



Evaluating the relationship between explicit and implicit drinking identity centrality and hazardous drinking



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ABSTRACT

Introduction: Drinking identity strength (how strongly one views oneself as a drinker) is a promising risk factor for hazardous drinking. A critical next step is to investigate whether the centrality of drinking identity (i.e., the relative importance of drinking vs. other identity domains, like well-being, relationships, education) also plays a role. Thus, we developed explicit and implicit measures of drinking identity centrality and evaluated them as predictors of hazardous drinking after controlling for explicit drinking identity strength.

Methods: Two studies were conducted ($N_s = 360$ and 450 , respectively). Participants, who self-identified as full-time students, completed measures of explicit identity strength, explicit and implicit centrality, and the Alcohol Use Disorders Identification Test (AUDIT). Study 1a evaluated two variants of the implicit measure (short- vs. long-format of the Multi-category Implicit Association Test); Study 1b only included the long form and also assessed alcohol consumption.

Results: In Study 1a, implicit and explicit centrality measures were positively and significantly associated with AUDIT scores after controlling for explicit drinking identity strength. There were no significant differences in the implicit measure variants, but the long format had slightly higher internal consistency. In Study 1b, results replicated for explicit, but not implicit, centrality.

Conclusions: These studies provide preliminary evidence that drinking identity centrality may be an important factor for predicting hazardous drinking. Future research should improve its measurement and evaluate implicit and explicit centrality in experimental and longitudinal studies.

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1. Introduction

Despite the long-standing emphasis on studying the self in psychology, identity assessments have been largely absent from empirical studies of alcohol misuse until recently. An emerging body of research has demonstrated that identification with alcohol-related behaviors and groups is associated with a wide range of drinking outcomes among college students (Lindgren, Foster, Westgate, & Neighbors, 2013a; Lindgren et al., 2013b, 2016a), community samples (Werntz, Steinman, Glenn, Nock, & Teachman, 2016), and treatment samples (Buckingham, Frings, & Albery, 2013). In particular, measures of *drinking identity* assess the strength of identification with drinking behavior (Lindgren et al., 2013a, 2013b), or alcohol itself (Gray, Laplante, Banon, Ambady, & Shaffer, 2011), and are robust predictors of drinking outcomes even after controlling for other well-established cognitive risk

factors for hazardous drinking (Lindgren, Ramirez, Olin, & Neighbors, 2016b). To our knowledge, however, the *centrality* of drinking identity (i.e., its importance relative to other domains of identity, such as one's relationships) has not been assessed with either implicit or explicit measures, nor do we know how it relates to hazardous drinking. Should centrality predict drinking outcomes, it suggests another potential intervention strategy (i.e., reducing the importance of one's drinking identity and/or increasing the importance of a different domain), which is critical given the burden of hazardous drinking nationally (Naimi, Nelson, & Brewer, 2010) and internationally (Rehm et al., 2009). We, therefore, developed implicit and explicit measures of drinking identity centrality and evaluated their utility as predictors of hazardous drinking (Studies 1a and 1b) and alcohol consumption (Study 1b only), after controlling for explicit measures of drinking identity strength.

1.1. Drinking identity strength and centrality

Current drinking identity measures typically assess the strength of that identity. These measures include self-report or *explicit measures* like the Alcohol Self Concept Scale (Lindgren et al., 2013b; adapted from Shadel & Mermelstein, 1996), which asks individuals to rate

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their agreement with statements regarding how strongly one identifies with alcohol or drinking. A set of indirect or *implicit measures* have also been developed from the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), which assesses the relative strength of automatic associations between constructs in memory (automatic in the sense of being difficult to consciously control). For example, the drinking identity IAT developed by Lindgren et al. (2013b) measures associations between stimuli represented by the categories *me*, *not me*, *drinker*, and *non-drinker*, and assumes that individuals with stronger (relative to weaker) drinking identities will have stronger associations between *drinker* and *me* stimuli relative to *drinker* and *not me* stimuli. Consistent with meta-analyses that support unique contributions of implicit and explicit measures of substance use (see Reich, Below, & Goldman, 2010; Roefs et al., 2011), implicit and explicit drinking identity measures evaluated simultaneously have both been shown to be robust predictors of alcohol consumption, problems, cravings, and risk of alcohol use disorders among college (cross-sectional: Lindgren et al., 2013b; longitudinal: Lindgren et al., 2016a, 2016b) and community samples (cross-sectional: Wernitz et al., 2016). Additionally, the interaction of implicit and explicit drinking identity was also recently found to be a significant predictor of in vivo drinking in a laboratory-based alcohol taste test (Frings, Melichar, & Albery, 2016) and of risk of alcohol use disorder in a community sample (Lindgren et al., 2016c). Further, compared to other well-established cognitive factors (i.e., alcohol expectancies, drinking norms, drinking motives), and other implicit alcohol-related associations (i.e., alcohol-approach, alcohol-excite, and alcohol-cope associations), drinking identity is a more robust and consistent predictor of drinking outcomes (Lindgren et al., 2013a, 2013b, 2016a). These findings suggest that both explicit and implicit measures of drinking identity are important cognitive risk factors for hazardous drinking.

Our conceptualization of drinking identity stems from the personal-ity and individual differences tradition, and we view identity as synonymous with the self-concept (see Lindgren, Neighbors, Gasser, Ramirez, & Cvencek, 2016d). Thus, we have focused on individual differences in implicit and explicit drinking identity wherein individuals will vary in the strength of that drinking identity. Consistent with general conceptualizations of the self-concept (e.g., Markus & Wurf, 1987) and associative models of the self-concept (e.g., Greenwald et al., 2002), we view identity as multi-faceted (i.e., individuals will have many identities) and as inherently dynamic (i.e., different identities will be activated in different contexts and will change across the lifespan). These different identities, which we refer to as *identity domains*, are thought to be organized hierarchically. Consistent with this assumption, research indicates that identity domains that are perceived as more central, or important, have been shown to have stronger influences on behavior and psychological functioning (Simon, 1992; Stryker & Serpe, 1982). We note that consideration of the centrality of an identity is also reflected in more social psychological formulations of identity, which emphasize groups and group membership (see Leach et al., 2008; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Leach and colleagues (2008), in particular, have put forth and found support for a hierarchical model of in-group identification. In this model, centrality, which they define as the extent one's membership in a given group is *important* and *salient*, plays a unique and important role in terms of the extent individuals are sensitive to and defend against threats to their in-group. Thus, whether considering identity from an individual differences or social group perspective, there is support for evaluating the importance of a particular identity domain relative to other identity domains.

