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## Evaluating implicit drinking identity as a mediator of drinking motives and alcohol consumption and craving



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### HIGHLIGHTS

- Does implicit drinking identity mediate between drinking motives and drinking?
- We tested this in a short-term prospective study of US undergraduates.
- Drinking identity uniquely mediated between social motives and consumption.
- Indirect effects were found for three motives when tested individually.
- Drinking identity is a robust predictor and a potential intervention target.

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### ABSTRACT

**Introduction:** Implicit drinking identity (i.e., cognitive associations between the self and drinking) is a reliable predictor of drinking. However, whether implicit drinking identity might mediate the relationship between other robust predictors of drinking and drinking outcomes is unknown. We hypothesized that implicit drinking identity would mediate the relationship between drinking motives and alcohol consumption and craving.

**Method:** We assessed drinking motives at Time 1, implicit drinking identity at Time 2 (on average, 11 days later) and self-reported alcohol consumption and craving at Time 3 (on average, 6 days later) in a sample of 194 US undergraduates (54% women) who reported at least one heavy drinking episode (4 drinks for women, 5 for men) in the past month. Participants completed self-report measures of drinking motives, daily alcohol consumption, and current craving.

**Results:** Implicit drinking identity uniquely mediated the relationship between social motives and alcohol consumption. It did not, however, mediate the relationship between motives and craving. Time 2 implicit drinking identity was positively associated with greater alcohol consumption and craving at Time 3, even after controlling for drinking motives. Subsequent analyses indicated significant indirect effects between social, enhancement, and coping motives (but not conformity) and consumption and craving when each motive was evaluated individually.

**Conclusions:** Implicit drinking identity continues to have promise as a predictor of drinking outcomes and as a target for interventions. Future experimental and prospective studies will be critical to establish the circumstances under which implicit drinking identity is strengthened and/or activated and the resulting effects on hazardous drinking.

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### 1. Introduction

Implicit drinking identity (IDI) refers to cognitive associations between the self and drinking that are thought to be activated rapidly, reflexively, and possibly without conscious control. The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) has been used to assess IDI (e.g., Gray, LaPlante, Bannon, Ambady, & Shaffer, 2011; Lindgren, Foster, Westgate, & Neighbors, 2013; Lindgren, Neighbors et al., 2013), and the resulting Drinking Identity IAT has demonstrated

strong internal consistency and test–re-test reliability (Lindgren, Foster, Westgate, & Neighbors, 2013; Lindgren, Neighbors, et al., 2013). Cross-sectionally, IDI is a strong predictor of drinking outcomes, including craving, problems, and consumption (Foster, Neighbors, & Young, 2014; Gray et al., 2011; Lindgren, Foster, et al., 2013; Lindgren, Neighbors, et al., 2013); and when considered in conjunction with other related, well-validated alcohol IATs, the Drinking Identity IAT was the only IAT that consistently predicted unique variance in drinking outcomes (Lindgren, Foster, et al., 2013; Lindgren, Neighbors, et al., 2013). Collectively, these findings indicate the promise of IDI as a marker of risk for hazardous alcohol consumption. However, all but one study has been cross-sectional (see Gray et al., 2011, which measured whether IDI prospectively predicted endorsing risky drinking practices: hooking up under the influence and drinking before going out to social events). No published studies have addressed whether IDI might predict alcohol consumption and craving prospectively or whether it might serve as a mediating process that underlies the relationship between other known predictors of drinking and drinking outcomes. Thus, we evaluated IDI as a mediator of the relationship between a powerful predictor of drinking behaviors (i.e., drinking motives) and drinking outcomes (i.e., alcohol consumption and craving).

