Differences in Implicit Associations About Alcohol Between Blacks and Whites Following Alcohol Administration*

SARAH L. PEDERSEN, PH.D., HAYLEY R. TRELOAR, M.A., CHAD M. BURTON, PH.D., AND DENIS M. MCCARTHY, PH.D.†

Department of Psychological Sciences, 210 McAlester Hall, University of Missouri, Columbia, Missouri 65211

ABSTRACT. Objective: Implicit cognitions about alcohol have been shown to be an important predictor of alcohol use. Relatively little research has been conducted on racial/ethnic differences in implicit cognitions or changes in implicit cognitions while intoxicated. This study examined differences between Blacks and Whites in positive and negative implicit associations about alcohol, as measured by the Implicit Association Test (IAT) and tested differences in IAT scores when participants were sober and intoxicated. **Method:** One hundred thirty-five young adults (46% of Black descent) participated in an alcohol-administration study, receiving a moderate dose of alcohol (0.72 g/kg alcohol for men, 0.65 g/kg for women). The IAT was administered in two sessions, one in which alcohol was administered (30 minutes after alcohol consumption) and one in which it was not, approximately 1 week apart.

Results: Repeated-measures mixed-factorial analyses of variance were conducted separately for positive and negative IAT scores. Blacks held lower positive and negative implicit cognitions about alcohol compared with Whites. Positive and negative IAT scores did not change as a function of intoxication. Positive explicit expectancies and self-reported past-month drinking behavior were related to positive IAT scores. Positive and negative IAT scores were also related to acute subjective response to alcohol, and this association differed by race. **Conclusions:** Results extend previous studies by providing evidence for racial differences in implicit cognitions about alcohol and by showing the stability of the IAT while participants are intoxicated. Future studies are needed to determine what factors contribute to racial differences in implicit cognitions. (*J. Stud. Alcohol Drugs*, 72, 270-278, 2011)

ADDICTIONS RESEARCHERS have increasingly highlighted the role of implicit cognitive processes in models of substance use risk (e.g., Rooke et al., 2008; Wiers and Stacy, 2006). Implicit substance-related cognitions are associated with the use of alcohol, marijuana, and cigarettes over and above explicit questionnaire measures (Ames and Stacy, 1998; Jajodia and Earleywine, 2003; McCarthy and Thompson, 2006; Stacy, 1997; Wiers et al., 2002). Measures of implicit cognitions are also shown to be sensitive to changes in context or motivation (Krank et al., 2005; Stacy, 1997). The current study had three primary aims. First, in light of substantial differences in drinking behavior between Black and White young adults, we tested differences in implicit alcohol cognitions between these two groups. Second, we examined changes in implicit alcohol cognitions following laboratory administration of alcohol and whether such changes differed across racial groups. Third, we examined if implicit cognitions about alcohol were related to acute subjective response to alcohol following alcohol administration.

Racial differences in drinking behavior and alcohol expectancies

Blacks start drinking later, consume significantly less alcohol, and are less likely to have an alcohol use disorder

compared with Whites, particularly in adolescence and young adulthood (e.g., Breslau et al., 2006; O'Malley and Johnston, 2002). One potential explanation for these racial differences is that Blacks may have lower levels of alcohol-related risk factors. Consistent with this, studies of explicit alcohol expectancies have indicated that Blacks report lower mean levels of positive expectancies about alcohol (McCarthy et al., 2001) and lower levels of specific positive expectancy domains (e.g., physical/social pleasure; Reese and Friend, 1994). Despite consistent mean differences between groups, it is unclear whether the expectancy-drinking association is the same for these racial groups. Reese and Friend (1994) found that positive expectancies were more predictive of White drinking behavior, whereas others have not found racial differences in this association (McCarthy et al., 2001). Whether implicit cognitions about alcohol differ between Blacks and Whites in mean level or association with alcohol use is not clear.

Implicit and explicit cognitions about alcohol

The majority of research on alcohol-related cognitions has focused on explicit cognitions, such as alcohol expectancies, that are assessed through questionnaire measures. However, there are a number of advantages to implicit measures of alcohol-related cognitions compared with explicit self-report measures. For example, dual-process models of cognition hold that measures of implicit cognitions are better able to assess cognitions or memory associations not open to introspection or outside of awareness (Evans and Coventry, 2006). The development of implicit cognitions may also be

Received: December 10, 2009. Revision: August 3, 2010.

*This research was supported by National Institute on Alcohol Abuse and Alcoholism grants R21 AA015218, T32 AA13526, and F31 AA017571.

†Correspondence may be sent to Denis M. McCarthy at the above address or via email at: mccarthydm@missouri.edu.

more sensitive to indirect learning through avenues such as parental modeling and media exposure compared with explicit expectancies about alcohol (Stacy and Wiers, 2010). Examining implicit cognitions may be particularly useful when examining differences in alcohol use across different cultures or races. Implicit measures may also be more sensitive to changes in accessibility of these memory associations (De Houwer, 2006). The accessibility or activation of these cognitions has been shown to be an important predictor of future substance use (Palfai and Wood, 2001; Stacy, 1997). Additionally, implicit measures may be more sensitive to changes in mood or environmental cues. For example, several studies have found changes in activation of alcohol-related cognitions following experimental mood manipulation (Birch et al., 2004; Krank et al., 2005), in response to alcohol-related cues (Rather and Goldman, 1994; Stritzke et al., 2004), and after exposure to vignettes depicting unsuccessful social situations (Lindgren et al., 2009). Van den Wildenberg et al. (2006) also found that implicit arousal associations were related to heart rate following alcohol consumption, such that higher implicit arousal associations were related to a decrease in heart rate.