Evaluating drinking identity centrality is not only important from the vantage of psychological theory. Doing so may also pinpoint unique intervention targets. For example, consider an individual who strongly identifies with drinking and for whom drinking is more central than other identity domains. Interventions could certainly focus on reducing the strength of the identity via shifting the individual's drinking identity to be a moderate drinker or a non-drinker, but they could also focus on decreasing the centrality of the drinking identity via increasing the

importance of alternate, competing identities. Thus, to the degree that identity centrality represents a unique construct (relative to identity strength), it might also be an additional intervention target. While speculative, it is possible that it may be easier for some people to strengthen an alternate identity (e.g., become more invested in their identity as a romantic partner or as student), and thereby indirectly reduce the importance of drinking identity, as opposed to trying to reduce drinking identity directly. Focusing on strengthening an alternate identity could be particularly important when individuals have lost a valued identity (see Dingle, Cruwys, & Frings, 2015, for work on the link between losing a valued identity and addiction) or when individuals lack other valued aspects of identity to focus on (see related work in Acceptance and Commitment Therapy on leading a valued life as a means to reduce mental health problems; Twohig, 2012).

To date, few studies have compared different aspects of identity and their relative importance in the field of alcohol research, though this comparative importance of distinct identity domains has been a valuable predictor in other fields; for example, race (Sellers, Kuperminc, & Damas, 1997), gender (Martire, Stephens, & Townsend, 2000; Settles, Jellison, & Pratt-Hyatt, 2009), and parenting (Gaunt & Scott, 2014). In the alcohol field, we know of one study from the United Kingdom (Tarrant & Butler, 2011) that compared identity domains (but not drinking identity). Students who had their "student" identities primed were less likely to report intentions of drinking within recommended guidelines for safe drinking compared to students who had "nationality" identities primed, suggesting that "student" identities have stronger associations with risky drinking (Tarrant & Butler, 2011). Some studies of drinking identity have evaluated multiple drinking-related identities relative to one another. For example, Buckingham et al. (2013) assessed both identification with addiction and with treatment recovery groups among members of Alcoholics Anonymous and Narcotics Anonymous, finding that individuals who perceived a "recovering addict" identity as more favorable relative to an "addict" identity were less likely to report relapse in the past month, past year, and past two years. A next critical step is, therefore, to develop measures that can assess the importance of identification with drinking relative to other common, meaningful identity domains and evaluate their predictive validity. Thus, we sought to develop implicit and explicit measures of drinking identity centrality and evaluate them as predictors of hazardous drinking.

1.1.1. Measuring drinking identity centrality

Dual process models of identity (general self-concept: Back, Schmukle, & Egloff, 2009; substance self-concept: Lindgren et al., 2016d) and behavior (general: Strack & Deutsch, 2004; addiction: Wiers et al., 2007) delineate two types of cognitive processes – implicit (fast/reflexive/impulsive) and explicit (slow/reflective/controlled). While recent evidence suggests that this dichotomous implicit/explicit separation may be an oversimplification (Van Bavel, Jenny Xiao, & Cunningham, 2012), these models nonetheless highlight the importance measuring both aspects of centrality.

Explicit cognitive processes are typically assessed via self-report that allows for more reflective controlled responding. Along these lines, to measure explicit drinking identity centrality, we sought to develop a questionnaire to evaluate the self-reported importance of drinking relative to each of a set of alternative identity domains. We drew from measures of alcohol problems (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; White & Labouvie, 1989) and from evidence-based cognitive behavioral psychotherapies (Behavioral Activation: Hopko, Lejuez, Ruggiero, & Eifert, 2003; Acceptance and Commitment Therapy: Hayes, Strosahl, & Wilson, 1999) to identify alternative, important identity domains: education/vocation, relationships (with friends, family, and peers/colleagues), and well-being (physical and mental health).

Implicit cognitive processes are typically assessed indirectly and often use reaction time measures. As noted above, implicit drinking identity associations have been most commonly assessed with the IAT,

which evaluates strengths of associations with the self when paired with drinker vs. non-drinker, representing opposite poles of the same identity. However, we wished to contrast different identity domains, so elected to instead use a variant of the IAT called the Multi-category IAT (MC-IAT; Axt, Ebersole, & Nosek, 2014), which enables comparisons across multiple categories (for a related approach in the clinical field, see also Clerkin, Teachman, Smith, & Buhlmann, 2014). As used by Axt et al., the MC-IAT evaluated implicit racial bias related to four racial groups (Asian, Black, Hispanic, and White) and used an extended format (i.e., more blocks) to evaluate all possible sets of contrasts (i.e., Asian vs. Black, Asian vs. Hispanic, Asian vs. White, Black vs. Hispanic, Black vs. White, Hispanic vs. White). An IAT score can be calculated for each of the six contrasts. Axt et al. then calculated an average score for all contrasts involving a specific racial group (e.g., Asian) and used it as a proxy for attitudes about Asians relative to the other racial groups. We reasoned that this measure and approach could be adapted to evaluate relative identities and sought to develop an MC-IAT that evaluated contrasts between different identity domains (i.e., drinking, education/vocation, relationships, well-being). Like the racial bias MC-IAT, the identity MC-IAT would yield IAT scores for each set of contrasts, and the average IAT score for all contrasts involving drinking could be used as a proxy for the importance of drinking relative to other domains (i.e., our implicit measure of centrality).

1.2. Study overview and hypotheses

The primary aims of the current studies were to develop implicit and explicit measures of drinking identity centrality and examine whether each accounts for unique variance in drinking outcomes in a student sample above and beyond established explicit measures of drinking identity strength. Given both implicit and explicit measures of the drinking identity strength construct have been found to predict unique variance in hazardous drinking, we hypothesized that both types of measures of drinking identity centrality would also predict hazardous drinking uniquely. We further expected that centrality measures would predict hazardous drinking above and beyond measures of drinking identity strength. We tested these hypotheses in two very similar studies. Both evaluated an implicit measure of drinking identity centrality (an adaptation of the MC-IAT developed for these studies), an explicit measure of drinking identity centrality (a self-report measure developed for the studies), explicit measures of identity strength (existing self-report questionnaire that evaluates how strongly one identifies as a drinker vs. non-drinker), and a measure of hazardous drinking. Study 1a included both a short and long variant of the implicit drinking identity centrality measure. Study 1b sought to replicate the findings from Study 1a using only the long variant of the implicit drinking identity measure (it appeared more internally consistent) and also included alcohol consumption as an outcome. Because of the similarity of the two studies, we describe their methods and results together.

