Development and Validation of the Alcohol Identity Implicit Associations Test (AI-IAT)

Heather M. Gray[*],
Harvard Medical School: Cambridge Health Alliance, Division on Addictions

Debi A. LaPlante,
Harvard Medical School: Cambridge Health Alliance, Division on Addictions

Brittany L. Bannon,
Tufts University

Nalini Ambady, and
Tufts University

Howard J. Shaffer
Harvard Medical School; Cambridge Health Alliance, Division on Addictions

Abstract

Alcohol identity is the extent to which an individual perceives drinking alcohol to be a defining characteristic of his or her self-identity. Although alcohol identity might play an important role in risky college drinking practices, there is currently no easily administered, implicit measure of this concept. Therefore we developed a computerized implicit measure of alcohol identity (the Alcohol Identity Implicit Associations Test; AI-IAT) and assessed its reliability and predictive validity in relation to risky college drinking practices. One hundred forty-one college students completed the AI-IAT. Again 3- and 6-months later, we administered the AI-IAT and indices of engagement in risky college drinking practices. A subset of participants also completed the previously-validated implicit measure of alcohol identity. Scores on the AI-IAT were stable over time, internally consistent, and positively correlated with the previously-validated measure of alcohol identity. Baseline AI-IAT scores predicted future engagement in risky college drinking practices, even after controlling for standard alcohol consumption measures. We conclude that the AI-IAT reliably measures alcohol identity, a concept that appears to play an important role in risky college drinking practices.

[*]Corresponding author. 101 Station Landing, Suite 2100, Medford, MA 02155, United States. Tel.:+1 781 806 8611; fax: +1 781 806 8629. hgray@challiance.org (H. M. Gray).

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1. Introduction

Risky drinking behavior among college students is an ongoing public health problem. Two risky drinking practices that have the potential to create short- and long-term harm are "pre-gaming" and "hooking up" after drinking. Pre-gaming is the practice of rapidly consuming alcohol before attending a social event, typically with friends within college residences, to become intoxicated or slightly intoxicated (Pedersen, LaBrie, & Kilmer, 2009). When pre-gaming, students become intoxicated, in part, to ease the anticipated discomfort associated with meeting new people and, for men in particular, to facilitate sex opportunities (Pedersen & LaBrie, 2007; Pedersen, LaBrie, & Kilmer, 2009). The disinhibitory effects of alcohol also play a key role in hooking up, or engaging in casual sexual encounters that might involve intercourse (Gute & Eshbaugh, 2008). Both of these behaviors are prevalent on campus and present obvious physical and sexual risks, including alcohol poisoning, blacking out, and unprotected or nonconsensual sex (Pedersen & LaBrieFlack et al., 2007; Pedersen & LaBrie, 2007).

1.1. Alcohol identity

Reducing the potential harms associated with these activities requires a better understanding of their antecedents. The theory of planned behavior (Ajzen, 1991) is one of the most well-supported theories of the antecedents of human behavior, including college students' alcohol consumption (Collins & Carey, 2007; Conner, Warren, Close, & Sparks, 1999; Huchting, Lac, & LaBrie, 2008). The model proposes that attitudes, subjective norms, and perceived behavioral control jointly determine intentions, and intentions, in turn, determine behavior. Recent research suggests that adding the concept of self-identity to the model improves the prediction of intentions and behavior (e.g., Charng, Piliavin, & Callero, 1988; Fekadu & Kraft, 2001; Pierro, Mannetti, & Livi, 2003; Smith et al., 2007). Self-identity has been defined as "the salient part of an actor's self which relates to a particular behavior" (Conner & Armitage, 1998, p. 1444). Because people are motivated to maintain consistency in their self views, (Lalwani & Shavitt, 2009; Steele, 1988), self-identity can be a powerful determinant of behavior. Alcohol identity appears to be an important antecedent to risky drinking practices. Alcohol identity is the extent to which an individual perceives drinking alcohol to be a defining characteristic of his or her self-identity (Conner, Warren, Close, & Sparks, 1999). Dollinger and colleagues have discovered that alcohol identity is positively associated with college students' alcohol consumption and engagement in risky drinking practices (Casey & Dollinger, 2007; Dollinger, 1996; Dollinger, Rhodes, & Corcoran, 1993). This is consistent with work on the broader role of self-identity in behavior.

