 6) and a D score using data from the test blocks (4 and 7). These correlations are typically in the .5 to .7 range for most IATs (see Greenwald et al., 2003). The Alcohol Control (.57), Alcohol Excitement (.52), Drinking Identity (.51), and Alcohol Approach (.48) IATs were the most consistent. The Alcohol Cope (.32) and Stress Drinking (.42) IATs were less consistent.

Test-retest Reliability—One week test-retest reliabilities for the IATs are presented in Table 2b. The strongest correlation was found for the Drinking Identity IAT ($r = .70$) and the weakest correlation was found for the Alcohol Control IAT ($r = .27$).

Relations Between IATs and Explicit Predictors—Means and standard deviations for the explicit predictors and their relations to the study IATs are displayed in Table 3a. Results were consistent with expectations and with a meta-analysis of IAT-explicit relations, which reported an average correlation of .21 between IATs and explicit measures of the same construct (e.g., Greenwald et al., 2009). Correlations were strongest between the Drinking Identity IAT and its explicit counterpart, the ASCS ($r = .25$), and the Alcohol

Excitement IAT and explicit enhancement ($r=.24$). The correlation between the Alcohol Cope IAT and its explicit counterpart, the DMQ-cope, was relatively weaker ($r=.12$). The Alcohol Approach IAT was practically uncorrelated with BAS-fun ($r=.04$), as was the Stress Drinking IAT with the DMQ-cope ($r=.04$). Consistent with predictions, the Alcohol Control IAT was mostly unrelated to the explicit measures (r range = $-.03$ to $.09$). Finally, in some instances IATs were more strongly correlated with explicit predictors that were not their specified counterpart – e.g., the Drinking Identity IAT had higher correlations with both DMQ-subscales than with explicit drinking identity.

Relations between IATs and Self-reported Drinking Outcomes—Table 3b contains the descriptive statistics for the three drinking outcomes and the zero-order correlations between the outcomes, the study IATs, and the explicit predictors. As expected, the Drinking Identity, Alcohol Excitement, and Alcohol Approach IATs were positively associated with all of the drinking outcomes. The Alcohol Cope BIAT was positively associated with consumption and cravings, but was not significantly associated with problems. Surprisingly, the Stress Drinking BIAT was not associated with any drinking outcomes. Consistent with expectations, the Alcohol Control IAT was not strongly associated with the drinking outcomes, with the highest observed correlation with consumption ($r=.08$). Finally, all of the explicit predictors were significantly correlated with all of the drinking outcomes, as expected, given they were selected as established predictors of these critical drinking outcomes.

Do IATs Predict Incremental Variance in Drinking Outcomes?

Analytic plan—Regression models were used to test whether (a) IAT scores predicted unique variance in the drinking outcomes (consumption, problems, and cravings) after controlling for explicit predictors, and (b) implicit $\times$ explicit interaction effects were significant. Inspection of the drinking outcome variables revealed that only the distribution of the cravings variable approximated a normal distribution. Thus, count regression models, which allow one to fit outcome variables with a range of distributions in addition to the normal distribution, were used for consumption and problems (see Atkins & Gallop, 2007; Cohen, Cohen, West, & Aiken, 2003). Models for those variables were fit with a negative binomial log link. Models for the cravings outcome were fit using ordinary least squares (OLS) regression. Analyses were only conducted for those IATs that were found to be at least weakly correlated to the drinking outcomes (Drinking Identity, Alcohol Excitement, Alcohol Approach, and Alcohol Cope; see Table 3b). They were not conducted for the Stress Drinking BIAT, or Alcohol Control IAT.

Each outcome variable was examined separately. Within each outcome variable, a model was fit for each IAT, its explicit counterpart, and the two-way implicit $\times$ explicit interaction term.² All models included participant gender (dummy coded, 0 = men, 1 = women). IAT and explicit measure scores were mean-centered to facilitate interpretation. All terms were entered simultaneously. To test the relative contribution of each IAT, a final model was fit that included all four IATs.