2. Material and method

2.1. Participants

Participants were recruited through the Project Implicit website¹ (www.implicit.harvard.edu). Individuals registered on the site were randomly assigned to the two current studies from a pool of various social cognition studies. Participants in both studies had to indicate that they were a full-time college student at the time of participation so

that the education identity domain would be personally relevant. If participants indicated they were not full-time college students, they were directed to a different study on Project Implicit.

2.1.1. Study 1a

Participants were 360 self-identified full-time college students, aged 18–66 ($M = 26.02$, $SD = 9.77$). Seventy percent indicated that they were female. The majority of the sample (81%) described themselves as not Hispanic or Latino, 12% as Hispanic or Latino, and 7% as “unknown” or did not respond. The sample reported their race as 66% White, 11% Black or African American, 7% Asian (50% East Asian and 50% South Asian), 6% other or unknown race, and <10% American Indian/Alaskan Native, Native Hawaiian or other Pacific Island, or more than one race.

2.1.2. Study 1b

Participants were 450 self-identified full-time college students, aged 18–110² ($M = 27.14$, $SD = 12.01$). Seventy percent of the sample indicated that they were female and 1% did not indicate their gender. Ethnicity was reported as 67% not Hispanic or Latino, 11% as Hispanic or Latino, and 8% as “unknown” or did not reply. Race was reported as 68% White, 15% Black or African American, 4% Asian (75% East Asian and 25% South Asian), 9% other or unknown race, and <3% American Indian/Alaskan Native, Native Hawaiian or other Pacific Island, or more than one race.

2.2. Measures

2.2.1. Study 1a

2.2.1.1. Explicit identity centrality. This measure was developed for this study. Participants used a 7-point Likert type scale to indicate the relative importance of four identity domains (i.e., drinking, well-being, relationships, and education). Two domains were presented in each item, which allows for the evaluation of one domain relative to another (e.g., “When you consider *drinking* versus *education*, which do you consider to be relatively more important to who you are?”). There were a total of 6 items/identity contrasts (drinking vs. education, drinking vs. relationships, drinking vs. well-being, education vs. relationships, education vs. well-being, relationships vs. well-being). Each domain anchored one end of the response scale (e.g., -3 Education is much more important to $+3$ Drinking is much more important). Drinking identity centrality was scored by averaging the three items/contrasts that included drinking (i.e., drinking vs. education, drinking vs. relationships, drinking vs. well-being). Note that those items were scored such that higher scores indicated greater importance of drinking relative to these other domains. Cronbach’s alpha = 0.64.

2.2.1.2. Implicit identity centrality. To measure implicit identity centrality, the MC-IAT (Axt et al., 2014) was administered to each participant. The MC-IAT is a variant of the Brief IAT (Sriram & Greenwald, 2009; itself an adaptation of the tradition IAT: Greenwald et al., 1998), and was used to measure the strength of associations between the self and multiple identity domains (drinking, well-being, relationships, and education). Participants are asked to categorize stimuli, which appear one at a time in the center of the computer screen, into two superordinate categories that have been paired together at the top of the screen, indicating whether or not the presented stimulus belongs in either of those categories (e.g., whether the stimulus “drunk” fits into either the “me” or “drinking” category – the answer would be yes in this case because drunk fits in the category drinking). Critically, the MC-IAT is an indirect measure in that participants are not self-reporting their opinion about whether the self and drinking are strongly associated; instead, the

¹ The Project Implicit infrastructure used for this study only allowed adults aged 18+ to participate. Though the sample provided at Project Implicit is not fully representative of the general population (it is more liberal and more highly educated), it does allow for the examination of individual differences because of the relative heterogeneity of the sample. See Nosek (2005) and Nosek et al. (2007) for discussions of the representativeness of Project Implicit samples to the U.S. population.

² The individual who reported being 110 years old was excluded from analyses. Results did not differ as a function of the individual’s inclusion.

speed of classification time is compared when categories are paired that match associations in memory (e.g., “me” and “drinking” for someone with a strong drinking identity) versus contradict those associations (e.g., “me” and “education” for someone who does not have a strong student identity). Being faster to classify the stimuli in one category pairing condition over another is thought to reflect stronger associations between those categories.

The MC-IAT consisted of fourteen blocks - the first two are practice blocks (they were omitted for analyses) and the remaining twelve blocks assessed the different possible identity pairings. Each block presented two labeled categories on the screen, and had stimuli from four categories appear one at a time to be classified as belonging to either of the two labeled categories or not; namely, stimuli from the two labeled categories appeared, as well as stimuli from two unlabeled categories that served as the “background” stimuli (to be classified as not belonging). The 12 different identity pairing blocks, presented in random order, included: associations between “me” (vs. “not me”) and: 1. “drinking” (vs. “education”), 2. “drinking” (vs. “relationships”), 3. “drinking” (vs. “well-being”), 4. “education” (vs. “drinking”), 5. “education” vs. (“well-being”), 6. “education” vs. (“relationships”), 7. “relationships” (vs. “drinking”), 8. “relationships” vs. (“education”), 9. “relationships” vs. (“well-being”), 10. “well-being” vs. (“drinking”), 11. “well-being” vs. (“education”), 12. “well-being” vs. (“relationships”). In each case, the bracketed categories provided the background stimuli (“me” was always a focal category, and “not me” was always a non-focal, background category). Participants were asked to categorize items presented one at a time as quickly as possible. If a stimulus belonged to one of the two focal categories (e.g., “me” or “drinking”), participants responded by pressing the “i” key. If a stimulus did not belong to one of the two focal categories, participants responded by pressing the “e” key. See Table 1 for full list of categories and associated stimuli.

Two variants of the MC-IAT were developed. The short format variant contained 12 trials per block (168 total trials) and the long format variant contained 16 trials per block (224 total trials). This was done to compare internal consistency between a long and short version of the MC-IAT, given this study was the first we know of to use the MC-IAT in the alcohol domain.