1.2. Measuring alcohol identity

To measure alcohol identity, Dollinger and colleagues (Casey & Dollinger, 2007; Dollinger, 1996; Dollinger, Rhodes, & Corcoran, 1993) used the autophotographic essay procedure (Ziller, 1990), which asks the participant to take a series of pictures that together represent an answer to the question, "Who are you?" The autophotographic essay is an implicit measure in that does not rely on introspective awareness and does not require self-reflection or deliberation (Nosek, Greenwald, Banaji, & Bargh, 2007). In this way, the autophotographic approach avoids some of the methodological artifacts associated with self-report measures of alcohol identity. Specifically, due to considerable introspective limits,

respondents might be unable to describe accurately the extent to which they possess an alcohol-related self-identity, "independent of their motivation or willingness to comply with the instruction"(Egloff & Schmukle, 2002, p. 1441).

However, the autophotoessay technique presents its own serious limitations. Most importantly, it is both financially and temporally intensive. It requires participants to take numerous photographs and prepare explanatory essays for each photo; trained judges must engage in comprehensive coding of those photos and essays. There is high cost involved in producing and scoring the autophotoessays. Moreover, human error can contribute to unreliability at several steps in this process, from the preparation of autophotoessays to the recording of scores. Because the measure is costly, lengthy, and relatively prone to errors, its application in clinical settings is limited. If alcohol identity is a concept that does predict a wide range of risky drinking practices, then it is important to develop an easily administered, brief, and automated measure of this concept.

1.3. Current study

Therefore, our goal in this work was to develop and validate an easily administered, implicit measure of alcohol identity and measure prospectively its association with future risky college drinking practices. To accomplish this, we created a new version of the Implicit Association Task (IAT; Greenwald, McGhee, & Schwartz, 1998), one of the most commonly-used techniques for measuring implicit cognitive processes. The IAT is a speeded reaction-time task that measures individuals' automatic associations with a concept of interest (Greenwald, McGhee, & Schwartz, 1998). Its predictive validity has been demonstrated in a wide range of domains, including alcohol and drug use behavior (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). Researchers have developed versions of the IAT to measure a variety of alcohol-related cognitions (Houben, Nosek, & Wiers, 2010; Houben, Rothermund, & Wiers, 2009; Ostafin & Palfai, 2006; Wiers, Rinck, Kordts, Houben, & Strack, 2010). In particular, several recent studies have used IATs to measure alcohol expectancies, which are associated with evaluative consequences of drinking (e.g. "wine" and "happy"; Thush & Wiers, 2007). The IAT also can be used to measure aspects of the self-identity, and other researchers have used this approach to measure aspects of participants' self-identity and their relation to actual behavior (Back, Schmukle, & Egloff, 2009; Egloff & Schmukle, 2002; Perugini & Leone, 2009). Whereas the IAT can be used to measure alcohol-related cognitions, on one hand, and aspects of self-identity, on the other hand, no research to our knowledge, has combined these two approaches to develop an IAT for alcohol identity.

Thus, the primary goal of this work was to develop the Alcohol-Identity Implicit Associations Test, an easily administered, implicit measure of alcohol self-identity. We examined the new measure's psychometric properties (i.e. test-retest reliability, internal consistency) and convergence with a previously validated and implicit measure of alcohol identity, the autophotographic essay procedure. On the basis of past work examining the psychometric properties of IATs, we hypothesized that the new measure would demonstrate moderate test-retest reliability (McCarthy & Thompsen, 2006) and high internal consistency (Nosek, Greenwald, Banaji, & Bargh, 2007).

We also examined the construct, predictive, and incremental validity of the AI-IAT. With regard to construct validity, we expected to observe moderate convergence with the autophotographic essay technique, the other existing implicit measure of alcohol identity (Cunningham, Preacher, & Banaji, 2001). With regard to predictive validity, we expected to observe moderate convergence between AI-IAT scores and future risky college drinking behaviors. A recent meta-analysis of predictive validity (Greenwald, Poehlman, Uhlmann, & Banaji, 2009) indicates that IAT scores converge moderately with actual alcohol and drug

use behavior (average correlation $r = 0.22$). Incremental validity is the extent to which a measure adds to the prediction of a criterion over and above other measures (Hunsley & Meyer, 2003). In this study we examined the extent to which the alcohol identity IAT predicts risky college drinking practices beyond traditional approaches to screening and case identification. Common approaches to identifying individuals whose drinking places them at risk for physical, psychological, social, and legal problems typically involve measures of alcohol consumption (Green et al., 2008). If the AI-IAT shows psychometric soundness and adds to the prediction of risky drinking practices beyond standard consumption measures, this would suggest that it might be used in future research and clinical endeavors to supplement commonly used tools.