Because of concerns regarding multiple testing and alpha inflation, a Bonferroni correction was applied. There were three, correlated outcome variables – on average, $r=.50$.

²Because participants completed six IATs throughout the session, we tested for possible order effects using a series of one-way ANOVAs. No order effects were observed for the Drinking Identity, Alcohol Excitement, Stress Drinking, or Alcohol Beverage IATs (all p 's $> .05$). There was evidence of order effects for the Alcohol Approach IAT and the Alcohol Cope IAT, with scores tending to decrease in magnitude the later participants completed them in the experimental session (p 's $< .05$). The regression analyses that follow were conducted both with and without order as a covariate for those IATs. Because the pattern and direction of the observed effects were virtually identical, we report the results without order as a covariate.

Accordingly, alpha was set to .029 based on the recommendations by Uitenbroek (1997) for corrections for correlated outcomes.

IATs as predictors of consumption—When examined separately, Drinking Identity, Alcohol Excitement, and Alcohol Approach IAT scores significantly predicted unique variance in drinks per week after controlling for their explicit counterparts (see Table 4). The IAT $\times$ explicit interaction was only significant for the Alcohol Excitement IAT. Figure 1 presents exponentiated predicted values derived from the negative binomial regression equation. High and low values of implicit and explicit measures were specified as one standard deviation above and below the respective mean (Cohen, Cohen, West, & Aiken, 2003). Alcohol Excitement IAT scores were more strongly related to the drinks per week at lower levels of explicit enhancement. In other words, the association between IAT scores and drinks per week was steeper/stronger for those who were lower in explicit enhancement motives. Finally, findings from the combined IAT model indicated that the Drinking Identity IAT scores predicted unique variance in drinking relative to the other IATs, with a non-significant trend for Alcohol Excitement IAT scores.

IATs as predictors of problems—The Drinking Identity IAT was the only IAT that significantly predicted unique variance in alcohol problems after controlling for explicit predictors (see Table 5). There was, however, also a non-significant trend for Alcohol Approach IAT scores predicting unique variance in problems after controlling for BAS-fun ($p < .053$). In the combined IAT model, only the Drinking Identity IAT predicted unique variance in problems.

IATs as predictors of cravings—Only the Drinking Identity IAT predicted significant variance in cravings after controlling for its explicit counterpart (see Table 6). None of the other IATs significantly predicted cravings. In the combined IAT model, the Drinking Identity and the Alcohol Excitement IATs each predicted unique variance.

Discussion

This study investigated the predictive validity of a variety of alcohol-related IATs, each of which was drawn from a well-supported theory of drinking, and examined both their ability to predict drinking behaviors individually and relative to one another. Overall, the most consistent findings were for the Drinking Identity IAT, with results indicating that it not only was positively related to alcohol consumption, problems, and cravings but that it also predicted unique variance in drinking outcomes after controlling for its explicit counterpart and for other study IATs. Zero-order relations between the Alcohol Excitement and Alcohol Approach IATs and the drinking variables were strong. However, those two IATs only significantly predicted unique variance in consumption after controlling for explicit predictors. Contrary to expectations, the Alcohol Cope and Stress Drinking BIATs were found to be, at best, weakly related to the drinking outcomes. When the relative predictability of the IATs was tested, the Drinking Identity IAT predicted unique variance in all three drinking outcomes, and the Alcohol Excitement IAT predicted unique variance in cravings.