### 1.1. Positive affect motives and IDI

Multiple factors likely contribute to associating one's self with being a drinker, and in turn, contribute to increased drinking behaviors, including factors related to one's social and family environment. We focused on factors related to the former, namely positive affect motives for drinking. Such motives, which include social and enhancement motives, concern the positively reinforcing properties of drinking, namely drinking because one likes the feeling (enhancement) or because one is celebrating a special occasion with friends (social). These motives are among the most powerful predictors of drinking (Cooper, 1994; Cooper, Frone, Russell, & Mudar, 1995; Kuntsche, Knibbe, Gmel, & Engels, 2005). We suggest that these motives might promote a stronger IDI, which in turn, might lead to increased drinking and craving. We propose that positive affect motives develop earlier than IDI. Classic social psychology theory provides some support for this notion – i.e., Bem's (1972) self-perception theory of personality hypothesizes that individuals come to know themselves from observations of their own behavior and the circumstances surrounding it. Thus, it is possible that awareness of the circumstances of one's behavior (here, drinking and having positive affective outcomes) would lead to increasingly “knowing” oneself (or identifying) as a drinker and that increased identification could lead to even greater alcohol consumption and craving. Note that awareness of one's drinking circumstances is more or less what is measured by established, validated Drinking Motives Questionnaires. Thus, it seems plausible that having stronger positive affect drinking motives could lead to a stronger IDI and, ultimately, more consumption and craving.

### 1.2. Negative affect motives and IDI

Previous research has also emphasized coping motives and conformity motives as proxies for evaluating negative reinforcement models of drinking (i.e., drinking to reduce negative affect, whether due to stress or problems, or concerns about fitting in; see Cooper, 1994; Kuntsche et al., 2005). Although our primary interests were positive affect motives, we recognized the importance of including coping and conformity motives because they also are uniquely associated with problem drinking (e.g., Stewart, Morris, Mellings, & Komar, 2006). Individuals who drink to cope or who drink to fit in might similarly come to associate themselves with drinking and ultimately have a stronger IDI, resulting in greater alcohol consumption and craving. However, another scenario also seems possible. If drinking for conformity and, possibly to a lesser extent, coping reasons is seen by individuals as less desirable

and/or acceptable, such drinking might be attributed more to the situation and could have little or no impact on associations with self. In that scenario, conformity and coping motives would be less or unlikely to be associated with a stronger IDI, but those motives would still be associated with higher alcohol consumption and cravings. Since both scenarios seemed plausible, our investigation of the negative affect drinking motives was exploratory.

### 1.3. Overview and hypotheses

Our goal was to evaluate whether IDI would mediate the relationship between drinking motives and alcohol consumption and cravings. Mediation was investigated in a short-term prospective study of US undergraduates. Drinking motives were assessed at Time 1 (via the web), IDI at Time 2 (in the laboratory, on average 10 days later), and self-reported consumption and craving at Time 3 (in the laboratory, on average 6 days after Time 2). We predicted that drinking motives and IDI would positively predict consumption and craving. We also predicted that the relationship between social and enhancement motives and alcohol consumption and cravings would be mediated by IDI. Our investigation of coping and conformity motives and drinking outcomes was exploratory.

## 2. Method

### 2.1. Participants

Participants included 194 undergraduates from a large, public university in the Pacific Northwest (106 women, 87 men, and 1 who declined to answer) between the ages of 18 and 25 years old ( $M = 20.58$ ,  $SD = 1.51$ ); 71% identified as White/Caucasian, 21% as Asian, and 5% as more than one race. The remaining 3% selected Black/African American, American Indian/Alaska Native, unknown or declined to answer. Eligibility criteria included endorsing at least one heavy drinking episode (4/5 or more standard drinks consumed on a single occasion for women/men) on the web-based survey at Time 1. This criterion was established as part of a larger study from which these data derive (see Procedures). All participants completed the Time 1 assessment; 192 (99%) completed Time 2; and 152 (78%) completed Time 3. There were no significant differences in dropout as a function of gender, participant age, or baseline alcohol consumption (all  $p$ 's > .05).

### 2.2. Measures

#### 2.2.1. Drinking motives

The Drinking Motives Questionnaire (DMQ; Cooper, 1994) measures the frequency of 20 motivations to drink (e.g., “to forget your worries,” “to be sociable”) on a scale ranging from 1 = “never/almost never” to 5 = “almost always/always.” The DMQ has four subscales: social, enhancement, coping, and conformity drinking motives (Cronbach's alphas = .87, .84, .84, & .82, respectively).