We achieved these research goals using a sample of students at a private New England college, during an academic year marked by increased attention to pre-gaming and hooking up after drinking. We developed the AI-IAT and administered it at baseline along with standard consumption measures. Three months and six months later, we administered a measure of risky drinking practices. In addition, using a sub-sample of participants, we indexed the extent to which scores on the AI-IAT converge with scores on the autophotoessay protocol, as used by Dollinger and colleagues (Casey & Dollinger, 2007; Dollinger, 1996; Dollinger, Rhodes, & Corcoran, 1993).

2. Method

2.1 Participants

The baseline sample consisted of 141 college students who responded to our efforts to recruit students (age 18-22) on campus at a private college in the Northeast. The college is medium-sized (i.e. approximately 5,000 undergraduates), has no religious affiliation, and fewer than 20% of its student body is involved in Greek life. Participants' mean age was 19.23 (SD = 1.09). Eight-seven percent of participants were below the legal drinking age (i.e. 18, 19, or 20 years old). The sample was primarily Caucasian (63%), with 21% Asian, 10% bi-racial or multiracial, 5% African American, and 1% Native American. Six percent identified their ethnicity as Hispanic/Latino. Ninety-seven participants (69%) were female, 42 (30%) were male, and two did not report their gender. The majority (n = 110) lived in college dorms; the remainder lived in fraternities or sororities (n = 3), off campus (n = 22), or somewhere else (n = 6).

2.2. Measures

2. 2. 1. Autophotoessays—Following standard procedures, we gave participants a disposable camera and the following instructions: "Over the next week, please take a series of photographs that you feel answer the question 'Who are you?' By way of example, you can choose to portray your typical everyday environment and your current lifestyle; you could portray how you are unique (like no other person) and how you are like some or all others; you could show the traits or personality characteristics that are self-defining; you could depict the personal projects or important life tasks you are working on at present; or you could use your imagination to convey the inner values that you hold dear, the things that are most important to you, or to tell you life story." We took several steps to attenuate self-presentation biases. First, we made it clear to participants that their cameras were coded using numeric codes rather than identifying information. Second, we did not request alcohol-related imagery or any other specific imagery. Third, participants did not learn that the study was focused on drinking behavior until after they returned their cameras. Two raters, blind to AI-IAT scores, coded the number of photos with alcohol imagery per participant for approximately 20% of participants. They achieved perfect agreement. One of

the raters coded the remainder of the photo-essays. On average, participants included very few alcohol-related images in their photo-essays ($M = 0.23$, SD = 0.60).

2. 2. 2. Alcohol-Identity IAT: AI -IAT—We developed the AI-IAT using the standard procedures for the IAT (Greenwald, McGhee, & Schwartz, 1998). The stimuli were alcohol-related pictures, drinking water-related pictures, self-relevant words (i.e., "self," "me," "mine," "my"), and other-relevant words (i.e., "they," "them," "theirs," "others"). In the "congruent" blocks, participants paired alcohol-related pictures with self-relevant words and water-related pictures with other-relevant words. For instance, participants would see an image of a beer bottle and would need to assign it either to the joint category "alcohol or me" or to the joint category "water or not me." In this case, assigning the beer bottle to the joint category "alcohol or me" would be considered the correct response. In the "incongruent" blocks, participants paired alcohol-related pictures with other-relevant words and water-related pictures with self-relevant words. Continuing with this example, participants would need to assign the image of a beer bottle to the joint category "alcohol or not me" rather than the joint category "water or me." Response latencies for these critical combination blocks were recorded and analyzed using the improved IAT scoring algorithm (Greenwald, Nosek, & Banaji, 2003). We calculated the relative strength of the association between alcohol-relevant pictures and self-relevant words for each participant by means of a standardized *D* score by subtracting the mean response latency for the alcohol/self blocks from the mean response latency for the alcohol/other blocks and dividing by the standard deviation of the response latency for all trials. Following past work (Houben, Nosek, & Wiers, 2010), we dropped AI-IAT data at each testing occasion from participants who produced greater than 40% errors in any of the four critical blocks (two participants each at the baseline, 3-month, and 6-month assessments). Errors were defined as trials in which participants made an incorrect pairing (i.e. assigning the image of a beer bottle to the joint category "water or me").

2. 2. 3. Alcohol consumption—We measured alcohol consumption using items from the 2001 College Alcohol Study (CAS; Wechsler et al., 2002): (1) past 30-day frequency of alcohol use, (2) past 30-day frequency of drunk occasions, (3) past 30-day usual number of drinks consumed during drinking episodes, (4) past 2-week frequency of binge drinking (with gender-specific criteria), and (5) typical drinks it takes to get drunk.[1] These variables showed high internal consistency ($\alpha = 0.86$). As a result, we averaged the z-scored responses to create a composite index of alcohol consumption, separately for each testing occasion.