Although alcohol-related cognitions have been found to predict drinking decisions and behavior, there is also evidence for a reciprocal effect—that acute intoxication from alcohol can change the accessibility or perception of alcohol-related cognitions. These changes may be particularly relevant for understanding heavy or hazardous use, because such changes may in turn influence drinking decisions within a given drinking event. For example, Wall et al. (2003) found that, compared with levels prior to drinking, participants reported lower levels of explicit expectancies related to aggression and risk taking after drinking. Additionally, they found that individuals rated alcohol outcomes, both positive and negative, more favorably after drinking. Expectancy activation, as measured by the Anticipated Biphase Alcohol Effects scale, has been found to differ on the ascending and descending limb of the blood alcohol curve (Earleywine and Martin, 1993) and to differentiate between heavy and light drinkers (Dunn and Earleywine, 2001). Positive expectancy words are also more easily recalled, as indicated by significantly faster reaction times, following modest levels of alcohol consumption (Palfai and Ostafin, 2003).

Several different methods of measuring implicit cognitions about alcohol and drugs have been developed (e.g., a modified Stroop: Stewart et al., 2002; accessibility tasks: Palfai et al., 1997; Read and Curtin, 2007; Read et al., 2004). Two different alcohol-modified versions of the Implicit Association Test (IAT) have been used in a number of studies (Houben and Wiers, 2006; Jajodia and Earleywine, 2003; Wiers et al., 2002). One version of the IAT can be administered in a unipolar format (Jajodia and Earleywine, 2003), where positive and negative alcohol words are con-

trasted with unrelated neutral words to provide an index of activation of either positive or negative alcohol expectancies. Studies using this unipolar IAT have found that positive IAT scores are related to positive explicit expectancies about alcohol (McCarthy and Thompson, 2006) and drinking behavior (Jajodia and Earleywine, 2003; McCarthy and Thompson, 2006). In these studies, negative IAT scores were not related to either negative explicit expectancies or drinking behavior. An alternate unipolar alcohol-IAT (Houben and Wiers, 2006) assesses arousal and sedation associations. Implicit arousal associations have been shown to be related to alcohol use, whereas implicit sedation associations have been shown to be related to alcohol-related problems (Houben and Wiers, 2006).

Specific aims

The present study had three primary aims. First, we tested racial differences in positive and negative implicit associations about alcohol, assessed using the positive/negative alcohol-modified IAT. Based on research with explicit expectancies (e.g., McCarthy et al., 2001), it was hypothesized that Blacks would hold lower levels of implicit positive cognitions. We also tested the association of implicit cognitions with explicit alcohol expectancies and self-reported drinking behavior and whether differences in implicit cognitions between groups were explained by either differences in explicit expectancies or self-reported drinking behavior. We hypothesized that individuals with higher positive explicit expectancies about alcohol and heavier past-month drinking would have higher implicit positive cognitions. Based on previous research (Jajodia and Earleywine, 2003; McCarthy and Thompson, 2006), we did not hypothesize an association between negative implicit cognitions and either negative explicit expectancies or drinking behavior.

Our second aim was to test potential activation of implicit alcohol associations following alcohol administration. We hypothesized that alcohol intoxication would result in greater activation of positive alcohol cognitions, indicated by higher positive IAT scores following alcohol consumption. Because a placebo manipulation can influence the activation of alcohol cognitions, we chose a no-beverage control session as our comparison. We also tested whether the effect of alcohol on implicit alcohol cognitions differed as a function of explicit expectancies and self-reported drinking behavior.

Our final aim was to examine if sober and intoxicated IAT scores were related to changes in acute subjective response to alcohol—stimulation and sedation—on the ascending and descending limbs of the breath alcohol concentration (BrAC) curve. We hypothesized that higher positive IAT scores would be related to experiencing increased stimulation following alcohol consumption. We also hypothesized that higher negative IAT scores would be related to experiencing increased sedation following alcohol consumption.

Method

Participants

Participants were 135 young adults who were administered the IAT (Greenwald et al., 1998) at two time points as part of a larger study battery. The sample was 49% male and had a mean age of 21.80 years ($SD = 1.18$, range: 21–26). Sixty-two participants (46%) were of African American descent, and 73 participants (54%) were of European American descent. To meet inclusion criteria as a Black participant for the study, those who identified as Hispanic or mixed race were required to have at least one biological parent who was Black. The majority of the sample (76%) had some college education and 14% reported being college graduates. Participants were required to be between the ages of 21 and 26 years and to be current drinkers. Participants were required to report at least one drinking episode in the past 5 months where their consumption was consistent with the amount they would receive in the present study (e.g., three to four drinks for a 165-pound man). Additionally, participants were excluded if they were currently an abstaining alcoholic, had significant medical or psychiatric illness (e.g., psychotic disorders, past head injury with loss of consciousness >5 minutes), or were currently taking medication for which the use of alcohol is contraindicated.

Procedures

Study procedures were approved by the University of Missouri's Institutional Review Board. Participants were recruited from the University of Missouri; the city of Columbia, MO; and the surrounding area. Fliers were placed at various locations at the University of Missouri and at local businesses. Potential participants received a basic phone screening to determine eligibility.