MC-IAT *D* scores were calculated using the guidelines for the Brief IAT presented in Nosek, Barn-Anan, Sriram, Axt, and Greenwald (2014). Six scores were calculated (called *D* scores), each representing the contrast between two identity domains (e.g., drinking vs. education). First, trials with reaction time latencies over 10,000 ms were removed, and the first four trials of each block (practice trials) were excluded. Then, reaction time latencies were truncated by recoding latencies <400 ms to 400 ms and >2000 ms to 2000 ms. MC-IAT data from a participant were excluded if >10% of that participant's response times were <400 ms or if >30% of that participant's responses were errors. Thirty-five (9.7%) participants who completed the MC-IAT were removed from analyses for those reasons. *D* scores for each identity pairing were calculated by subtracting the mean reaction time for one block of a contrast (for example, when “drinking” and “me” were the focal labeled categories, and “relationships” and “not me” were the unlabeled, background categories) from the mean reaction time for the other block of the same contrast (when “relationship” and “me” were the focal categories, and “drinking” and “not me” were the background

categories) and then dividing the difference by the standard deviation of the reaction times during both blocks.

Using these *D* scores, aggregate implicit scores were calculated for each identity domain by averaging the three *D* scores that included that identity domain; for example, the aggregate drinking identity score was the average of the drinking vs. education, drinking vs. well-being, and drinking vs. relationships *D* scores (as per Axt et al., 2014). The four identity aggregate scores are interdependent because the mean of the four aggregate scores for each participant is necessarily zero. Positive scores on the aggregate measure indicate a stronger association between the self and the targeted identity construct, relative to the other identities assessed. Thus, for drinking identity centrality, a higher score indicates a stronger association between the self and drinking than the average association between the self and education, well-being, and relationships.

Internal consistency was calculated by dividing the trials in each scored block into two parallel subsets, calculating *D* scores for each subset, and measuring the correlation between the *D* scores. For the long format, the subsets consisted of the trials outlined in Sriram and Greenwald (2009), while the short format omitted trials 19 and 20 from subset 1 and trials 17 and 18 from subset 2. Only the drinking identity centrality aggregate score was used in these analyses: long format internal consistency was 0.67; short format was 0.55.

2.2.1.3. Explicit drinking identity strength. Two measures were used to evaluate drinking identity strength. The first used two semantic differential questions that mirrored the relative structure of drinking identity IATs (Werntz et al., 2016). That is, participants were asked to report the extent to which they thought of themselves as drinking or abstaining and to what extent they thought of others as drinking or abstaining using a 9-point Likert type scale from “completely as drinking” to “completely as abstaining.” Explicit drinking identity strength was scored by subtracting the “others” question from the “self” question. Thus, higher scores indicated stronger drinking identity. The second measure was a single item adapted from the Alcohol Self-Concept Scale (Lindgren et al., 2013b). It asked, “How important is drinking to who you are as a person?” Participants responded using a 5-point Likert scale (1, *Not important at all* to 5, *The most important*). Three additional items assessed the importance of the three other identity domains (i.e., each item assessed the importance of education, relationships, and well-being to who the participant is as a person, respectively). Because our focus was on drinking identity strength and not the strength of each of these three domains, per se, these items were not used in analyses. Note also that the relative importance of drinking versus these three domains was assessed via the explicit centrality measure.

2.2.1.4. Hazardous drinking. The Alcohol Use Disorder Identification Test (AUDIT; Babor et al., 2001) evaluates risk for alcohol use disorders and was used as an index of hazardous drinking. The 10-item measure assesses consumption, consequences, and symptoms of dependence. Items are summed and scores range from 0 to 40. Cronbach's alpha = 0.83.

2.2.2. Study 1b

All of the above measures were used in Study 1b. However, only the long format of the MC-IAT was used to evaluate implicit centrality. The same screening criteria were used, and MC-IAT scores for 40 individuals (8.9% of participants) were removed from analyses. Alphas were as follows: 0.66 for explicit centrality; 0.61 for the MC-IAT; and 0.80 for the AUDIT.

In addition, a measure of alcohol consumption was added: participants' typical weekly alcohol consumption over the past three months was assessed using the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Martlatt, 1985). The measure asks participants to report the number of drinks they consumed on each day of a typical week in the past three months. A sum of the responses represents total drinks per

Table 1
Implicit centrality: multicategory IAT (MC-IAT) category labels and stimuli.

Category labels	Stimuli
Me	Me, my, mine, self
Not me	Others, they, them, theirs
Drinking	Drinking, drinker, partier, drunk
Well-being	Well-being, health, adjusted, wellness
Education	Education, college, student, studying
Relationships	Friends, family, peers, relationships

week. Participants were told U.S. standard drink equivalencies (12 oz. beer, 10 oz. microbrew, 4 oz. wine, 1.5 oz. 80 proof hard liquor).

2.3. Procedures for studies 1a and 1b

Both studies were approved by the University of Virginia IRB. The studies used the same procedural framework. The only differences were that participants in Study 1a were randomly assigned to either the long or short format of the MC-IAT, and that Study 1b only included the long format of the MC-IAT and also added the DDQ. In both studies, participants were randomly assigned to the study by Project Implicit and completed online informed consent. As part of the informed consent process, they were asked to indicate whether they wished to participate in the study and whether they were full-time college students. Those individuals who consented and who met the full-time student qualification then completed the measures in random order. Afterwards, participants were debriefed, and the rationale for the study design was explained. Participants were given the option to see their implicit identity centrality scores during debriefing. They were not compensated for participating.

3. Results

3.1. Study 1a

The negative value of the mean MC-IAT drinking identity centrality scores (long format: -0.16 ; short format: -0.12) indicated that, on average, drinking was less central to participants' identity than the other domains (i.e., average scores were <0 , $ps < 0.001$). The distribution of MC-IAT scores, whether examined separated by format or combined, approximated a normal distribution. There was no difference in MC-IAT score between the short and long MC-IAT format, $t(312) = -0.84$, $p = 0.40$. In addition, the number of errors, fast trials (<400 ms), and slow trials (>2000 ms) all did not differ as a function of format (all $ps > 0.05$). Because no significant differences were found in the MC-IAT scores as a function of format, and participants' characteristics (age, gender, race, ethnicity, AUDIT scores, explicit identity strength, and explicit centrality) also did not differ as a function of format (all $ps > 0.05$), we collapsed across format for subsequent analyses and format was included as a covariate.

3.1.1. Descriptive statistics and correlations

Table 2 provides descriptive statistics and zero-order correlations for all study variables. Note, although this was not a clinical sample, 24% of participants had AUDIT scores of 8 or more (i.e., a recommended clinical

threshold for potential hazardous drinking; see Babor et al., 2001), suggesting a broad range of drinking levels in the sample. Explicit and implicit drinking identity centrality (referred to as centrality for simplicity) measures were positively correlated with AUDIT scores; effect sizes were small to moderate. Centrality scores had small to moderate correlations with identity strength measures. Implicit and explicit centralities were positively correlated with one another, but those correlations were small in magnitude. Also, consistent with previous studies, explicit drinking identity strength measures were positively correlated with AUDIT scores; effect sizes were moderate to large.