2. 2. 4. Risky college drinking practices—We included a measure of risky college drinking practices at the 3- and 6-month assessments. This measure included three questions each for pre-gaming and hooking up. Questions about pre-gaming were "Pre-gaming (i.e., drinking with friends before going out to a party or bar) is something I do regularly," "Pre-gaming is important to my social life," and "I don't feel fully ready to go out at night unless I've pre-gamed." Questions about hooking up were "It is not uncommon for me to hook up with someone after a night of drinking," "I find that it's easier to hook-up when I'm drunk," and "Hooking up after a night of drinking is important to my social life." Participants responded to all items on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*). The six items evidenced co-linearity as a single composite; factor analysis revealed a single component with Eigenvalue greater than one at each assessment. Consequently, we averaged responses and created a composite index of risky drinking practices, our central outcome ($\alpha = 0.88$ at 3-month assessment and 0.89 at 6-month assessment).

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[1]Participants were oriented in the questionnaire as to what constitutes a standard alcoholic drink. We defined binge drinking has consuming five or more drinks on a single occasion (four or more drinks for women).

2. 3. Procedure

We used several strategies to recruit participants: an email to undergraduates who had previously expressed interested in participating in psychology studies; a targeted ad on a social networking website; flyers posted around campus; and direct solicitation at the campus student center. During recruitment, we did not mention the study's focus on alcohol use. Eligibility criteria were being a student at the University between the ages of 18-22. We assembled a database of potential participants and invited the first 154 individuals who expressed interest in the study to participate in the autophotoessay protocol; 91 agreed. The baseline assessment took place approximately one week later. We invited all potential participants in our database to complete the baseline assessment and 141 assented. Of these, 118 (84%) completed the 3-month assessment (on average 107 days after baseline) and 120 (85 %) completed the 6-month assessment (on average 178 days after baseline). Participants completed the study in single laboratory rooms equipped with personal computers. (A sub-set of participants completed the subsequent phases of the study on-line from remote locations.[2]) Participants always completed an informed consent statement first, followed by the AI-IAT, the CAS, and the risky college drinking measures. We compensated participants at each phase of the study with gift certificates to an online retailer. The Institutional Review Boards of Cambridge Health Alliance and Tufts University approved the study. We completed this study during the 2009-2010 academic year.

3. Results

3. 1. Attrition

We first explored potential differences between participants who completed the follow-up assessments and those who failed to complete follow-up assessments, both with regard to demographic characteristics (i.e., gender and college residence) and alcohol outcomes at baseline. We did not observe a gender disparity in terms of completion of the 3-month assessment. However, more women (19 of 97) than men (2 of 42) failed to complete the 6-month assessment, $\chi^2 (1) = 5.05$, $p < .05$. With regard to year of graduation, a greater proportion of juniors (45%) failed to complete the 3-month assessment, compared to freshmen (14%), sophomores (10%), and seniors (6%) (Kruskal-Wallis $p < .05$). There were no attrition differences associated with college residence. With regard to baseline alcohol outcomes, there were no differences between participants who did and did not complete the 3-month assessment. Participants who failed to complete the 6-month assessment, however, had higher baseline alcohol consumption scores ($M = 0.36$, SD = 0.91) compared with completers ($M = -0.10$, SD = 0.81), $t (136) = 2.36$, $p < 0.05$.

3.2 Descriptive Statistics: Alcohol Consumption, AI-IAT Scores, and Risky Drinking Practices

We examined baseline CAS responses to get a better sense of the participants' drinking patterns. During the 30 days prior to the baseline assessment, participants had a drink of alcohol 5.17 times (SD = 4.29) and drank enough to get drunk 2.92 times (SD = 3.12). They averaged 3.58 (SD = 2.63) alcoholic drinks per drinking occasion and 1.68 (SD = 2.30) episodes of binge drinking during the two weeks prior to baseline. They reported consuming an average of 5.50 (SD = 2.59) drinks to get drunk. During the month before baseline, they averaged a total of 2.88 (SD = 4.21) past-month alcohol-related problems. CAS scores did not appear to vary across the three testing sessions (repeated measures $F (2, 212) = 1.38$, ns).

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[2]Five participants completed the study on-line at the 3-month assessment and sixteen completed the study on-line at the 6-month assessment. Participation format had no impact on AI-IAT scores or error rates at either occasion.