The Importance of Implicit Drinking Identity

Results from the present study suggest that it may be useful to incorporate implicit drinking identity into alcohol research. In this study, the Drinking Identity IAT had excellent test-retest reliability ($r = .70$), particularly strong for an implicit measure. Moreover, it had the highest effect sizes (when predicting drinking outcomes) of the study IATs (ranging from .19 to .36) and predicted variance in alcohol consumption, problems, and cravings after

accounting for explicit drinking identity. In the combined IAT regression models, the Drinking Identity IAT also predicted unique variance in all three drinking outcomes. Thus, the Drinking Identity IAT appears to account for distinct variance from explicit drinking identity as well as from the other study IATs. This pattern of results is consistent with recent research on the theory of planned behavior, which suggests that including measures of one's identification with a problem behavior improves the prediction of that behavior (e.g., Casey & Dollinger, 2007; Conner et al., 1999; Fekadu & Kraft, 2001; Gray et al., 2011). Ultimately, implicit drinking identity may represent an unexploited target to consider for college student drinking prevention. This notion is indirectly supported by empirically-supported intervention programs, such as the brief alcohol screening and intervention for college students (BASICS; Dimeff, Baer, Kivlahan, & Marlatt, 1999), which focuses on generating lists of alternative behaviors when a student indicates an interest in reducing drinking, usually by way of a conversation about important aspects of identity and values.

Alcohol Excitement and Alcohol Approach IATs: Predictive, but Less So

When considered individually, the Alcohol Approach and Alcohol Excitement IATs performed well. Both IATs had test-retest correlations of .45 or higher, and positive, significant correlations were observed between each IAT and the drinking outcomes. However, once explicit predictors were controlled for, their performance was weaker. In those analyses, the Alcohol Excitement and Alcohol Approach IATs predicted significant variance only for consumption, with the Alcohol Approach IAT also having a non-significant trend for predicting problems. Similarly, in the models that examined the IATs collectively, the Alcohol Excitement IAT predicted unique variance in cravings only, with a non-significant trend for predicting consumption.

Some of the inconsistency in findings for the Alcohol Approach and Alcohol Excitement IATs is likely due to covariances between them. The two IATs are correlated at .44, and thus share almost 20% of their variance. This covariance will make it a more difficult test when their ability to predict drinking outcomes are compared in the combined IAT models. Also, when considering the two IATs individually, they were – like all of the study IATs – paired with explicit predictors that were significantly related to the drinking outcomes. In other words, the study design intentionally created a relatively rigorous test for establishing the IATs' incremental, predictive validity. Different choices in explicit measures or IAT variants could result in a different pattern of findings.

Despite mixed findings for these IATs, they may still be useful targets for intervention efforts. They were related to the drinking outcomes in general, and to alcohol consumption in particular. Supporting this premise, Wiers et al. (2010) found that re-training alcohol-approach associations was associated with short-term reduced drinking in heavy drinking college students, and in a follow-up study, with lower relapse rates for patients completing an in-patient alcohol abuse program (Wiers et al., 2011).

Remaining Challenges: Coping and Problems

The pattern of results also indicates two important challenges for future alcohol-related IAT research. First, this study included two adaptations of Lindgren et al.'s (2011) Alcohol Cope IAT, which had been previously demonstrated to predict drinking after controlling for explicit coping. These adaptations, which included a change to the BIAT format and inclusion of a task that explicitly focused on stress-related drinking to cope, did not improve the Alcohol Cope IAT's psychometric properties. Both variants had low internal consistencies and much lower zero-order correlations with explicit coping and drinking behaviors than the variant used by Lindgren et al. Whether that is a reflection of the BIAT

format and/or of the specific stimuli used cannot be determined from this study. Additional research will be necessary to address this issue and refine the Alcohol Cope IAT.

Second, only the Drinking Identity IAT significantly predicted unique variance in alcohol-related problems. As discussed above, the tests conducted were deliberately intended to be conservative – thus, the inclusion of explicit counterparts that were strongly associated with the drinking outcome variables, including problems. The Drinking Identity IAT passed this test but the others did not, whether considered individually or relative to one another. It may be that additional IAT variants would also have significantly predicted problems – e.g., Houben and Wiers (2006) found that an alcohol sedation IAT significantly predicted unique variance in alcohol problems – and this would be important to address in future research

Clinical Implications

Taken together, Drinking Identity, Alcohol-Excitement, and Alcohol Approach IATs had generally strong findings. This study adds to the extant literature on alcohol-related IATs as findings not only support the utility of the IATs in drinking research, but also indicate the utility of some of the IATs in predicting current cravings. This may be especially timely as cravings are being proposed as an addition to the diagnostic criteria for substance use disorders for the fifth addition of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-V; De Bruijn, Van Den Brink, De Graaf, & Vollebergh, 2005; Grant, 2011).