3.1.2. Evaluating centrality as unique predictors of AUDIT scores

Next we evaluated implicit and explicit centrality measures as predictors of AUDIT scores after controlling for explicit drinking identity strength. A zero-inflated negative binomial (ZINB) model was used because the distribution of AUDIT scores was positively skewed and included a substantial number of zeros (18%). The ZINB model was compared to negative binomial, zero-inflated Poisson, and Poisson models, and it was a better fit (Long & Freese, 2014). Briefly, a zero-inflated model simultaneously fits two models: (1) a count portion, which models the distribution using a negative binomial, and (2) a logistic portion, which models the excess zeros using a logistic regression. A key theoretical assumption underlying ZINB models is that there are two kinds of zeros in the data: (1) sometimes zeros (i.e., people who drink rarely and who have AUDIT scores of zero), and (2) always zeros (i.e., people who never drink and who always have AUDIT scores of zeros). The ZINB model yields probability estimates of being either type of zero. The count portion thus models the full range of scores in the distribution (i.e., a continuous outcome to indicate drinking severity), and the logistic portion models the odds of being an excess zero vs. a sometimes zero (i.e., the odds of being an abstainer vs. someone who drinks occasionally).

The model included age, gender, and MC-IAT format as covariates. It also included both measures of explicit drinking identity strength and the implicit and explicit measures of centrality as predictors. The single-item explicit identity strength measure and the explicit centrality measure had considerable positive skew, and the model would not converge when they were included without transformation. Thus, explicit identity strength measure and the explicit centrality measure were transformed to binary variables (the lowest score = no drinking identity/drinking identity not at all important [relative to other identity domains]; anything else = at least some drinking identity/drinking identity at least somewhat important [relative to other identity domains]), which enabled the model to converge. This strategy has been used successfully elsewhere in analyses when a measure of explicit

Table 2
Study 1a descriptive statistics and correlations for study variables.

Variable	1	2	3	4	5	6	7	8
1. Age	–							
2. Gender	0.04	–						
3. MC-IAT format	0.02	0.00	–					
4. AUDIT	-0.12^*	-0.10	-0.02	–				
5. Explicit ID (SemDiff)	-0.01	-0.10	0.01	0.42***	–			
6. Explicit ID (Self-Con)	-0.10	-0.10	-0.07	0.48***	0.29***	–		
7. Explicit centrality	-0.09	-0.13^*	-0.02	0.33***	0.21***	0.31***	–	
8. Implicit centrality	-0.06	-0.13^*	0.05	0.22***	0.18**	0.07	0.12*	–
Mean	26.02	–	–	5.22	-1.34	1.38	-2.82	-0.14
Standard deviation	9.77	–	–	4.89	2.21	0.70	0.49	0.39

Note. $N = 360$. Gender was coded as 0 = men and 1 = women. MC-IAT format was coded 0 = long format of the MC-IAT, 1 = the short format of the MC-IAT. AUDIT = Alcohol Use Disorders Identification Test; higher scores indicate greater risk of alcohol use disorders. Explicit ID (SemDiff) = scores on the semantic differential measure of drinking identity; higher scores indicate stronger drinking identity. Explicit ID (Self-Con) = single item assessing alcohol self-concept; higher scores indicate stronger drinking identity. Explicit centrality was coded 0 = drinking not at all important relative to other domains identity domains (education, well-being and relationships); 1 = drinking at least somewhat important relative to other identity domains. Implicit centrality = variant of the MC-IAT; higher scores indicate greater importance of drinking relative to education, well-being, and relationships.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

drinking identity strength was highly positively skewed (see Lindgren et al., 2016b).

Please see Table 3 for the complete ZINB results. In the count portion of the model, both measures of explicit identity strength were positively associated with AUDIT scores (semantic differential: $e^b = 1.12$, $p < 0.001$; single-item self-concept: $e^b = 1.59$, $p < 0.001$), replicating prior research. These coefficients are exponentiated and indicate that for every one unit increase in the explicit identity strength measures, AUDIT scores would increase by a factor of 1.12, and 1.59, respectively. Critically, the explicit and implicit centrality scores (explicit: $e^b = 1.28$; implicit: $e^b = 1.28$) were both also positively and significantly associated with AUDIT scores, indicating that they predict hazardous drinking even after controlling for explicit identity strength.

In the logistic portion of the model, which predicts the odds of being an always zero, only the single-item self-concept ($e^b = 0.09$, $p < 0.05$) and implicit centrality ($e^b = 0.17$, $p < 0.10$) measures were significantly associated with AUDIT scores. For every one unit increase in those measures, the odds of being an always zero on the AUDIT decreases by a factor of 0.09 and 0.17, respectively. Thus, the centrality measures appeared to be significant predictors (count portion: implicit and explicit; logistic portion: implicit only) after controlling for explicit identity strength, suggesting that drinking identity strength and centrality are not redundant and that both are associated with hazardous drinking.

3.1.2.1. Exploratory analyses. Three sets of exploratory analyses were conducted, and we summarize them briefly. First, we tested whether MC-IAT format moderated the relation between the implicit centrality and AUDIT scores. The moderation effect was not significant in either the logistic or count portions (all $ps > 0.05$). Second, we tested whether participant age or gender moderated the relationships between centrality and AUDIT scores. None of the tested moderation effects were significant (all $ps > 0.05$). Third, we tested the explicit centrality \times implicit centrality interaction. It was non-significant in the logistic and count portions of the model (all $ps > 0.05$).

3.2. Study 1b

3.2.1. Descriptive statistics and correlations

Study 1b descriptive statistics and zero-order correlations are presented in Table 4. Consistent with Study 1a, approximately 24% of participants had an AUDIT score of 8 or more. Also consistent with Study 1b, both measures of explicit identity strength were positively correlated with alcohol outcomes (AUDIT and DDQ scores); those correlations were moderate in magnitude. Explicit centrality was positively correlated with identity strength and alcohol outcomes. Effect sizes were small

for the former and moderate for the latter. In contrast to Study 1a, implicit centrality was significantly correlated with only the semantic differential measure of explicit identity strength.