On average, participants produced negative AI-IAT scores, indicating relatively greater association of "water" and "me," as compared with "alcohol" and "me." Average scores were -0.24 (SD = 0.42), -0.31 (SD = 0.38), and -0.34 (SD = 0.40) at the baseline, 3-month, and 6-month assessments, respectively. All three mean scores were significantly lower than zero (all p's <.001).

Participants' scores on the index of risky college drinking practices were stable across the two follow-up assessments ($r = 0.91$, $p < .001$). Average scores for the 3-month and 6-month assessments were 2.45 (SD = 1.08) and 2.44 (SD = 1.08) on a 5-point scale, respectively, indicating moderate agreement with the pre-gaming and hooking-up statements.

As in past research (Greenwald, Nosek, & Banaji, 2003; Ostafin & Palfai, 2006), participants who completed the congruent blocks first had higher AI-IAT scores (i.e. stronger self + alcohol associations) than participants who completed the incongruent blocks first (baseline $t(136) = 4.25$, $p < .001$; 3-month $t(115) = 5.60$, $p < .001$; 6-month $t(115) = 4.72$, $p < .001$).

3.3. Reliability of the AI-IAT

3. 3. 1. Stability—The AI-IAT showed stability over time. As Table 1 indicates, correlations among AI-IAT scores at the three occasions were positive and statistically significant (correlation r's were 0.38, 0.48, and 0.49).

3. 3. 2. Internal consistency—We created two partial measures to examine the internal consistency of baseline AI-IAT scores (Greenwald, Nosek, & Banaji, 2003). One partial measure was based on responses to the first presentation of each stimulus (i.e., the first time a participant sorted an image of a beer bottle into one of the joint categories "alcohol or me" or "water or not me"), and the other was based on responses to the second presentation of each stimulus (i.e., the second time the participant used the same sorting system for the same image). We applied the scoring algorithm to each set of responses and computed the correlation between the two resulting scores. The correlation between partial measures ($r = 0.90$, $p < .001$) indicated adequate internal consistency.

3. 4. Validity of the AI-IAT

3. 4. 1. Convergent validity—We examined the extent to which participants' AI-IAT scores across the baseline, 3-month, and 6-month assessments correlated with the number of alcohol-related images included in their photo-essays. Correlations were positive across all three occasions (baseline $r = 0.13$, ns; 3-month $r = 0.36$, $p < .01$; 6-month $r = 0.27$, $p < .05$). AI-IAT scores generally correlated with concurrent CAS alcohol consumption scores, as well (baseline $r = 0.27$, $p < .01$; 3-month $r = 0.11$, ns; 6-month $r = 0.28$, $p < .01$). Table 1 summarizes these results.

3. 4. 2. Predictive validity—We next examined whether AI-IAT scores predicted future risky drinking practices. We controlled for participant gender and AI-IAT order (congruent or incongruent blocks first) in Step 1 of all regression analyses (Ostafin & Palfai, 2006). At Step 2, inclusion of baseline AI-IAT scores accounted for an additional 12% of the variance in 3-month risky drinking behaviors, $F(1, 110) = 14.98$, $p < .001$. Participants who had stronger associations between "alcohol" and "me" at baseline were more likely to engage in risky drinking behaviors three months later ($\beta = 0.38$). Baseline AI-IAT scores continued to predict 6-month risky drinking behaviors, accounting for an additional 7% of the variance, $F(1, 110) = 8.41$, $p < .01$. Participants who had stronger associations between "alcohol" and

"me" at baseline were more likely to engage in risky drinking behaviors six months later (β = 0.29). Table 2 summarizes these results.

3. 4. 3. Incremental validity—Next, we examined the extent to which the AI-IAT predicted future risky college drinking practices after controlling for CAS alcohol consumption levels. To investigate this question, we performed a series of hierarchical regressions entering participant gender and IAT order in at Step 1, CAS scores at Step 2, and baseline AI-IAT scores at Step 3. With regard to 3-month risky college drinking practices, baseline AI-IAT accounted for an additional 3% of the variance after accounting for CAS alcohol consumption levels, $F(1, 109) = 9.82$, $p < .01$. Again, participants who had stronger associations between "alcohol" and "me" at baseline were more likely to engage in risky drinking behaviors three months later (β = 0.20). The same pattern held at the 6-month assessment: baseline AI-IAT accounted for an additional 2% of the variance after accounting for CAS alcohol consumption levels, $F(1, 109) = 4.32$, $p < .05$, $\beta = 0.14$.AI-IAT scores generated at the 3-month assessment also predicted risky college drinking practices after controlling for CAS scores, $F(1, 109) = 4.32$, $p < .05$, $\beta = 0.14$). Table 3 summarizes these results.