Participants who met eligibility criteria were scheduled for an interview. On the interview day, participants provided informed consent and completed the interview, study tasks, and questionnaires in a private office. As part of a larger study, Black participants received \$40 for their participation in the interview. Whites completed an abbreviated assessment battery and received \$10 for their participation in the interview.

Participants were scheduled for a second appointment approximately 1 week after the initial interview. They were instructed to refrain from alcohol for 24 hours before the session and to refrain from other drug use for 48 hours. They were also instructed to not eat or drink any fluids other than juice or water (e.g., no caffeinated beverages, dairy products) for 8 hours before their session (starting at 12 midnight the evening prior). Participants who were taking medication that is safe to use while consuming alcohol but that could

affect subjective or physiological assessments (e.g., pseudoephedrine) were asked to not take the medication before the alcohol-administration session.

The alcohol-administration session took approximately 5 hours. Participants arrived at the laboratory at 8:00 A.M. and a low-fat breakfast was provided. A questionnaire was administered to verify compliance with pre-session instructions. A BrAC test was used to verify abstinence from alcohol. If participants reported not adhering to study protocol (e.g., ate breakfast before coming into the laboratory), they were rescheduled for a different day. Women were given a urine pregnancy test, and one participant was excluded for testing positive on the pregnancy test.

Between 8:30 and 9:00 A.M., baseline measures were taken. At 9:00 A.M., participants received an alcoholic beverage. Participants received a dose of alcohol equivalent to 0.72 g/kg alcohol for men and 0.65 g/kg alcohol for women, which is designed to reach a peak blood alcohol concentration of approximately .075 mg% to .080 mg% (Sher and Walitzer, 1986). The alcohol drinks were made using 50% alcohol (vodka), in 20% solution with noncaffeinated soda (tonic). Beverages were consumed over a 15-minute period.

Participants were assessed before beverage consumption and then at seven time points at regular intervals following consumption. The IAT and a BrAC test were administered approximately 30 minutes after alcohol consumption. Subjective response to alcohol was assessed at all eight time points. The alcohol administration and assessment were conducted in a private office, with a semi-recumbent chair, separate from that used for interviews. At approximately 12:00 P.M., each participant was provided lunch. To minimize risk, the following procedures outlined in the National Institute on Alcohol Abuse and Alcoholism Recommended Council Guidelines on Ethyl Alcohol Administration in Human Experimentation were used (National Institute on Alcohol Abuse and Alcoholism, 2005). Participants were not allowed to leave the laboratory until their observable behavior had returned to normal and until their BrAC fell below .02%. Each participant was also required to travel home by taxi (provided by the study) or with a friend. Participants were required to state in writing that they would not drive a car or operate other machinery for 3 hours after leaving the laboratory. As part of a larger study, Blacks were reimbursed \$100. Whites completed a reduced assessment battery and were therefore reimbursed \$50 for participation in the session.

Measures

Alcohol use. Participants were asked about past-month (30 days) drinking behavior, including how many times they had at least one drink of alcohol (range: 0–28), average drinks per drinking day (range: 0–15), frequency of consuming five or more drinks of alcohol at one time (range: 0–20), and the largest number of drinks on one occasion (range:

0-21). These individual items were standardized and a past-month drinking variable was created using the mean of these four items. This composite past-month drinking variable was found to have good internal consistency in the current sample ($\alpha = .84$).

Explicit alcohol expectancies. The Comprehensive Effects of Alcohol questionnaire (CEOA; Fromme et al., 1993) was used to assess explicit expectancies about alcohol. The CEOA is a well-established measure of alcohol outcome expectancies. The CEOA has 38 items, which have been found to load on two higher order factors of positive (e.g., "If I were under the influence of alcohol, I would be more social.") and negative (e.g., "If I were under the influence of alcohol, I would take risks.") expectancies (Fromme et al., 1993). The CEOA has demonstrated good test-retest and internal consistency reliability (α 's ranging from .59 to .89; Fromme and D'Amico, 2000), and has been found to be associated with alcohol use in adolescent and college student populations (Fromme and D'Amico, 2000; Fromme et al., 1993). The current study used the two higher order factors to examine positive and negative expectancies. Both factors had high internal consistency in the current sample: $\alpha = .91$ for the positive factor and $\alpha = .87$ for the negative factor. These factors were included as separate covariates in the prediction of implicit associations about alcohol.

Implicit Association Test. The IAT (Greenwald et al., 1998) was used to assess implicit cognitions about alcohol. The IAT is an indirect measure of the association between attributes (e.g., positive, negative) and targets (e.g., flowers, insects). The traditional IAT has been modified to assess positive and negative implicit attitudes about alcohol (Wiers et al., 2002). Support has been found for internal consistency reliability and validity for the alcohol-modified IAT (McCarthy and Thompsen, 2006). A complete list of words for each attribute and target of the IAT used in the current study is provided in Table 1.

The IAT used in the current study assessed both positive and negative associations about alcohol. Word lists were modeled after previous IAT studies (Jajodia and Earleywine, 2003; McCarthy and Thompsen, 2006). Target categories were alcohol (e.g., vodka, beer) and mammals (e.g., goat, rabbit). Attribute categories were positive (e.g., happy, attractive), negative (e.g., dangerous, sick), and neutral (e.g., basic, historical). The difference, or *D* score, between reaction times when positive or neutral attributes were paired with alcohol constituted the positive IAT and the difference, or *D* score, for negative and neutral attributes constituted the negative IAT. Each participant completed both the positive and negative IAT and the attribute pairings (i.e., positive-neutral, negative-neutral, neutral-positive, and neutral-negative) were counterbalanced to account for potential order effects. Recommended procedures for data cleaning and improved scoring of the IAT (computation of *D* scores) were followed (Greenwald et al., 2003).