3.2.2. Evaluating centrality as unique predictors of AUDIT and DDQ scores

The same analytic framework from Study 1a was used in Study 1b. Both the AUDIT and DDQ distributions were positively skewed and had a substantial number of zeros, and fit statistics indicated that ZINB provided the best fit. Age, gender, the two drinking identity strength variables, and the two centrality variables were entered into ZINB models. The single-item explicit identity strength measure and the explicit centrality measure had considerable positive skew and were again transformed to binary variables using the same approach as in Study 1a. Two ZINB models were run: the first evaluated AUDIT scores; the second evaluated DDQ scores.

Consistent with Study 1a, both drinking identity strength variables were positively and significantly associated with AUDIT scores in the count portion (see Table 5). However, in this study, neither of the centrality measures were significantly associated with AUDIT scores. None of the identity strength or centrality measures were significant predictors in the logistic portion. The differences in findings could reflect that the fit statistics for the ZINB model in Study 1b were less strong than those observed in Study 1a. Thus, the model was re-run as a negative binomial (the second best fit); the pattern of results found was identical to the count portion with the exception that the explicit, but not implicit, centrality measure was positively and significantly associated with AUDIT scores ($e^b = 1.24$, $p = 0.01$).

A similar pattern of results was observed for the count portion of DDQ scores. Both measures of drinking identity strength and explicit (but not implicit) centrality were positively and significantly associated with alcohol consumption. In the logistic portion, the semantic differential measure of drinking identity strength and the implicit centrality measure were significantly associated with consumption in the expected direction (i.e., having a weaker or less central drinking identity was associated with greater the odds of being abstainer). The other identity measures were non-significant.

Two exploratory moderation analyses were conducted. First, we tested whether participant age or gender moderated the relationships between centrality and AUDIT scores or DDQ scores. There was no evidence of moderation (all $ps > 0.05$). Second, we evaluated the explicit centrality \times implicit centrality interaction, which was not significant (all $ps > 0.05$).

3.2.2.1. Follow-up MC-IAT analyses. The discrepancy in the performance of the implicit centrality measure in Study 1a compared to Study 1b

Table 3
Models evaluating drinking identity strength and salience as predictors of AUDIT scores.

	Logistic portion of model			Count portion of model		
	Exp (b)	Z	95% CI	Exp (b)	Z	95% CI
DV = AUDIT						
Age	0.41	1.96****	–1.80–0.00	0.98	–3.60***	–0.03 to –0.01
Gender	0.72	–0.50	–1.61–0.95	1.02	0.27	–0.15–0.20
MC-IAT format	3.05	2.04*	0.04–2.91	1.07	0.78	–0.10–0.23
Explicit ID (SemDiff)	0.79	–1.50	–0.54–0.07	1.12	5.26***	0.07–0.16
Explicit ID (Self-Con)	0.09	–2.33*	–4.45 to –0.38	1.59	4.94***	0.28–0.65
Explicit centrality	0.24	–1.32	–3.56–0.69	1.28	2.21*	0.03–0.47
Implicit centrality	0.17	–2.78**	–3.06 to –0.53	1.28	2.21*	0.03–0.46

Note. $N = 360$. N included in analyses (due to invalid MC-IAT scores or missing data) = 308. MC-IAT format was coded 0 = long format of the MC-IAT, 1 = the short format of the MC-IAT. AUDIT = Alcohol Use Disorders Identification Test; higher scores indicate greater risk of alcohol use disorders. Explicit ID (SemDiff) = scores on the semantic differential measure of drinking identity; higher scores indicate stronger drinking identity. Explicit ID (Self-Con) = single item assessing alcohol self-concept; higher scores indicate stronger drinking identity. Explicit centrality was coded 0 = drinking not at all important relative to other domains identity domains (education, well-being and relationships); 1 = drinking at least somewhat important relative to other identity domains. Implicit centrality = variant of the MC-IAT; higher scores indicate greater importance of drinking relative to education, well-being, and relationships.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

**** $p = 0.05$.

Table 4
Study 1b descriptive statistics and correlations for study variables.

Variable	1	2	3	4	5	6	7	8
1. Age	–							
2. Gender	–0.08*	–						
3. AUDIT	–0.20***	–0.06	–					
4. DDQ	–0.06	–0.13*	0.68***	–				
5. Explicit ID (SemDiff)	0.01	–0.04	0.42***	0.39***	–			
6. Explicit ID (Self-Con)	0.02	0.01	0.45***	0.38***	0.25***	–		
7. Explicit centrality	–0.08	–0.03	0.32***	0.40***	0.20***	0.25***	–	
8. Implicit centrality	–0.11*	–0.08	0.09	0.09**	0.11*	0.04	0.01	–
Mean	27.96	–	5.37	5.79	–1.28	1.47	–2.82	–0.04
Standard deviation	11.37	–	4.76	8.62	2.21	0.80	0.49	0.33

Note. $N = 449$. Gender was coded as 0 = men and 1 = women. AUDIT = Alcohol Use Disorders Identification Test; higher scores indicate greater risk of alcohol use disorders. Explicit ID (SemDiff) = scores on the semantic differential measure of drinking identity; higher scores indicate stronger drinking identity. Explicit ID (Self-Con) = single item assessing alcohol self-concept; higher scores indicate stronger drinking identity. Explicit centrality was coded such that high scores indicated greater relative importance of drinking compared to other identity domains (education, well-being and relationships). Implicit centrality = variant of the MC-IAT; higher scores indicate greater importance of drinking relative to education, well-being, and relationships.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

was puzzling, particularly because it appeared that the two variants of the MC-IAT were essentially identical, with the exception of the slightly stronger internal consistency of the longer format. The lack of a format main effect or a format \times implicit centrality interaction seemed to provide further support for their similarity. However, given the discrepant findings, we re-examined the data from Study 1a, testing each MC-IAT format subsample separately (so the same format could be compared across studies). A ZINB model was run for each format and yielded different results. In the long format sample, implicit centrality was significantly associated with AUDIT scores in the logistic, but not count, portion: the same pattern and direction of effects found in Study 1b DDQ scores. However, in the short format sample, the opposite pattern was observed: implicit centrality was significantly associated with AUDIT scores in the count, but not logistic, portion.

4. Discussion

These are the first studies (to our knowledge) to develop and test explicit and implicit measures of drinking identity centrality. Results indicated that the extent to which individuals view drinking, relative to

other domains, as central to their identity is associated with greater risk of alcohol use disorders (Study 1a and 1b) and higher alcohol consumption (Study 1b). Moreover, although findings were somewhat mixed, the pattern of findings indicated that identity centrality often predicted these outcomes after controlling for identity strength, providing initial evidence that these constructs, although modestly related, are not redundant.