4. Discussion

The primary goal of this research was to develop and prospectively validate an implicit measure of alcohol identity among a sample of college students. We discuss these results first in terms of the psychometric properties of the AI-IAT, and second in terms of the predictive and incremental validity of the AI-IAT.

4. 1. Reliability of the AI-IAT

As hypothesized, the AI-IAT scores showed moderate test-retest reliability. Intercorrelations among scores generated at the three assessments are similar to, though slightly lower than, reliability scores reported in a previous study of an alcohol-expectancy IAT (McCarthy & Thompsen, 2006). Some have noted that although the temporal stability of the IAT is somewhat lower than that derived from explicit measures, the high stability of explicit measures might result more from participants' ability to present consistent responses rather than true attitude consistency (Cunningham, Preacher, & Banaji, 2001). IATs are less susceptible to this self-presentation concern. As in past research, we observed high internal consistency (Nosek, Greenwald, Banaji, & Bargh, 2007).

4. 2. Validity of the AI-IAT

4. 2. 1. Convergent validity—We observed moderate convergence with the autophotographic essay technique. The level of convergence is similar to other observations of the convergent validity of implicit measures (Cunningham, Preacher, & Banaji, 2001). We suggest that the convergence of AI-IAT scores with autophotographic essay scores was compromised by the lack of variability in autophotographic essay scores, as only 16% of participants who completed autophotoessays included at least one alcohol-related image. This was potentially due, in part, to the fact that a considerable number of returned photographs were unusable because participants failed to use the cameras correctly (i.e. they did not remember to use the flash and returned photos that were too dark to code). Compared to the autophotoessay procedure, the AI-IAT offers considerable ease of administration and is relatively immune from human error. Participants completed the AI-IAT independently and only required about five minutes to do so. In future work, we plan to continue our exploration of the convergent validity of the AI-IAT by comparing scores against other potential measures of alcohol identity.

4. 2. 2. Predictive validity—These results suggest that, as hypothesized, alcohol identity measured at the implicit level is associated with future engagement in pre-gaming and hooking up after drinking, risky drinking activities that are prevalent among college students. Specifically, participants whose AI-IAT responses indicated a stronger association between the concepts "alcohol" and "me" were more likely to engage in future risky drinking practices than those with a weaker AI-IAT association between these concepts. This result adds to the literature indicating that self-identity is an important predictor of behavior. On a practical level, these results suggest that reducing the extent to which college students incorporate the concept of "alcohol" into their broader self-concepts might decrease their engagement in these risky drinking practices.

4. 2. 3. Incremental validity—With regard to incremental validity, our findings indicate that the AI-IAT adds to the prediction of risky drinking practices beyond the influence of standard alcohol consumption measures, which, as mentioned, typically are used in screening and case identification. Because the AI-IAT offers low costs and ease of administration, clinicians can incorporate a version of it in their existing efforts to identify college students who might be on the verge of developing dangerous drinking habits. Developers of the IAT have suggested previously that versions of the IAT might be useful in clinical settings, particularly as a supplement to standard assessments (Nosek, Greenwald, Banaji, & Bargh, 2007). In addition, a measure such as the AI-IAT might be useful as a method of providing motivational feedback to students who have already been identified as potential risky drinkers (e.g., first-time violators of college drinking rules). The IAT can be easily modified so as to provide scores directly to participants. These scores might be used a non-judgmental, non-confrontational manner to highlight potential ambivalence about current drinking practices and to elicit a desire to change one's behavior, similar to the basic tenets of motivational interviewing (Lewis et al., 2010).

We consider this investigation as a first step towards establishing the clinical utility of this new measure. In this work, we document the psychometric properties of the AI-IAT among a sample of relatively light drinkers. The logical next step is to use a sample of at-risk participants. We suggest that the AI-IAT might show stronger evidence of incremental validity among a sample of individuals who are motivated to hide their alcohol consumption behavior. This hypothesis is based on the role of social sensitivity in the incremental validity of the IAT. Social sensitivity refers to the extent to which a construct's measurement is influenced by impression management concerns (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). In general, the IAT shows stronger evidence of incremental validity when the construct being measured is socially sensitive (e.g., racial attitudes), because impression management can undermine the validity of typical self-report measures but has a smaller impact on the IAT (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). We suggest that given the relatively low levels of problematic drinking among our sample, for the vast majority of our participants, alcohol use was not a socially sensitive topic. Thus, their responses to the traditional self-report measure were less susceptible to impression management concerns and thus highly correlated with outcomes, leaving little room in variance in outcomes (Engelhard, Huijding, van den Hout, & de Jong, 2007). Additional research is required to determine how the incremental validity of the AI-IAT changes as a function of the characteristics of the sample. We hypothesize that when participants are more motivated to present a favorable impression in self-report measures, the predictive validity of self-report measures will decrease and the incremental validity of the AI-IAT will therefore improve. If the incremental validity in clinical settings is acceptable, clinicians might wish to supplement traditional approaches to risk assessment (i.e., clinical interviews, self-reports) with the AI-IAT or other implicit, performance-based measures.