#### 2.2.2. IDI

IDI was assessed using the Drinking Identity Implicit Association Test (IAT; Lindgren, Neighbors, et al., 2013). The IAT is a computerized sorting task with seven blocks. It measures participants' reaction time sorting stimuli, which appear onscreen individually. Blocks 1, 2, and 5 are practice blocks that teach participants the task. Blocks 3, 4, 6, and 7 are the critical blocks. In those blocks, participants sort stimuli representing the four concepts in each IAT (“drinker,” “nondrinker,” “me,” and “not me”) using two response options (left or right). For example, stimuli representing “drinker” or “me” concepts are sorted using the left key; stimuli representing “nondrinker” or “not me” are sorted using the right key. Errors occur when participants incorrectly sort stimuli (e.g., sorting a “drinker” stimulus using the right key). After two blocks (with multiple trials in each), the pairings are

switched: now, stimuli representing “drinker” or “not me” are sorted using the left key and stimuli representing “nondrinker” or “me” are sorted using the right key. The order of the pairings is counterbalanced. The reaction time for the first pairing – “drinker” and “me” vs. “nondrinker” and “not me” is compared to the latter pairing – “drinker” and “not me” vs. “nondrinker” and “me” – and that difference serves as an index of the relative strength of IDI associations. Faster reaction times completing the first pairing compared to the second pairing would indicate a relatively stronger association with “drinker” and “me” (vs. “drinker” and “not me”) or a stronger IDI. IAT stimuli consisted of the following words: me, my, mine, self (“me” category); they, their, them, others (“not me” category); drinker, partier, drunk, drink (“drinker” category); and nondrinker, abstainer, sober, abstain (“nondrinker” category).

Greenwald's (2007) generic IAT syntax was used to create the IAT; it was run using Inquisit (2010). IAT scores were calculated using the recommended D score algorithm (Greenwald, Nosek, & Banaji, 2003), which calculates the difference in the average reaction time for the two pairings and divides that by the pooled standard deviation of the reaction times. D scores were calculated such that higher scores represent stronger “me” and “drinker” associations or stronger IDI. Consistent with Nosek, Greenwald, and Banaji's (2007) recommendations, participants' scores were screened for high levels of error (e.g., errors in 30% or more trials) and responding too quickly (e.g., 10% or more trials faster than 300 ms). All participants were below those thresholds.

### 2.2.3. Drinking outcomes

**2.2.3.1. Alcohol consumption.** Weekly summary scores of alcohol consumption were calculated from self-reported daily drinking over the course of a typical week using the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985). Standard drink volume definitions were provided to participants (12 oz. beer, 10 oz. microbrew beer, 4 oz. wine, 1.5 oz. 80-proof hard liquor). At Time 1, participants reported their daily drinking over the course of a typical week based on their drinking over the last month (Cronbach's alpha = .63). At Time 3, participants reported their daily drinking over the last week (Cronbach's alpha = .57).

**2.2.3.2. Alcohol craving.** The 12-item Alcohol Craving Questionnaire (ACQ; Singleton, Tiffany, & Henningfield, 1995) assesses current craving for alcohol. Participants indicate their agreement on a 7 point scale anchored by  $-3 =$  “strongly disagree” to  $3 =$  “strongly agree.” Three items were reverse-coded, and a composite was then created by summing all responses (Cronbach's alpha = .85).

### 2.3. Procedures

Procedures were approved by the university's Institutional Review Board. Participants were recruited from a list of full-time students between the ages of 18–25 provided by the university registrar's office. An email invited them to participate in a study about cognitive processes and alcohol and included a link to a website where they completed informed consent procedures and a battery of screening questionnaires.<sup>1</sup> Of the 1108 students who completed the online questionnaire (Time 1), 194 met the heavy drinking episode criterion and noted their willingness to attend two lab-based sessions (an additional 125 of those screened met criteria but were assigned to a different study focusing on implicit alcohol approach associations). Eligible participants were

immediately routed to an online scheduling system to schedule their first lab session. At the first lab-based session (Time 2), they completed the Drinking Identity IAT. Participants scheduled their follow-up appointment, which was to occur one week later, immediately after completing Time 2 procedures. At the second lab-based session (Time 3), the measures of alcohol consumption and cravings were completed. Participants were compensated \$15 for completing the screening, \$20 for the first lab session, and \$25 for the second lab session.