TABLE 1. Implicit Association Test word list

Alcohol	Mammals	Negative	Neutral	Positive	Neutral
vodka	goat	dangerous	elaborate	happy	basic
rum	sheep	sick	tall	attractive	historical
whiskey	rabbit	angry	daily	sociable	brown
beer	donkey	mean	compact	confident	stationary
gin	elephant	depressed	related	sexy	steep
tequila	llama	unhappy	digital	relaxed	sandy

Response to alcohol. Acute subjective response to alcohol was evaluated at baseline and at all measurement points following beverage consumption using the Biphasic Alcohol Effects Scale (Martin et al., 1993). This measure assesses separate sedating and stimulating effects of alcohol on both the ascending and descending limb of the BrAC curve. Participants were instructed to indicate how they were feeling "right now" on a 1 (not at all) to 10 (extremely) scale for 14 different adjectives (e.g., elated, talkative, energized, sluggish, inactive, sedated). This measure has been used to discriminate sedating and stimulating effects of alcohol in alcohol challenge studies and has a four-factor structure (Type of Response $\times$ Blood Alcohol Curve Limb; Earleywine and Erblich, 1996). Both factors, stimulation and sedation, had high internal consistency at all time points across the BrAC curve in the current sample: α 's ranged from .88 to .94 for stimulation and from .81 to .91 for sedation.

Results

Descriptive information

Table 2 presents mean levels of past-month drinking behavior, explicit alcohol expectancies, and implicit cognitions separately by race. Whites reported drinking alcohol more frequently, consuming a greater quantity of drinks, consuming at least five drinks on more occasions, and consuming a greater number of drinks on a single occasion compared with Blacks. Whites also endorsed higher levels of both positive and negative explicit alcohol expectancies. Racial differences in implicit cognitions closely paralleled explicit alcohol expectancies, with Whites having higher levels of both positive and negative implicit cognitions. The one exception to this was that mean levels of intoxicated positive implicit cognitions did not significantly differ across race. Table 3 presents the zero-order correlations among study variables separately by race.

We then tested for potential order effects of the IAT. Participants were randomly assigned to one of four conditions that counterbalanced the order in which the IAT block trials were presented. Univariate analyses of variance (ANOVAs) indicated that the sober positive IAT did not have order effects; however, order effects were found for the intoxicated positive IAT and the sober and intoxicated negative IAT ($ps < .001$). Follow-up analyses showed that participants who

TABLE 2. Descriptive statistics for past-month alcohol use variables, explicit alcohol expectancies, and implicit alcohol cognitions

Variable	Blacks <i>M</i> (<i>SD</i>)	Whites <i>M</i> (<i>SD</i>)
Frequency	5.98 (5.38)	9.64 (5.44)***
Quantity	3.05 (1.67)	4.99 (2.75)***
Five or more drinks	2.26 (3.08)	5.12 (4.35)***
Largest number of drinks	5.48 (3.88)	9.68 (4.64)***
Positive alcohol expectancies	2.73 (0.60)	2.95 (0.38)*
Negative alcohol expectancies	2.25 (0.51)	2.47 (0.45)**
Positive sober IAT score	0.18 (0.37)	0.33 (0.31)**
Positive intoxicated IAT score	0.22 (0.39)	0.34 (0.39)
Negative sober IAT score	0.33 (0.39)	0.47 (0.36)*
Negative intoxicated IAT score	0.34 (0.43)	0.49 (0.37)*

Notes: Values are means and standard deviations of raw scores. *T* tests were used to compare mean level differences between Blacks and Whites. IAT = Implicit Association Test.

* $p < .05$; ** $p < .01$; *** $p < .001$.

completed a trial with alcohol paired with positive or negative words first were faster than participants who completed trials with alcohol paired with neutral words first. Supplementary analyses (not presented) were run with dummy-coded order variables, and the pattern of results for all study analyses remained unchanged.

Implicit cognitions by racial groups and sober and intoxicated sessions

We tested whether positive and negative IAT scores differed significantly between racial groups and between sober and intoxicated sessions. A set of 2 (race) $\times$ 2 (sex) $\times$ 2 (session: sober, intoxicated) mixed-factorial ANOVAs were conducted separately for both positive and negative IAT scores. Supplementary analyses where BrAC at the 30-minute time point ($M_{\text{BrAC}} = .067$ mg%) were run to account for potential differences in IAT scores due to intoxication level. Results with BrAC included as a covariate resulted in the same pattern of findings.

For the positive IAT, a main effect of race, $F(1, 131) = 6.77$, $p < .01$; partial $\eta^2 = .05$, indicated that Whites had higher positive IAT scores. No main effects were observed for session, $F(1, 131) = 0.84$, n.s., partial $\eta^2 < .01$, or sex, $F(1, 131) = 1.21$, n.s., partial $\eta^2 < .01$. For the negative IAT, we again observed a main effect of race, $F(1, 131) = 6.14$, p

$< .05$, partial $\eta^2 = .05$, with Whites having higher negative IAT scores. No main effects were observed for session, $F(1, 131) = 0.34$, n.s., partial $\eta^2 < .01$, or sex, $F(1, 131) = 0.45$, n.s., partial $\eta^2 < .01$. No interactions between session, sex, and race were revealed for either positive or negative IAT scores.