4. 3. Alcohol identity within the theory of planned behavior

The theory of planned behavior (Ajzen, 1991) offers a potential explanation for the association between baseline AI-IAT scores and future engagement in risky college drinking practices. Some research suggests that the self-identity adds to the prediction of intentions and behavior across a wide range of domains, including safe sex practices (Fekadu & Kraft, 2001), healthy eating (Pierro, Mannetti, & Livi, 2003), blood donation (Charng, Piliavin, & Callero, 1988), and consumer behavior (Smith et al., 2007). It has been suggested that engaging in identity-relevant behavior not only helps to maintain consistency in the broader self-concept, but also strengthens social bonds (Charng, Piliavin, & Callero, 1988; Conner & Armitage, 1998; van den Putte, Yzer, Willemsen, & de Bruijn, 2009). By publicly engaging in behavior that is perceived as normative (e.g., pre-gaming and hooking up), college students can publicly reinforce their shared self-identities and thus strengthen their relationships with one another. This is consistent with the broader role of peer influences in young adult substance use (Verkooijen, de Vries, & Nielsen, 2007). Indeed, risky drinking practices are often viewed as a way of building and solidifying interpersonal relationships, particularly among college women (LaBrie, Hummer, & Pedersen, 2007).

4. 4. Limitations

This study is not without its limitations. Because we did not include a measure of behavioral intentions, it is unclear whether alcohol identity had a direct or an indirect influence on behavior. The theory of planned behavior assumes that intentions mediate the effects of subjective norms, attitudes, perceived behavioral control, and other unspecified variables on behavior (Ajzen, 1991). Evidence in support of this assumption is mixed. Some past work (Charng, Piliavin, & Callero, 1988) has indicated that self-identity has only an indirect influence on behavior, through its impact on intentions. However, other work indicates that among young adults, identification with a behaviorally-defined social group (e.g., "People who exercise") directly predicts relevant behavior (Hamilton & White, 2008; Rivis & Sheeran, 2003). The direct relationship between self-identity and behavior is particularly strong when many people in the peer group engage in the relevant behavior (Rivis & Sheeran, 2003). It is unclear, on the basis of the current work alone, whether thinking of oneself as a drinker automatically leads to risky drinking behaviors, or instead has impact by shaping intentions.

The small sample size in this study might have limited our ability to detect statistically significant associations. The sample was fairly homogenous in terms of some demographic characteristics (e.g., age, education level) and all came from one university. Future research should examine the association between the AI-IAT and outcome measures in a larger, more heterogeneous sample of college students. Another direction for future research is the inclusion of individuals who exhibit more risky drinking patterns, either within a college setting or from a clinical setting (i.e., individuals seeking treatment for alcohol use disorders). As discussed above, we suspect that the AI-IAT will show stronger evidence of incremental validity among individuals who might be motivated to suppress beliefs or attitudes towards drinking alcohol.

4. 5. Novel contributions

The current study extends existing research in several ways. First, because we evaluated the relationship between implicit alcohol identity and risky drinking practices longitudinally, we tentatively conclude that alcohol identity contributes to the development of risky drinking habits. We should note, however, that the relationship between alcohol identity and risky drinking practices is likely recursive. In other words, regularly engaging in risky drinking practices likely strengthens the alcohol identity, as demonstrated in other behavioral domains (Charng, Piliavin, & Callero, 1988; Farmer & Van Dyne, 2010). In addition,

engaging in risky drinking practices before college could have contributed to development of an alcohol identity in college.

Also, we have focused on behaviors that are relatively less severe than other frequently studied activities (e.g., drunk driving, drinking daily, drinking enough to pass out). This is in keeping with an emerging trend in the literature, including studies of playing in drinking games (Borsari, 2004; Lewis et al., 2010) and behavior that occurs only in special circumstances, such as Spring Break and on the twenty-first birthday (Lee, Lewis, & Neighbors, 2009; Lewis et al., 2010). More research is needed to specify how alcohol identity interacts with other individual-level and situational antecedents of these relatively less severe behaviors.