An exciting next step will be to test the causal relationship between these implicit associations and drinking outcomes. Specifically, targeting implicit drinking identity, and perhaps also associations with alcohol as being exciting and eliciting approach tendencies, may help to augment current alcohol prevention and intervention programs. Cognitive bias modification studies hold particular promise in this regard. These computer-based training programs typically involve practice learning a new contingency related to disorder-relevant material (e.g., learning to attend to non-alcoholic beverages; learning to interpret an ambiguous situation as safe rather than dangerous). There is considerable evidence that cognitive bias modification programs can reduce cognitive biases and symptoms related to psychopathology in general (see review by Hertel & Mathews, 2011; though effect sizes are small, see Hallion & Ruscio, 2011), and to alcohol specifically (Wiers et al., 2011), and even recent findings showing that implicit associations can be directly modified (e.g., Clerkin & Teachman, 2010).

Theoretical Implications

Overall, findings were consistent with both general and addiction-specific dual process models of addiction (e.g., Stacy & Wiers, 2010; Strack & Deutsch, 2004). According to those theories, implicit measures of alcohol-related cognitions should predict impulse-related alcohol outcomes and should account for unique variance in those outcomes after controlling for explicit predictors. There was evidence of this pattern for the Drinking Identity, Alcohol Excitement, and Alcohol Approach IATs, although strength of effects varied depending upon the IAT and the outcome. Effect sizes for the main effects of the IATs when predicting outcomes tended to fall in the small to medium range (e.g., Cohen, 1988), consistent with meta-analyses of alcohol-related IATs (e.g., Rooke et al., 2008). Explicit predictors, in contrast, tended to have larger main effects. This difference in magnitude is largely consistent with previous studies (Reich et al., 2010), and perhaps unsurprising since the explicit predictors and drinking outcomes share method variance (i.e., they are all self-report questionnaires).

There was also a significant implicit $\times$ explicit interaction involving the Alcohol Excitement IAT when predicting drinks per week. Its pattern was consistent with arguments that implicit measures may assess cognition of which people may be unaware and/or unwilling to report. It is unclear why implicit $\times$ explicit interactions were not observed with the Drinking Identity and Alcohol Approach IATs. Non-significant trends for both IATs were observed for the consumption variable, and it may be that the design was underpowered for detecting interactions that are relatively small in magnitude.

Methodological Implications

One of the notable findings from the present study concerns the variability in findings across the different IATs. Thus, the IATs appear to capture meaningfully different associations related to alcohol, which allows researchers considerable opportunity to select the exact implicit measure for the alcohol-relevant construct of interest to them. The null results for the Alcohol Control IAT provide a particularly promising contrast to the other IATs. Although the Drinking Identity, Alcohol Excitement, and Alcohol Approach IATs all showed predictive validity for multiple explicit drinking measures, the Alcohol Control IAT showed low test–retest reliability and did not relate strongly to the other IATs, the explicit drinking predictors, or outcome measures. Given this IAT was designed as a control task that would match the other IATs in terms of presence of alcohol stimuli, but not be meaningfully related to drinking problems, these results add to the validity of the IATs because there is evidence of both convergent and discriminant validity in the expected directions (as a function of the specific IAT). Moreover, the Alcohol Control IAT had the largest observed internal consistency, suggesting that the lack of observed relations was not due to the construction of the IAT categories or stimuli.