### 2.4. Analyses

Statistical analyses focused on evaluating mediation using SAS PROCES (Hayes, 2013). Mediation was assessed by evaluating indirect effects between motives and drinking outcomes through IDI. Standard errors were bootstrapped (10,000 samples), which provides a more accurate evaluation of mediation tests and is less restricted by distributional assumptions in comparison to traditional regression approaches. Approximately 20% of the sample did not complete the T3 assessment. We compared those who completed the T3 assessment with those who did not and found no differences in any of the T1 motives or T2 identity. Thus, analyses were based on complete cases. All variables were standardized prior to analyses. Thus, all parameter estimates are standardized. The number of days between the first and second assessments and the number of days between the second and third assessments were included as covariates to control for variability in the timing of assessments. Time between the first and second assessment was not associated with drinking identity, drinks per week, or craving. Time between the second and third assessment was not associated with IDI or craving, but was negatively associated with drinking ( $\beta = -.20, p = .01$ ).

## 3. Results

### 3.1. Correlations

Descriptive statistics and inter-correlations for the primary study variables are presented in Table 1. The zero-order correlations between IDI (at Time 2) and drinking outcomes (at Time 3) were positive and significant, albeit modest in magnitude. Social and enhancement motives (at Time 1) were positively and significantly correlated with IDI (at Time 2). Coping motives (at Time 1) were significantly and positively correlated with IDI (at Time 2), although that relation was small in magnitude. Finally, conformity motives (at Time 1) were not significantly correlated with IDI (at Time 2). There was no evidence of sex differences in any of the four drinking motives or in alcohol craving (all  $p$ 's  $> .21$ ). As is typical, there were sex differences in alcohol consumption, with men reporting greater consumption than women,  $t(148) = 3.56, p = .001$ . Results (reported below) were unchanged if sex was included as a covariate.

### 3.2. Evaluating drinking identity as a mediator

In the first PROCESS model, IDI was examined as a mediator between social, enhancement, coping, and conformity motives (entered simultaneously) and drinks per week (see Fig. 1). Results indicated that only social motives were uniquely associated with IDI, partially in line with hypotheses (recall that both social and enhancement motives were expected to be predictors). In turn, IDI was significantly associated with subsequent drinking when controlling for motives. Furthermore, none of the direct effects of motives on drinks per week were significant (all  $p$ 's  $> .30$ ). Examination of IDI as a mediator of the association between social motivation and drinks per week revealed a significant indirect effect ( $ab = .044; SE = .030; 95\%$  bootstrap CI:  $.001 - .138$ ), as anticipated. In contrast, there was not a significant indirect effect of enhancement motives ( $ab = .023; SE = .022; 95\%$  bootstrap CI:  $-.006 - .092$ ), coping motives ( $ab = .021; SE = .029; 95\%$  bootstrap

<sup>1</sup> This study was part of a larger study investigating whether implicit associations can be trained. Training tasks occurred at Time 2 (after the administration of the Drinking Identity IAT) and Time 3 (after the administration of the drinking consumption measure and before the administration of the craving measure). There were no effects of training (either at Time 2 or Time 3), and no differences in drinking or craving as a function of training condition (all  $p$ 's  $> .05$ ).