Anecdotal evidence suggests that many college students are aware of the risks inherent in pre-gaming and hooking up while drunk. For instance, in an article about emerging drinking trends in the study site's student newspaper during our data collection period, a sophomore spoke of pre-gaming as "…the underlying cause of a lot of the dangerous situations." However, students are also aware that these behaviors are becoming normative; another student wrote, "It is more the norm than the exception for students to 'hook up' while drunk. For many, it would even come as a surprise to hear that a friend had been sober when he or she 'made the first move.'" It is likely that these countervailing pressures—awareness of the risks and awareness of social norms—jointly determine engagement in pre-gaming and hooking-up. Alcohol identity appears to be another determinant of risky college drinking practices. The addition of an implicit measure of alcohol identity, such as the AI-IAT, to traditional assessment tools might improve the ability to predict and prevent some of the hazards of risky college drinking practices.

Acknowledgments

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Research highlights

- We developed a computerized implicit measure of alcohol identity (the AI-IAT)

- We administered the AI-IAT to a sample of undergraduate students

- Participants completed multiple assessments over the course of an academic year

- The AI-IAT showed acceptable test-retest reliability and internal consistency

- The AI-IAT showed moderate convergent, predictive, and incremental validity

Table 1

Correlations Among Autophotoessay, AI-IAT, CAS, and Risky Drinking Practices Scores.

Measure	1	2	3	4	5	6	7	8	9
1. Autophotoessay	–	.13	.07	.36**	.13	.10	.27*	.22	.22
2. Baseline AI-IAT		–	.27**	.49**	.19*	.32**	.38**	.23*	.24*
3. Baseline CAS			–	.10	.83**	.79**	.18	.83**	.76**
4. 3-Month AI-IAT				–	.11	.15	.48**	.20*	.17
5. 3-Month CAS					–	.76**	.27*	.81**	.71**
6. 3-Month Risky Drinking Practices						–	.18	.76**	.91**
7. 6-Month AI-IAT							–	.28**	.19*
8. 6-Month CAS								–	.78**
9. 6-Month Risky Drinking Practices									–

Note. CAS = College Alcohol Survey. AI-IAT = Alcohol-Identity Implicit Association Test

*
$p < .05$,

**
$p < .01$

Table 2

Summary of Regression Analyses Predicting Future Risky Drinking Practices from AI-IAT Scores.

	R^2	ΔR^2	ΔF	df	β
Outcome: 3-Month Risky Drinking Practices					
Step 1	.03		1.81	2, 111	
Gender					.17[†]
AI-IAT Order					-.05
Step 2	.15	.12	14.98**	1, 110	
Baseline AI-IAT Score					.38**
Outcome: 6-Month Risky Drinking Practices					
Step 1	.04		2.27	2, 111	
Gender					.19[†]
AI-IAT Order					-.06
Step 2	.11	.07	8.41**	1, 110	
Baseline AI-IAT Score					.29**
Outcome: 6-Month Risky Drinking Practices					
Step 1	.05		2.43[†]	2, 102	
Gender					.15
AI-IAT Order					-.14
Step 2	.08	.04	4.14*	1, 101	
3-Month AI-IAT Score					.23*

Note. Gender (0 = female, 1 = male); CAS = College Alcohol Survey; Alcohol-Identity Implicit Association Test (AI-IAT) order (0 = incongruent first, 1 = congruent first); AI-IAT Score (more positive = stronger alcohol + self associations).

[†]
$p < .10$,

*
$p < .05$,

**
$p < .01$

Table 3

Summary of Regression Analyses Predicting Future Risky Drinking Practices from AI-IAT Scores, Controlling for CAS Index.

	R^2	ΔR^2	ΔF	df	β
Outcome: 3-Month Risky Drinking Practices					
Step 1	.03		1.81	2, 111	
Gender					.17[†]
AI-IAT Order					-.05
Step 2	.64	.61	182.74**	1, 110	
Baseline CAS Index					.80**
Step 3	.67	.03	9.82**	1, 109	
Baseline AI-IAT Score					.20**
Outcome: 6-Month Risky Drinking Practices					
Step 1	.04		2.27	2, 111	
Gender					.19[†]
AI-IAT Order					-.06
Step 2	.60	.56	155.52**	2, 110	
Baseline CAS Index					.78**
Step 2	.62	.02	4.32*	1, 109	
Baseline AI-IAT Score					.14*

Note. Gender (0 = female, 1 = male); CAS = College Alcohol Survey; Alcohol-Identity Implicit Association Test (AI-IAT) order (0 = incongruent first, 1 = congruent first); AI-IAT Score (more positive = stronger alcohol + self-associations).

[†]
$p < .10$,

*
$p < .05$,

**
$p < .01$