We also note that implicit and explicit centrality measures were, at best, weakly correlated with one another (r 's = 0.12 [Study 1a], 0.01 [Study 1b]). This finding is contrary to previous work using implicit and explicit measures of drinking identity (e.g., Lindgren et al., 2013b, 2016c) as well as findings from meta-analyses of implicit and explicit measures (e.g., Greenwald, Poehlman, Uhlmann, & Banaji, 2009), which tend to report correlations around 0.25. Given previous findings – both in the alcohol and substance use domain as well as in other areas of psychology – that implicit and explicit measures of identity are reliable and robust predictors (see Back et al., 2009; Greenwald & Farnham, 2000; Lindgren et al., 2016d), we suspect that the weaker relationships observed here – including the implicit and explicit measures' relations with one another and with hazardous drinking – reflect the need to

Table 5
Models evaluating drinking identity strength and salience as predictors of AUDIT scores and alcohol consumption.

	Logistic portion of model			Count portion of model		
	Exp (b)	Z	95% CI	Exp (b)	Z	95% CI
DV = AUDIT ($N = 350$)						
Age	0.78	–0.10	–5.27–4.77	0.98	–4.06***	–0.03 to –0.01
Gender	1.24	0.08	–4.82–5.25	0.90	–0.74	–0.39–0.18
Explicit ID (SemDiff)	0.81	–1.47	–0.50–0.07	1.13	3.74***	0.06–0.18
Explicit ID (Self-Con)	0.28	–1.29	–3.19–0.66	1.51	2.81***	0.12–0.70
Explicit centrality	0.63	–0.43	–2.53–1.62	1.22	1.72	–0.03–0.43
Implicit centrality	0.53	–0.32	–4.44–3.18	1.07	0.29	–0.39–0.53
DV = DDQ ($N = 348$)						
Age	0.89	–0.69	–0.46–0.22	0.99	–1.67	–0.02–0.00
Gender	0.65	–0.72	–1.61–0.74	0.76	–1.83	–0.56–0.02
Explicit ID (SemDiff)	0.67	–2.01*	–0.79 to –0.01	1.25	5.81***	0.15–0.30
Explicit ID (Self-Con)	0.45	–1.23	–2.06–0.47	1.55	2.68**	0.12–0.76
Explicit centrality	0.50	–1.12	–1.89–0.51	1.55	2.53*	0.10–0.78
Implicit centrality	0.19	–2.49*	–3.01 to –0.36	1.09	0.44	–0.30–0.48

Note. $N = 450$. N 's included in analyses vary due to missing data and invalid MC-IAT scores. Gender was coded as 0 = men and 1 = women. AUDIT = Alcohol Use Disorders Identification Test; higher scores indicate greater risk of alcohol use disorders. DDQ = Daily Drinking Questionnaire; scores indicate drinks per week. Explicit ID (SemDiff) = scores on the semantic differential measure of drinking identity; higher scores indicate stronger drinking identity. Explicit ID (Self-Con) = single item assessing alcohol self-concept; higher scores indicate stronger drinking identity. Explicit centrality was coded such that high scores indicated greater relative importance of drinking compared to other identity domains (education, well-being and relationships). Implicit centrality = variant of MC-IAT; higher scores indicate greater importance of drinking relative to education, well-being, and relationships.

*** $p < 0.001$.

** $p < 0.01$.

* $p < 0.05$.

improve the centrality measures and stimuli versus their ultimate inability to capture meaningful aspects of identity (whether via self-report or reaction time measures). However, additional research will clearly be needed to test this supposition.

These data suggest the importance of integrating both drinking identity strength and centrality into theoretical models of hazardous drinking. Yet most extant psychological theories of drinking (e.g., Leonard & Blane, 1999; Wiers et al., 2007) make no mention of drinking identity. Frings and Albery (2015) are the first we know of to put forth a model of substance use (in this case, substance use recovery) that explicitly includes drinking identity. This model and related empirical work (see Beckwith, Best, Dingle, Perryman, & Lubman, 2015; Buckingham et al., 2013) suggests that developing more adaptive alcohol-related drinking identities can facilitate the cessation of problematic substance use. The current studies, along with related work on drinking identity strength in college (e.g., Lindgren et al., 2013a, 2013b, 2016a, 2016b) and community (Werntz et al., 2016) samples, suggest that having a stronger and/or more central drinking identity might also contribute to the initiation and/or escalation of hazardous drinking. In essence, while long-standing psychological theories, importantly, have focused on the role of the appetitiveness (wanting), attractiveness (liking), and motivations for and expectancies about drinking as predictors of hazardousness drinking, they have not considered how associations with the self and drinking develop, strengthen, and compete with other identity domains. Data from drinking identity studies have demonstrated that these associations are not redundant with other psychological factors and uniquely contribute to hazardous drinking.

These findings are also consistent with more general psychological theories related to identity and the self-concept (e.g., Back et al., 2009; Greenwald et al., 2002; Markus & Wurf, 1987) as well as those related to social identities, groups, and group membership (e.g., Leach et al., 2008; Turner et al., 1987). Although these theories vary to the extent they emphasize the individual versus groups, they all emphasize the multi-faceted nature of identity, the hierarchical nature of identity, and the importance of identity in predicting behavior. Our own approach leans heavily on associative and dual process models of self-concept and focuses on individual differences in identity, hence our emphasis on implicit and explicit measures and on the evaluation of whether individual differences in identity strength and centrality are associated with important behavioral outcomes (i.e., hazardous drinking). Approaches that are more social psychological and emphasize groups and social identities are clearly relevant, and we suspect the research on centrality would be enriched by drawing more fully on these approaches. For example, Leach and colleagues' (2008) model of in-group identification defines centrality as including both the importance and *saliency* (emphasis added) of an identity. The centrality measures used here – especially, the explicit measure – focus solely on the importance of one identity relative to another. We could imagine future research that also assesses the saliency of one identity relative to another and suspect that findings would have important implications for theories of hazardous drinking (and substance misuse) as well as prevention efforts.