Limitations and Future Directions

There are several limitations to the present study. First, although an explicit predictor that was conceptually linked to the IAT and significantly related to the drinking outcome variables was always examined, the counterparts for some IATs (e.g., Drinking Identity, Alcohol Excitement, Alcohol Cope) were more directly related than for others (e.g., Alcohol Approach). Second, the method difference for the Alcohol Cope and Stress Drinking IATs, namely that they used the BIAT format, is also a limitation as noted above. Third, our study focused on a sample of university students from the Pacific Northwest region of the US. Although the magnitude of the IAT-self-reported correlations is consistent with those reported in recent meta-analyses and other studies (see Greenwald et al., 2009; Reich et al., 2010; Rooke et al., 2008), generalizability to other samples needs to be tested. Fourth, this study relied exclusively on self-reported measures of alcohol consumption. Those measures are well-validated and widely used, but additional studies should include measures of actual drinking. Finally, although there has been substantial research on substance use/abuse with IAT measures, the scientific basis for understanding these measures is still developing. Beyond this, conceptual interpretation of IAT measures cannot be regarded as fully established (see De Houwer et al., 2009). Fuller discussion of these questions can be found in the recent meta-analytic review by Roefs et al. (2011).

Conclusion

Because of the importance of predicting and reducing heavy drinking and alcohol-related problems in US college students, our goal was to evaluate the reliability and validity of multiple alcohol-related IATs. Findings from the present study indicate that, relative to the other associations measured, drinking identity associations were the most consistent predictor of drinking outcomes. Ultimately, drinking identity associations may be an important target for prevention and intervention efforts.

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Figure 1.

Exponentiated values predicted for alcohol consumption (drinks per week) by the Alcohol Excitement IAT $\times$ Enhancement Drinking Motives interaction. High and low values represent ± 1 SD from the mean. DMQ-Enh = scores on the enhancement subscale of the Drinking Motives Questionnaire. AUDIT = scores on the Alcohol Use Disorder Identification Test.

Table 1

Stimuli for Study IATs and BIATs.

Category 1	Category 2	Attribute (or Category) 1	Attribute (or Category) 2
Alcohol Approach IAT			
Labels Alcohol	Water	Approach	Avoid
Stimuli Choose 4 pictures of alcoholic beverages	4 pictures of water	approach, closer, advance, forward, toward	avoid, away, leave, withdraw, escape
Alcohol Excitement IAT			
Labels Alcohol	Water	Excite	Depress
Stimuli Choose 4 pictures of alcoholic beverages	4 pictures of water	cheer, high, fun, amplify, excite	sedate, deplete, lessen, depress, quiet
Drinking Identity IAT			
Labels Me	Not me	Drinker	Non-drinker
Stimuli me, my, mine, self	they, them, theirs, other	drinker, partier, drunk, drink	non-drinker, abstainer, sober, abstain
Alcohol Beverage IAT			
Labels Alcohol	Dessert	Beverage	Food
Stimuli 4 pictures of alcoholic beverages	4 pictures of dessert	beverage, liquid, sip	food, chew, solid
Alcohol Cope BIAT			
Labels I drink alcohol	I drink water	to Cope	Unlabeled ^a
Stimuli Choose 4 pictures of alcoholic beverages	4 pictures of water	cope, help, deal, manage	disregard, neglect, ignore, dismiss
Stress Drinking BIAT			
Labels I drink alcohol	I reach out	I'm stressed	Unlabeled ^a
Stimuli drink, alcohol, beer, liquor	friend, text, call, talk	stress, problem, worried, anxious	neutral, calm, peaceful, serene

Note. The Alcohol Approach IAT is based on Ostafin and Palfai (2006). The Alcohol Cope and Alcohol Excitement IATs were modifications of IATs used in Lindgren et al. (2011). All stimuli are available from the first author upon request. Personalized IATs (Alcohol Approach, Alcohol Excitement, and Alcohol Cope) displayed 15 pictures, of which participants were instructed to choose 4.