Implicit and explicit cognitions about alcohol

To test whether sober and intoxicated IAT scores differed as a function of explicit expectancies we ran a parallel series of ANOVAs (Race $\times$ Sex $\times$ Session) adding explicit expectancies as a covariate. Two separate ANOVAs were run for positive and negative alcohol expectancies. A main effect for positive explicit expectancies was found, $F(1, 130) = 12.26$, $p < .001$, partial $\eta^2 = .09$, indicating that having more positive explicit expectancies was related to higher positive IAT scores. However, this main effect was qualified by a Session $\times$ Explicit Positive Expectancy interaction, $F(1, 130) = 9.29$, $p < .01$, partial $\eta^2 = .07$, showing that positive explicit expectancies were related to sober positive IAT scores ($r = .44$, $p < .001$) but not to intoxicated IAT scores ($r = .12$, n.s.). Negative explicit expectancies were not related to either sober or intoxicated negative IAT scores. The association between explicit expectancies and IAT scores did not differ as a function of race.

Implicit associations about alcohol and self-reported drinking behavior

To test whether sober and intoxicated IAT scores differed as a function of past-month drinking behavior, we ran a parallel series of ANOVAs (Race $\times$ Sex $\times$ Session) adding past-month drinking as a covariate. Past-month drinking behavior was significantly related to positive IAT scores, $F(1, 130) = 4.39$, $p < .05$, partial $\eta^2 = .03$, indicating that individuals who consumed more alcohol in the past month had higher positive IAT scores. Past-month drinking was not associated with negative IAT scores. Past-month drinking did not interact with session, race, or sex in predicting change in positive or negative IAT.

We then ran mediation analyses to test whether the association between race and alcohol use was explained by

TABLE 3. Zero-order correlations for study variables for Blacks and Whites

	1.	2.	3.	4.	5.	6.	7.
1. Past-month drinking	—						
2. Positive expectancies	.22/.19	—					
3. Negative expectancies	.02/-.17	.43***/.35**	—				
4. Positive sober IAT	.13/.02	.46***/.33**	.12/.20	—			
5. Positive intox. IAT	.13/.25*	.05/.15	.11/.04	.26*/.47***	—		
6. Negative sober IAT	-.15/-.15	-.12/.05	-.09/.02	-.10/.02	.06/.27*	—	
7. Negative intox. IAT	-.08/-.09	-.10/.16	.00/-.06	-.07/.09	.20/.27*	.52***/.48***	—

Note: Scores are Blacks/Whites. Intox. = intoxicated.

* $p < .05$; ** $p < .01$; *** $p < .001$.

FIGURE 1. Race $\times$ Positive Intoxicated Implicit Association Test (IAT) Score $\times$ Time. The figure presents the three-way interaction between race, positive intoxicated IAT score, and time in the prediction of subjective stimulation on the ascending limb of the breath alcohol concentration curve. Estimated means of Biphasic Alcohol Effects Scale (BAES) stimulation are plotted at 1 *SD* above and below the mean of positive IAT scores. Pos. = positive; mins = minutes.

differences in implicit cognitions about alcohol (race $\rightarrow$ implicit cognitions $\rightarrow$ alcohol use) or if the association between race and implicit cognitions could be explained by differences in alcohol use (race $\rightarrow$ alcohol use $\rightarrow$ implicit cognitions). Analyses were run separately for each IAT outcome measure (i.e., sober positive IAT, intoxicated positive IAT, sober negative IAT, intoxicated negative IAT) using path analysis and indirect effects tests in Mplus 5.2 (Muthén and Muthén, 2009). Results of these analyses did not support mediation, as the indirect effect of race on alcohol use through implicit cognitions was not significant for any of the four IAT outcomes. The indirect effect of race on implicit cognitions through alcohol use was also not significant.

Implicit associations about alcohol and acute subjective response

The final aim of the current study was to examine if implicit cognitions about alcohol were related to acute response to alcohol, as measured by self-reported stimulation and sedation. All analyses controlled for sober levels of stimulation and sedation. Sets of 2 (race) $\times$ 2 (sex) $\times$ 3 (assessment

time point) mixed-factorial ANOVAs were conducted for analyses examining acute response on the ascending limb. Separate sets of 2 (race) $\times$ 2 (sex) $\times$ 4 (assessment time point) ANOVAs were conducted to examine acute response on the descending limb. Analyses were conducted separately for each IAT score (positive/negative, sober/intoxicated) and ascending (15-, 30-, 45-minute assessments) and descending (60-, 90-, 120-, 150-minute assessments) limbs of the BrAC curve.

Stimulation was associated with the intoxicated positive IAT, with a Significant Time $\times$ Intoxicated Positive IAT score interaction on the ascending limb, $F(1, 128) = 5.63$, $p < .01$, partial $\eta^2 = .04$. These results indicate that having higher intoxicated positive IAT scores was related to sharper increases in stimulation on the ascending limb. A significant three-way interaction between race, positive intoxicated IAT, and time was also found, $F(1, 127) = 4.39$, $p < .05$, partial $\eta^2 = .03$ (Figure 1). Follow-up ANOVAs run within racial group showed that intoxicated positive IAT scores were related to sharper increases in stimulation on the ascending limb for Blacks, $F(1, 57) = 6.94$, $p < .001$, partial $\eta^2 = .11$, but not for Whites, $F(1, 69) = 0.30$, $p = .74$, partial $\eta^2 < .01$. Sober

positive IAT scores were not related to stimulation on either the ascending or descending limbs of the BrAC curve.