**Table 1**  
Means and correlations for study variables.

	N	M	(SD)	1	2	3	4	5	6	7
1. Social motives (T1)	194	3.71	0.91	–	.64***	.48***	.44***	.33***	.17*	.33***
2. Enhancement motives (T1)	194	3.13	1.00		–	.51***	.28***	.30***	.20*	.36***
3. Coping motives (T1)	194	2.08	0.87			–	.45***	.19**	.16†	.55***
4. Conformity motives (T1)	194	1.84	0.76				–	.07	.10	.16†
5. Drinking Identity IAT (T2)	192	0.22	0.36					–	.23**	.30***
6. Drinks per week (T3)	151	8.59	8.61						–	.28***
7. Craving (T3)	150	–13.80	11.92							–

Notes. T1 = Time 1. T2 = Time 2. T3 = Time 3.

\*\*\*  $p < .001$ .

\*\*  $p < .01$ .

\*  $p < .05$ .

†  $p < .06$ .

CI:  $-.011$ – $.113$ ), or of conformity motives ( $ab = -.025$ ;  $SE = .023$ ; 95% bootstrap CI:  $-.094$ – $.002$ ) on drinks per week.

Subsequent models examined each motive individually. Results revealed that IDI mediated associations between three of the four motives (social:  $ab = .064$ ;  $SE = .033$ ; 95% bootstrap CI:  $.012$ – $.146$ ; enhancement:  $ab = .057$ ;  $SE = .032$ ; 95% bootstrap CI:  $.007$ – $.134$ ; and coping:  $ab = .051$ ;  $SE = .032$ ; 95% bootstrap CI:  $.007$ – $.139$ ) and drinks per week. IDI did not mediate conformity motives and drinks per week ( $ab = .016$ ;  $SE = .019$ ; 95% bootstrap CI:  $-.012$ – $.068$ ).

Next, IDI was examined as a mediator between motives (entered simultaneously) and craving. Path coefficients between motives and IDI were the same as for the previous model (see Fig. 1 for coefficient values). IDI was also significantly associated with subsequent craving when controlling for motives ( $\beta = .16$ ,  $p = .03$ ). Neither social nor enhancement nor conformity motives had significant direct effects on craving ( $p$ 's  $> .13$ ). However, coping had a strong and significant direct effect on craving ( $\beta = .57$ ,  $p < .001$ ). Tests of mediation revealed no significant indirect effect of any motives on craving through IDI.

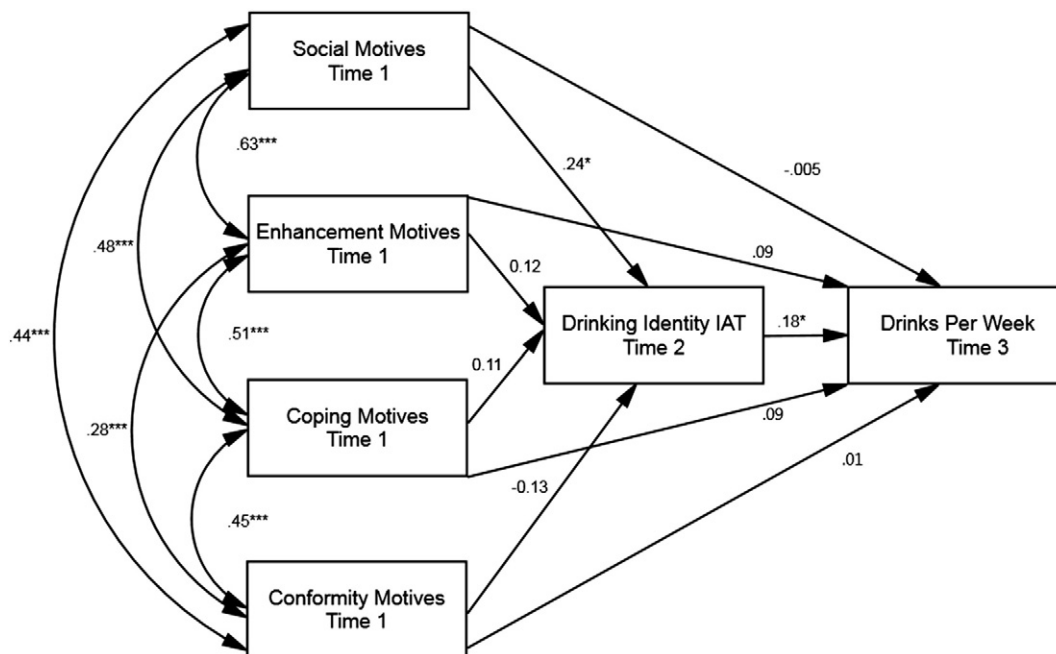
Subsequent models examined each motive individually. Results revealed that IDI mediated the association between three of the four motives (social:  $ab = .073$ ;  $SE = .033$ ; 95% bootstrap CI:  $.021$ – $.155$ ; enhancement:  $ab = .066$ ;  $SE = .031$ ; 95% bootstrap CI:  $.015$ – $.138$ ; and coping  $ab = .046$ ;  $SE = .028$ ; 95% bootstrap CI:  $.008$ – $.121$ ). IDI did not