^aIn the BIAT, the second target is left unlabeled. Participants are instructed to press a specific key for any words other than those belonging to the labeled categories.

Table 2a

Zero-order Correlations and Descriptive Statistics for Study IATs

IAT	1	2	3	4	5	6	M	SD	Range
1. Drinking Identity	--	.21***	.12*	.17**	-.07	.02	.04	.39	-.096–0.96
2. Alcohol Excitement		--	.44***	.17**	-.03	-.10	-.01	.41	-.1.03–0.96
3. Alcohol Approach			--	.19**	-.11	.13*	-.15	.35	-.1.09–0.74
4. Alcohol Cope				--	-.00	-.17**	-.26	.44	-.1.31–0.96
5. Stress Drinking					--	.01	.53	.44	-.0.79 – 1.41
6. Alcohol Control						--	.71	.33	-.1.00 – 1.30

Note. N = 300. N's vary slightly for each cell. The Alcohol Cope and Stress Drinking IATs used the Brief IAT format. IATs were scored such that higher scores indicated stronger associations with the constructs described in the IAT's name.

* $p < .05$.

** $p < .10$.

*** $p < .001$.

Table 2b

One week Test–Retest Reliabilities for Study IATs.

IAT	Time 1		Time 2	
	Test–Retest	M	SD	M
Drinking Identity	.70***	.18	.36	.24
Alcohol Excitement	.49**	.06	.35	.04
Alcohol Approach	.45**	-.11	.39	.05
Alcohol Cope	.34*	-.21	.45	-.14
Stress Drinking	.35*	.52	.43	.40
Alcohol Control	.27	.71	.31	.59

Note. A subset of the sample ($n = 39$) returned to the laboratory one week later and completed the IATs again. N's vary slightly for each cell. The Alcohol Cope and Stress Drinking IATs used the Brief IAT format.

* $p < .05$.
** $p < .10$.
*** $p < .001$.

Table 3a

Zero-order correlations and Descriptive Statistics for Study IATs and Explicit Predictors.

IAT	ASCS	DMQ-Enhance	DMQ-Cope	BAS-Fun
Drinking Identity	.25 ***	.32 ***	.31 ***	.17 **
Alcohol Excitement	.27 ***	.24 ***	.18 **	.13 *
Alcohol Approach	.12 **	.10	.09	.04
Alcohol Cope	.17 **	.11	.12 *	.00
Stress Drinking	.03	-.02	.04	-.03
Alcohol Control	.09	.07	-.03	.01
M	-11.98	2.58	1.63	11.26
SD	5.31	1.21	0.73	2.24

Note. N = 300. N's vary slightly for each cell. The Alcohol Cope and Stress Drinking IATs used the Brief IAT format. For all measures, higher scores indicate more extreme responding in the direction assessed. ASCS = Alcohol Self-Concept Scale. DMQ-Enhance = the enhance subscale of the Drinking Motives Questionnaire; DMQ-Cope = the coping subscale of the Drinking Motives Questionnaire; BAS-Fun = the fun-seeking subscale of the Behavioral Activation Scale.

*
 $p < .05$.

**
 $p < .10$.

 $p < .001$.

Table 3b

Zero-order correlations and Descriptive Statistics for Drinking Outcomes, IATs, and Explicit Predictor.

	Consumption	Cravings	Problems
M	8.22	-15.49	4.32
SD	9.96	10.03	6.62
IATs			
Drinking Identity	.32 ***	.28 ***	.23 ***
Alcohol Excitement	.24 ***	.22 ***	.16 **
Alcohol Approach	.14 *	.12 *	.12 *
Alcohol Cope	.18 **	.12 *	.04
Stress Drinking	-.00	-.05	.03
Alcohol Control	.08	.02	.04
Explicit Predictors			
ASCS	.51 ***	.49 ***	.49 ***
DMQ-Enhance	.47 ***	.58 ***	.43 ***
DMQ-Cope	.40 ***	.62 ***	.57 ***
BAS-Fun	.30 ***	.23 ***	.31 ***

Note. N = 300. N's vary slightly for each cell. The Alcohol Cope and Stress Drinking IATs used the Brief IAT format. Drinks per Week = number of drinks consumed on a typical week in the last three months; Cravings = score on the Alcohol Craving Scale – Short Form, Revised; Problems = score on the Rutgers Alcohol Problem Index.