Sedation on the descending limb was related to the sober negative IAT, with a significant main effect, $F(1, 126) = 6.26, p < .05$, partial $\eta^2 = .05$, that was qualified by a Significant Time $\times$ Sober Negative IAT interaction, $F(1, 126) = 3.15, p < .05$, partial $\eta^2 = .02$. These results indicate that higher sober levels of negative implicit cognitions are related to experiencing sharper decreases in sedation on the descending limb. Significant three-way interactions between race, sober negative IAT, and time on the ascending and descending limbs were also found—ascending limb sedation: $F(1, 127) = 3.07, p < .05$, partial $\eta^2 = .02$; descending limb sedation: $F(1, 125) = 2.87, p < .05$, partial $\eta^2 = .02$. Follow-up ANOVAs run within racial groups showed that for Whites, higher sober negative IAT scores were related to sharper increases in sedation on the ascending limb and sharper decreases in sedation on the descending limb—ascending limb: $F(1, 69) = 2.64, p = .08$, partial $\eta^2 = .04$; descending limb: $F(1, 69) = 7.20, p < .001$, partial $\eta^2 = .09$. These effects were not observed for Blacks—ascending limb: $F(1, 57) = 0.79, p = .46$, partial $\eta^2 = .01$; descending limb: $F(1, 55) = 0.39, p = .74$, partial $\eta^2 < .01$. Intoxicated negative IAT scores were not related to sedation on either limb of the BrAC curve. Results also supported specificity of these effects: Positive IAT scores were not associated with sedation on either the ascending or descending limb, and negative IAT scores were not associated with stimulation on either limb.

Discussion

The current study examined racial differences in implicit cognitions about alcohol and potential differences in these cognitions when participants were sober and intoxicated. Prior studies have found that Blacks drink less alcohol (e.g., Breslau et al., 2006) and have lower positive alcohol expectancies (e.g., McCarthy et al., 2001) compared with Whites. We extended this to implicit cognitions about alcohol, demonstrating that Blacks have lower levels of both positive and negative implicit cognitions about alcohol compared with Whites. We did not observe any differences in positive or negative IAT scores across sober and intoxicated sessions.

Racial differences in implicit cognitions

Racial differences were parallel across explicit and implicit measures, with Blacks having lower positive and negative alcohol expectancies and IAT scores. Lower levels of both positive and negative alcohol-related cognitions for Blacks is consistent with their lower lifetime experience with drinking and lower exposure to modeling of alcohol use and alcohol-related consequences compared with Whites. However, implicit cognitions did not account for (mediate) the

association between race and recent alcohol use. Future studies could explore lifetime drinking history and exposure to alcohol-related modeling rather than recent drinking behavior. Research on the development of implicit cognitions also raises the possibility that these cognitions develop through more indirect avenues (e.g., media exposure; Stacy and Wiers, 2010). Incorporating environmental (e.g., alcohol outlet density, advertising) and cultural variables (e.g., religious preference) that may differ across races is an important next step in understanding the mean-level differences in implicit cognition found in the current study.

We also found that implicit alcohol cognitions, both sober and intoxicated, were related to subjective response to alcohol following alcohol administration and that this association differed across race. These findings highlight the potential importance of assessing both sober and intoxicated implicit cognitions, as they were related to changes in acute response to alcohol at different points along the BrAC curve. Intoxicated positive IAT scores were related to increases in stimulation on the ascending limb of the BrAC curve, whereas sober negative IAT scores were related to experiencing decreases in sedation on the descending limb. Additionally, positive implicit cognitions were related to sharper increases in stimulation for Blacks and negative implicit cognitions about alcohol were related to change in sedation for Whites. Further research is required to examine the reciprocal association between implicit cognitions and acute response to alcohol. The current study raises the possibility that over time, as young Blacks gain more experiences with using alcohol, the stimulation they experience may shape their cognitions, which would then increase positive associations about alcohol over time. A similar transaction may occur for Whites with the sedating effects of alcohol and negative alcohol-related cognitions.

Implicit and explicit cognitions

Results of our study differ from a similar study conducted by Palfai and Ostafin (2003) that also examined the influence of alcohol on activation of implicit alcohol cognitions. Where this study found increased activation of alcohol cognitions under intoxication, our study found no differences in positive or negative implicit alcohol cognitions across sober and intoxicated sessions. This may be the result of methodological differences between the two studies. The implicit task used by Palfai and Ostafin (2003) may be more sensitive to change as a function of contextual manipulations such as intoxication. Prior studies have found a moderate degree of test-retest reliability for the alcohol modified IAT (McCarthy and Thompson, 2006), indicating that the IAT may not be as sensitive to moment-to-moment changes. Another difference between the two studies is that Palfai and Ostafin (2003) administered the participant's beverage of choice (i.e., beer to frequent beer drinkers). Participants in our study did

not necessarily receive their beverage of choice, as all participants received vodka and tonic. This could reduce the activation of alcohol associations from conditioned cues (taste, smell; Staiger and White, 1991). Finally, Palfai and Ostafin (2003) examined the effect of a low dose of alcohol (mean peak BrAC of .04), whereas mean peak BrAC in our study at the time of IAT completion was 0.067. Future studies using different methods of measuring implicit cognitions and administering different types and amounts of alcohol would allow us to further test the activation of implicit cognitions while intoxicated.