mediate conformity motives and craving ( $ab = .019$ ;  $SE = .024$ ; 95% bootstrap CI:  $-.023$ – $.075$ ).

#### 4. Discussion

We investigated IDI as a mediator of the relationship between drinking motives and drinking outcomes. When motives were examined in concert, IDI significantly and uniquely mediated the relationship between as single motive (social) and a single outcome (alcohol consumption). However, when motives were examined individually, IDI mediated associations between three of the four motives (social, enhancement, and coping) and consumption and craving. Other notable findings included that IDI positively predicted alcohol consumption over the next week and craving one week later, even after controlling for all four drinking motives.

We had expected IDI to uniquely mediate the relationship between both positive affect motives (i.e., social and enhancement motives) and both drinking outcomes. We evaluated this hypothesis by entering all four motives simultaneously. Consideration of the motives simultaneously is a more conservative test, and the null findings for enhancement motives might stem from the strength of the correlation between social and enhancement motives ( $r = .64$ ). This possibility



**Fig. 1.** Implicit drinking identity as a mediator of the relationship between social motives and drinking. Standardized path coefficients are presented in a PROCESS mediation model with bootstrapping. Lengths of time between assessment periods were included as covariates but not shown in the figure for clarity.



was supported by findings from subsequent analyses that, when considered individually, social and enhancement as well as coping motives had significant indirect effects on consumption and craving through IDI. Taken together, it appears that drinking motives other than conformity are indirectly related to drinking through IDI and that social motives are particularly associated with IDI. The uniqueness of the relationship between social motives and IDI could reflect underlying conceptual differences. Drinking for social reasons is inherently about drinking with others, and there may be a tighter functional relationship between that motive and identifying as a drinker.

Finally, when including all motives simultaneously, we found no unique mediation effects for positive affect motives and alcohol craving. It is possible that such a relationship would be more likely to occur in individuals with longer and/or more severe drinking histories. Study participants, on average, did not endorse craving. These possibilities are post-hoc but suggest intriguing avenues for future research. Interestingly, when examined individually, there were significant indirect effects between three of the four motives (not conformity) and craving through IDI. Taken together, these sets of analyses suggest that positive affect motives might be indirectly associated with craving through IDI but uniquely so.

There also was an exploratory investigation of negative affect drinking motives. The individual models found support for coping (but not conformity) having an indirect effect on consumption and craving through IDI, but the simultaneous models found no evidence of unique effects for coping or conformity. Collectively, these findings may be consistent with the possibility that drinking for those reasons, particularly conformity, could be seen as less acceptable by those who so do and perhaps, be more likely to be attributed to situational influences. Along these lines, coping and, especially, conformity drinking motives were least likely to be endorsed by participants, a pattern found in other studies (e.g., Kuntsche, Stewart, & Cooper, 2008), which could suggest a reluctance to link such motives to the self. Such possibilities suggest the importance of experimental and developmental studies that can directly test whether the self (and IDI) is more or less likely to be strengthened or activated by specific drinking motives.

Finally, the study also extended our understanding of IDI by evaluating it prospectively. The study time period was very short-term, but it is the first we know of to evaluate and to demonstrate that IDI predicts alcohol consumption and craving prospectively. These findings held even after controlling for drinking motives. Additional research that evaluates these relations over longer intervals is clearly warranted, but this is an important first step.