*
p < .05.

**
p < .10.

p < .001.

Table 4

Regression Models Predicting Alcohol Consumption from IATs and Explicit Predictors.

	Consumption <i>B</i>	SE <i>B</i>	<i>t</i>	Cohen's <i>d</i>
Drinking Identity IAT				
Gender	−0.24	0.13	−1.85	0.22
Drinking Identity IAT	0.67**	0.20	3.32	0.39
ASCS	0.10***	0.02	6.02	0.71
IAT × ASCS	−0.07	0.03	−2.10	0.25
Alcohol Excitement IAT				
Gender	−0.46***	0.13	−3.62	0.43
Alcohol Excitement IAT	0.50**	0.16	3.10	0.37
DMQ-Enhance	0.56***	0.06	9.14	1.09
IAT × DMQ-Enhance	−0.37*	0.15	−2.39	0.29
Alcohol Approach IAT				
Gender	−0.49**	0.14	−3.40	0.41
Alcohol Approach IAT	0.63**	0.21	2.97	0.35
BAS-Fun	0.17***	0.03	5.25	0.63
IAT × BAS-Fun	−0.17	0.09	−1.88	0.22
Alcohol Cope BIAT				
Gender	−0.53***	0.14	−3.75	0.44
Alcohol Cope BIAT	0.19	0.16	1.20	0.14
DMQ-Cope	0.63***	0.11	5.66	0.67
BIAT × DMQ Cope	−0.08	0.23	−0.35	0.04
Combined IAT Model				
Gender	−0.26	0.15	−1.72	0.21
Drinking Identity IAT	0.78***	0.20	3.95	0.48
Alcohol Excitement IAT	0.44†	0.20	2.17	0.26
Alcohol Approach IAT	0.39	0.23	1.71	0.21
Alcohol Cope BIAT	0.12	0.17	0.68	0.08

Note. IAT scores and explicit predictors were grand-mean centered. Gender was dummy-coded (0 = men, 1 = women). Cohen's $d = 2t/\sqrt{df}$. The regression models used generalized linear models with a negative binomial log link. Consumption = number of drinks consumed on a typical week in the last three months. ASCS = Alcohol Self-Concept Scale. DMQ-Enhance = the enhance subscale of the Drinking Motives Questionnaire; DMQ-Cope = the coping subscale of the Drinking Motives Questionnaire; BAS-Fun = the fun-seeking subscale of the Behavioral Activation Scale. Corrected alpha = .029.

*
 $p < .029$.

**
 $p < .01$.

 $p < .001$.

Table 5

Regression Models Predicting Alcohol Problems from IATs and Explicit Predictors.

	Alcohol Problems <i>B</i>	SE <i>B</i>	<i>t</i>	Cohen's <i>d</i>
Drinking Identity IAT				
Gender	0.16	0.16	1.00	0.12
Drinking Identity IAT	0.53 *	0.21	2.49	0.29
ASCS	0.13 ***	0.02	6.26	0.74
IAT × ASCS	−0.07	0.04	−1.60	0.19
Alcohol Excitement IAT				
Gender	−0.14	0.16	−0.92	0.11
Alcohol Excitement IAT	0.33	0.20	1.64	0.20
DMQ-Enhance	0.64 ***	0.07	8.72	1.04
IAT × DMQ-Enhance	−0.23	0.19	−1.23	0.15
Alcohol Approach IAT				
Gender	−0.02	0.17	−0.14	0.02
Alcohol Approach IAT	0.50 †	0.26	1.94	0.23
BAS-Fun	0.21 ***	0.04	5.51	0.66
IAT × BAS-Fun	−0.06	0.11	−0.50	0.06
Alcohol Cope BIAT				
Gender	−0.23	0.16	−1.48	0.17
Alcohol Cope BIAT	−0.21	0.18	−1.13	0.13
DMQ-Cope	0.95 *	0.12	7.69	0.91
BIAT × DMQ Cope	0.11	0.26	0.41	0.05
Combined IAT Model				
Gender	0.13	0.18	0.72	0.09
Drinking Identity IAT	0.77 **	0.22	3.45	0.42
Alcohol Excitement IAT	0.42	0.24	1.73	0.21
Alcohol Approach IAT	0.29	0.29	1.01	0.12
Alcohol Cope BIAT	−0.07	0.20	−0.36	0.04