4.1. Potential clinical implications

The current findings also hint at important potential clinical implications. Recent work suggests that developing competing *alcohol-related* identities may be effective in reducing hazardous drinking among non-clinical drinkers and preventing relapse among alcohol-dependent individuals (i.e., developing a recovering addict vs. addict identity; see Buckingham et al., 2013; Frings & Albery, 2015). If we can establish that drinking identity centrality relative to *non-alcohol related* identity domains is a reliable predictor of drinking, it would be consistent with the idea that increasing an identity in a non-alcohol related domain could also be important for reducing hazardous drinking (e.g., strengthening identity domains related to relationships). While this claim is

clearly speculative, research in social psychology suggests that activating a given identity domain impacts subsequent behavior. For example, Asian American women who had their ethnic identities activated performed better on a mathematics test (consistent with stereotypes regarding Asians and quantitative skills), but those who had their gender identities activated performed worse (consistent with stereotypes regarding women and quantitative skills), compared to a control group who had neither identity activated (Shih, Pittinsky, & Ambady, 1999). Similarly, qualitative work with individuals in treatment for drug and alcohol problems (e.g., Dingle et al., 2015) suggests the importance of both developing a more adaptive identity related to substance use (i.e., a recovery identity) and developing new non-substance identities. One potential strategy may be to have students consider the relative long-term benefits of drinking compared to other behaviors (e.g., studying or maintaining healthy relationships) to shift the relative importance of identification with these behaviors.

Additionally, our findings for prediction by the centrality measures combined with the advent of cognitive bias modification approaches for treating addiction and risky drinking (see Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013) suggest adding cognitive training to reduce internalization of one's drinking identity may augment existing interventions. One could imagine approach-avoidance training that encourages approach toward images reflecting non-drinking identities (e.g., a picture of the participant studying or spending time with loved ones) and avoidance of drinking identity images. However, recent experiments with null findings (see Lindgren et al., 2015) and a recent meta-analysis (Cristea, Kok, & Cuijpers, 2016) raise important questions about the utility of these approaches, at least in their current form and with populations with less severe problems.

Interestingly, it may be that implicit and explicit drinking identity centrality predict different aspects of drinking outcomes, which may suggest they confer risk in unique ways. While we are reticent to over-interpret the current findings, given results were somewhat mixed and these are the first studies in this domain, there was some suggestion that the explicit centrality measure was a more reliable predictor of the continuous indicators of drinking severity (the count portion of the models) while the implicit centrality measure was a more reliable predictor of the dichotomous zero outcomes (i.e., the excess zeros in the logistic portion of the models). If this pattern is replicated, it may suggest different prevention and intervention implications (e.g., differentially predicting outcomes for harm reduction, which reduces but does not aim to eliminate drinking, versus abstinence).

4.2. Need to improve measurement

The pattern of results, while promising, also indicates a need to improve measurement of these constructs. In Study 1a, it seemed that the performance of the implicit centrality measures (i.e., the two variants of MC-IAT) was equivalent, with the long-format seeming slightly more internally consistent. However, results from Study 1b revealed that the long-format MC-IAT was rarely related to the drinking variables. Follow up re-analyses of Study 1a revealed that the short-format of the MC-IAT was actually the more robust predictor of AUDIT scores, even though it was slightly lower in internal consistency. Going forward, it will be important to replicate these tests with the short-format MC-IAT. In addition, steps should be taken to improve the measure, such as considering changes to stimuli (e.g., using pictures of the individual doing activities tied to the identity being measured, like drinking). In addition, the explicit centrality measure and the single-item explicit identity strength measure were highly positively skewed and had to be reduced to a binary variable for models to converge, suggesting they too could be improved to increase sensitivity. We suspect that self-presentation concerns may be a factor (i.e., individuals may view the endorsement of a drinking identity as pejorative) and developing ways to assess identity centrality (and strength) that are less susceptible to those concerns will be important next steps. In addition, while we

had a theoretically- and clinically-driven rationale for our choice of the other identity domains, it may be that other identity variants or domains would be more useful and/or relevant to different individuals. For example, one could imagine identity domains that are framed in terms of a social group (e.g., drinkers, students) versus framed (as in this study) in terms of an outcome or process (e.g., drinking, education). One could also imagine focusing on other identity domains (e.g., athlete, artist).

4.3. Limitations and future directions

The results of the present study contribute to the growing body of research focusing on identity-related cognitions and hazardous drinking; however, the study is not without limitations. First, the MC-IAT, our measure of implicit identity centrality, is a relative measure. While we frame our discussion of IAT scores as indicating the relative centrality of drinking, this cannot be understood without considering the specific contrasting categories (i.e., it is drinking identity centrality relative to how central well-being, relationship, and education identities collectively are). Thus, if we happened to choose alternate identity domains that are not central to the person, this could provide a weak test compared to contrasting drinking identity to a very personally significant domain. This was one reason that drinking identity was contrasted with three different domains in the present study and a student sample was used, so we expect we were likely capturing other important identity domains for most people. Second, the study only included explicit measures of identity strength. While this was due to time constraints (research studies conducted on Project Implicit are typically 15 min or less), future studies could include implicit measures of identity strength (for example, a drinking identity or alcohol identity IAT) to evaluate whether identity centrality measures predict above and beyond them as well. Third, participants were required to self-identify as full-time students to participate, and we cannot confirm (or disprove) their status. If participants did not represent their status accurately, the education domain may not have been as relevant and could have affected the results (though we have no reason to suspect people would misrepresent their student status). Going forward, researchers might consider an idiographic approach for the alternative identity domains wherein individuals could select the domains themselves. Such a strategy would allow for an investigation of student and non-student (i.e., professional/working) populations. Relatedly, although the age range and diversity of the study's sample was broader than most college samples, generalizability may also be limited because Project Implicit samples tend to be more politically liberal, more educated and younger than the general US population (Nosek et al., 2007). Finally, the present study is cross-sectional. Future research would benefit from prospective and experimental studies assessing drinking identity centrality as a predictor.

4.4. Conclusion

The present studies provide a preliminary investigation of drinking identity centrality as a predictor of hazardous drinking and evaluated both an explicit and implicit measure of centrality. Results, though somewhat mixed, suggested identity centrality, while modestly correlated with identity strength, was not redundant and accounted for additional variance in hazardous drinking. Measurement of the construct should be improved, but it appears that centrality has the potential to be an important risk factor and intervention target for reducing hazardous drinking.

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Contributors

Drs. Lindgren, Teachman, and Ramirez, and Ms. Olin designed the study. Mr. Namaky programmed the study, oversaw data collection, and wrote the method section. Dr. Lindgren conducted the analyses and wrote the results section. Drs. Lindgren and Ramirez and Ms. Olin wrote the introduction and discussion sections. All authors, including Dr. Teachman, reviewed and edited all sections of the manuscript. All authors have contributed to and approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest. B. Teachman has a significant financial interest in Project Implicit, Inc., which provided services in support of this project under contract with the University of Virginia.

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