Study findings support theories that IDI may be an important risk factor for hazardous drinking (see Gray et al., 2011; Lindgren, Foster, et al., 2013; Lindgren, Neighbors, et al., 2013). Current theoretical accounts of hazardous drinking (e.g., Stacy & Wiers, 2010; Wiers & Stacy, 2006) have tended to focus on implicit attitudes (whether drinking is associated with positive or negative attributes), implicit associations about alcohol's effects (whether alcohol is arousing or sedating), or implicit appetitive inclinations (whether one has approach or avoid associations with drinking), and those theories have clearly advanced the field. Those accounts, however, have not considered IDI and likely would be strengthened by doing so. Prevention and intervention efforts might also be augmented by considering IDI. One possibility might be to seek to train IDI directly (akin to the approach taken by Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). As our understanding of IDI develops, efforts might also target other contextual or dispositional factors that influence the activation and/or strengthening of IDI, with social drinking motives as one possible factor.

This study represents an initial foray into evaluating IDI as a mediator of drinking motives and drinking outcomes. Naturally, it has limitations. First, these findings concern a single, albeit relatively large, sample of US undergraduates, and the intervals between assessments were short. Further, all study variables other than craving (which assessed craving "right now") are constructs that are likely to be

relatively stable over the assessment interval. It is critical to examine more diverse samples and evaluate IDI's utility as a predictor over longer periods. The current focus on young adult, college students is not itself problematic because this group has particularly high levels of alcohol consumptions and problems (e.g., Johnston, O'Malley, Bachman, & Schulenberg, 2011), but it is important to investigate whether IDI plays a role in adolescence and in middle-aged and older adults. Similarly, evaluating whether these patterns hold for lighter and heavier drinkers will be useful. Finally, due to design limitations, we could not test for reciprocal relationships between study variables or consider change in the variables.

#### 4.1. Conclusion

Despite these limitations, this study advances the field of implicit cognition and hazardous drinking. To our knowledge, it is the first time that IDI has been evaluated as a mediator of the relationship between drinking motives and drinking outcomes. There was partial support for our hypotheses as IDI significantly and uniquely mediated the relationship between social motives and alcohol consumption. Findings also supported IDI as a short-term prospective predictor of consumption and craving. Findings continue to support IDI as a robust predictor of drinking outcomes and as a potential target for intervention. Experimental and longer-term prospective studies will be critical to establish the circumstances under which IDI is strengthened and/or activated and the resulting effects on hazardous drinking.

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#### Contributors

Drs. Lindgren, Neighbors, Wiers, and Teachman designed the study. Dr. Lindgren outlined the manuscript, wrote the Introduction, and edited all sections. Ms. Gasser oversaw data collection, and wrote the Method section. Dr. Neighbors conducted the analyses and wrote the Results section. Drs. Wiers and Teachman wrote the Discussion section. All authors have contributed to and approved the final manuscript.

#### Conflict of interest

All authors declare that they have no conflicts of interest.

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#### References

- Bem, D.J. (1972). Self-perception theory. *Advances in Experimental Social Psychology*, 6, 1–62.
- Collins, R.L., Parks, G.A., & Marlatt, G.A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology*, 53, 189–200.
- Cooper, M.L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, 6, 117–128.
- Cooper, M.L., Frone, M.R., Russell, M., & Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology*, 69, 990–1005.
- Foster, D.W., Neighbors, C., & Young, C.M. (2014). Drink refusal self-efficacy and implicit drinking identity: An evaluation of moderators of the relationship between self-awareness and drinking behavior. *Addictive Behaviors*, 39, 196–204.
- Gray, H.M., LaPlante, D.A., Bannon, B.L., Ambady, N., & Shaffer, H.J. (2011). Development and validation of the Alcohol Identity Implicit Associations Test (AI-IAT). *Addictive Behaviors*, 36, 919–926. <http://dx.doi.org/10.1016/j.addbeh.2011.05.003>.
- Greenwald, A.G. (2007). Generic IAT software. Available from: [http://faculty.washington.edu/agg/iat\\_materials.htm](http://faculty.washington.edu/agg/iat_materials.htm)
- Greenwald, A.G., McGhee, D.E., & Schwartz, J.K. (1998). Measuring individual differences in implicit cognition: The Implicit Association Test. *Journal of Personality and Social Psychology*, 74, 1464–1480. <http://dx.doi.org/10.1037/0022-3514.74.6.1464>.
- Greenwald, A.G., Nosek, B.A., & Banaji, M.R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85, 197–216.