Note. IAT scores and explicit predictors were grand-mean centered. Gender was dummy-coded (0 = men, 1 = women). Cohen's $d = 2t / df$. The regression models used generalized linear models with a negative binomial log link. ASCS = Alcohol Self-Concept Scale. DMQ-Enhance = the enhance subscale of the Drinking Motives Questionnaire; DMQ-Cope = the coping subscale of the Drinking Motives Questionnaire; BAS-Fun = the fun-seeking subscale of the Behavioral Activation Scale. Corrected alpha = .029.

†
 $p < .053$.

*
 $p < .029$.

**
 $p < .01$.

 $p < .001$.

Table 6

Regression Models Predicting Alcohol Cravings per Week from IATs and Explicit Predictors.

	Alcohol Cravings <i>B</i>	SE <i>B</i>	<i>t</i>	Cohen's <i>d</i>
Drinking Identity IAT				
Gender	−0.24	1.03	−0.24	0.03
Drinking Identity IAT	4.11 **	1.35	3.05	0.36
ASCS	0.89 ***	0.10	8.50	1.00
IAT × ASCS	−0.07	0.23	−0.29	0.03
Alcohol Excitement IAT				
Gender	−1.84	0.95	−1.94	0.23
Alcohol Excitement IAT	1.90	1.20	1.59	0.19
DMQ-Enhance	4.62 ***	0.40	11.48	1.37
IAT × DMQ-Enhance	−0.14	1.01	−0.14	0.02
Alcohol Approach IAT				
Gender	−1.41	1.19	−1.19	0.14
Alcohol Approach IAT	−6.95	8.29	−0.84	0.10
BAS-Fun	0.97 ***	0.26	3.72	0.44
IAT × BAS-Fun	0.88	0.72	1.22	0.15
Alcohol Cope BIAT				
Gender	−2.89 **	0.92	−3.14	0.37
Alcohol Cope BIAT	0.43	1.04	0.42	0.05
DMQ-Cope	8.66 ***	0.63	13.82	1.63
BIAT × DMQ Cope	−1.97	1.35	−1.46	0.17
Combined IAT Model				
Gender	−0.46	1.18	−0.39	0.05
Drinking Identity IAT	5.32 **	1.52	3.49	0.42
Alcohol Excitement IAT	3.68 *	1.57	2.34	0.28
Approach Avoid IAT	0.29	1.80	0.16	0.02
Alcohol Cope BIAT	1.02	1.33	0.76	0.09

Note. IAT scores and explicit predictors were grand-mean centered. Gender was dummy-coded (0 = men, 1 = women). Cohen's $d = 2t / df$. The regression models used ordinary least squares regression. Alcohol cravings = score on the Alcohol Craving Scale – Short Form, Revised. ASCS = Alcohol Self-Concept Scale. DMQ-Enhance = the enhance subscale of the Drinking Motives Questionnaire; DMQ-Cope = the coping subscale of the Drinking Motives Questionnaire; BAS-Fun = the fun-seeking subscale of the Behavioral Activation Scale.

Corrected alpha = .029.

* $p < .029$.

** $p < .01$.

*** $p < .001$.