- Hayes, A.F. (2013). *Introduction to mediation, moderation, and conditional process analysis*. New York: The Guilford Press.
- Inquisit 3.0.5.0 [computer software]. (2010). Seattle, WA: Millisecond Software.
- Johnston, L.D., O'Malley, P.M., Bachman, J.G., & Schulenberg, J.E. (2011). *Monitoring the future national survey results on drug use, 1975–2010. Volume II: College students and adults ages 19–50*. Retrieved from The University of Michigan, Institute for Social Research (Monitoring the Future website: [http://monitoringthefuture.org/pubs/monographs/mtf-vol2\\_2010.pdf](http://monitoringthefuture.org/pubs/monographs/mtf-vol2_2010.pdf)).
- Kuntsche, E., Knibbe, R., Gmel, G., & Engels, R. (2005). Why do young people drink? A review of drinking motives. *Clinical Psychology Review, 25*, 841–861.
- Kuntsche, E., Stewart, S.H., & Cooper, M.L. (2008). How stable is the motive-alcohol use link? A cross-national validation of the Drinking Motives Questionnaire Revised among adolescents from Switzerland, Canada, and the United States. *Journal of Studies on Alcohol and Drugs, 69*, 388–396.
- Lindgren, K.P., Foster, D.W., Westgate, E.C., & Neighbors, C. (2013). Implicit drinking identity: Drinker + me associations predict college student drinking consistently. *Addictive Behaviors, 38*, 2163–2166.
- Lindgren, K.P., Neighbors, C., Teachman, B.A., Wiers, R.W., Westgate, E., & Greenwald, A.G. (2013). I drink therefore I am: Validating alcohol-related Implicit Association Tests. *Psychology of Addictive Behaviors, 27*, 1–13, <http://dx.doi.org/10.1037/a0027640>.
- Nosek, B.A., Greenwald, A.G., & Banaji, M.R. (2007). The Implicit Association Test at age 7: A methodological and conceptual review. *Social psychology and the unconscious: The automaticity of higher mental processes* (pp. 265–292).
- Singleton, E.G., Tiffany, S.T., & Henningfield, J.E. (1995). Development and validation of a new questionnaire to assess craving for alcohol. *Problems of drug dependence, 1994: Proceeding of the 56th Annual Meeting, The College on Problems of Drug Dependence, Inc., Volume II: Abstracts. NIDA Research Monograph, 153*. (pp. 289). Rockville, MD: National Institute on Drug Abuse.
- Stacy, A.W., & Wiers, R.W. (2010). Implicit cognition and addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology, 6*, 551–575, <http://dx.doi.org/10.1146/annurev.clinpsy.121208.131444>.
- Stewart, S., Morris, E., Mellings, T., & Komar, J. (2006). Relations of social anxiety variables to drinking motives, drinking quantity and frequency, and alcohol-related problems in undergraduates. *Journal of Mental Health, 15*, 671–682.
- Wiers, R.W., Eberl, C., Rinck, M., Becker, E.S., & Lindenmeyer, J. (2011). Retraining automatic action tendencies changes alcoholic patients' approach bias for alcohol and improves treatment outcome. *Psychological Science, 22*, 490–497, <http://dx.doi.org/10.1177/0956797611400615>.
- Wiers, R., & Stacy, A. (Eds.). (2006). *Handbook of implicit cognition and addiction*. Thousand Oaks, CA: Sage.