Interestingly, although we did not find evidence for expectancy activation while participants were intoxicated, we found that positive explicit expectancies were more related to sober positive implicit cognitions than intoxicated implicit cognitions. This could indicate that intoxicated alcohol cognitions may assess a slightly different construct than either implicit cognitions or explicit expectancies assessed while sober. As hypothesized, past-month drinking behavior was related to both sober and intoxicated positive IAT scores. Consistent with previous studies done while participants were sober (Jajodia and Earleywine, 2003; McCarthy and Thompson, 2006), negative IAT scores at both time points were unrelated to negative explicit expectancies and drinking behavior.

Limitations and future directions

The current study has several limitations. First, we used a single dose level of alcohol, which prevented testing dose effects on the activation of implicit cognitions. We also chose a no-beverage session, rather than a placebo session, as our comparison condition. Although this limited our ability to isolate pharmacological from expectancy effects on the IAT, we did not observe a significant session effect on the IAT. Additionally, participants were aware they were participating in an alcohol-administration study and completed both IAT sessions in the same laboratory, which may have activated implicit cognitions in the sober session, decreasing our power to see change in expectancy activation while intoxicated. The design of the current study also precluded our ability to differentiate between expectancy activation as a result of exposure to alcohol-related cues (e.g., being enrolled to participate in a study on alcohol) or the pharmacological effects of alcohol. Similarly, another limitation is that the order of sessions was not counterbalanced, which could confound practice effects with alcohol effects. Prior studies in our lab have not observed practice effects on repeated administrations of the alcohol IAT (McCarthy and Thompson, 2006).

Another limitation of the present study is the restriction of the sample to current drinkers (a requirement of this type of alcohol-administration study). Limiting the sample to current drinkers restricts the range of drinking variables and can reduce the range of drinking risk factors, such as expectancies and implicit cognitions. Future studies could

examine differences in implicit cognitions about alcohol between racial groups that include a wider range of drinker categories (e.g., abstainers) to see if results replicate in a more generalizable sample.

Implicit cognitions about alcohol are important predictors of drinking behavior and have been found to add prediction over explicit expectancy measures (e.g., Stacy, 1997). Research has not focused on racial differences in implicit alcohol-related cognitions and relatively few studies have examined implicit cognitions about alcohol while participants are intoxicated. The current study extended previous research by examining implicit cognitions about alcohol, using the IAT, in an alcohol-administration study with Blacks and Whites. Differences in implicit cognitions between African Americans and Whites mirrored explicit expectancy differences and were not explained by differences in recent drinking behavior. Results also suggest that although implicit cognitions are a relatively stable construct when participants are either sober or intoxicated, these cognitions may be differentially related to explicit expectancies and acute subjective response to alcohol.

References

- Ames, S. L., & Stacy, A. W. (1998). Implicit cognition in the prediction of substance use among drug offenders. *Psychology of Addictive Behaviors*, 12, 272-281.
- Birch, C. D., Stewart, S. H., Wall, A.-M., McKee, S. A., Eismor, S. J., & Theakson, J. A. (2004). Mood-induced increases in alcohol expectancy strength in internally motivated drinkers. *Psychology of Addictive Behaviors*, 18, 231-238.
- Breslau, J. S., Aguilar-Gaxiola, S., Kendler, K. S., Su, M., Williams, D., & Kessler, R. C. (2006). Specifying race-ethnic differences in risk for psychiatric disorder in a USA national sample. *Psychological Medicine*, 36, 57-68.
- De Houwer, J. (2006). What are implicit measures and why are we using them. In R. W. Wiers & A. W. Stacy (Eds.), *The handbook of implicit cognition and addiction* (pp. 11-28). Thousand Oaks, CA: Sage.
- Dunn, M. E., & Earleywine, M. (2001). Activation of alcohol expectancies in memory in relation to limb of the blood alcohol curve. *Psychology of Addictive Behaviors*, 15, 18-24.
- Earleywine, M., & Martin, C. S. (1993). Anticipated stimulant and sedative effects of alcohol vary with dosage and limb of the blood alcohol curve. *Alcoholism: Clinical and Experimental Research*, 17, 135-139.
- Earleywine, M., & Erblich, J. (1996). A confirmed factor structure for the Biphasic Alcohol Effects Scale. *Experimental and Clinical Psychopharmacology*, 4, 107-113.
- Evans, J. St. B. T., & Coventry, K. (2006). A dual process approach to behavioral addiction: The case of gambling. In R. W. Wiers & A. W. Stacy (Eds.), *The handbook of implicit cognition and addiction* (pp. 29-44). Thousand Oaks, CA: Sage.
- Fromme, K., & D'Amico, E. J. (2000). Measuring adolescent alcohol outcome expectancies. *Psychology of Addictive Behaviors*, 14, 206-212.
- Fromme, K., Stroot, E. A., & Kaplan, D. (1993). Comprehensive effects of alcohol: Development and psychometric assessment of a new expectancy questionnaire. *Psychological Assessment*, 5, 19-26.
- Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognitions: The implicit association test. *Journal of Personality and Social Psychology*, 74, 1464-1480.

- Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the IAT: An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85, 197-216.
- Houben, K., & Wiers, R. W. (2006). Assessing implicit alcohol associations with the Implicit Association Test: Fact or artifact? *Addictive Behaviors*, 31, 1346-1362.
- Jajodia, A., & Earleywine, M. (2003). Measuring alcohol expectancies with the implicit association test. *Psychology of Addictive Behaviors*, 17, 126-133.
- Krank, M., Wall, A.-M., Stewart, S. H., Wiers, R. W., & Goldman, M. S. (2005). Context effects on alcohol cognitions. *Alcoholism: Clinical and Experimental Research*, 29, 196-206.
- Lindgren, K. P., Neighbors, C., Ostafin, B. D., Mullins, P. M., & George, W. H. (2009). Automatic alcohol associations: Gender differences and the malleability of alcohol associations following exposure to a dating scenario. *Journal of Studies on Alcohol and Drugs*, 70, 583-592.
- Martin, C. S., Earleywine, M., Musty, R. E., Perrine, M. W., & Swift, R. M. (2003). Development and validation of the biphasic alcohol effects scale. *Alcoholism: Clinical and Experimental Research*, 17, 140-146.
- McCarthy, D. M., Miller, T. L., Smith, G. T., & Smith, J. A. (2001). Disinhibition and expectancy in risk for alcohol use: Comparing Black and White college samples. *Journal of Studies on Alcohol*, 62, 313-321.
- McCarthy, D. M., & Thompson, D. M. (2006). Implicit and explicit measures of alcohol and smoking cognitions. *Psychology of Addictive Behaviors*, 20, 436-444.
- Muthén, L. K. & Muthén, B. O. (1998-2007). *Mplus user's guide* (version 5). Los Angeles, CA: Author.
- National Advisory Council on Alcohol Abuse and Alcoholism. (2005). *Recommended council guidelines on ethyl alcohol administration in human experimentation* (Revised). Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.
- O'Malley, P. M., & Johnston, L. D. (2002). Epidemiology of alcohol and other drug use among American college students. *Journal of Studies on Alcohol, Supplement 14*, 23-39.
- Palfai, T. P., Monti, P. M., Colby, S. M., & Rohsenow, D. J. (1997). Effects of suppressing the urge to drink on the accessibility of alcohol outcome expectancies. *Behavior Research and Therapy*, 35, 59-65.
- Palfai, T. P., & Ostafin, B. D. (2003). The influence of alcohol on the activation of outcome expectancies: The role of evaluative expectancy activation in drinking behavior. *Journal of Studies on Alcohol*, 64, 111-119.
- Palfai, T. P., & Wood, M. D. (2001). Positive alcohol expectancies and drinking behavior: The influence of expectancy strength and memory accessibility. *Psychology of Addictive Behaviors*, 15, 60-67.
- Rather, B. C., & Goldman, M. S. (1994). Drinking-related differences in the memory organization of alcohol expectancies. *Experimental Clinical Psychopharmacology*, 2, 167-183.
- Read, J. P., & Curtin, J. J. (2007). Contextual influences on alcohol expectancy processes. *Journal of Studies on Alcohol and Drugs*, 68, 759-770.
- Read, J. P., Wood, M. D., Lejuez, C. W., Palfai, T. P., & Slack, M. (2004). Gender, alcohol consumption and alcohol expectancies in college drinkers. *Experimental and Clinical Psychopharmacology*, 12, 298-308.
- Reese, L., & Friend, R. (1994). Alcohol expectancies and drinking practices among Black and White undergraduate males. *Journal of College Student Development*, 35, 319-325.
- Rooke, S. E., Hine, D. W., & Thorsteinsson, E. B. (2008). Implicit cognition and substance use: A meta analysis. *Addictive Behaviors*, 33, 1314-1328.
- Sher, K. J., & Walitzer, K. S. (1986). Individual differences in the stress-response dampening effect on alcohol: A dose-response study. *Journal of Abnormal Psychology*, 95, 159-167.
- Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, 106, 61-73.
- 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.
- Staiger, P. K., & White, J. M. (1991). Cue reactivity in alcohol abusers: Stimulus specificity and extinction of the responses. *Addictive Behaviors*, 16, 211-221.
- Stewart, S. H., Hall, E., Wilkie, H., & Birch, C. (2002). Affective priming of alcohol schema in coping and enhancement motivated drinkers. *Cognitive Behavior Therapy*, 31, 68-80.
- Stritzke, W. G. K., Breiner, M. J., Curtin, J. J., & Lang, A. R. (2004). Assessment of substance cue reactivity: Advances in reliability, specificity, and validity. *Psychology of Addictive Behaviors*, 18, 148-159.
- Wall, A.-M., Thrussell, C., & Lalonde, R. N. (2003). Do alcohol expectancies become intoxicated outcomes? A test of social-learning theory in a naturalistic bar setting. *Addictive Behaviors*, 28, 1271-1283.
- Wiers, R. W., & Stacy, A. W. (2006). Implicit cognition and addiction. *Current Directions in Psychological Science*, 15, 292-296.
- Wiers, R. W., van Woerden, N., Smulders, F. T. Y., & de Jong, P. J. (2002). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology*, 111, 648-658.
- van den Wildenberg, E., Beckers, M., van Lambaart, F., Conrod, P. J., & Wiers, R. W. (2006). Is the strength of implicit alcohol associations correlated with alcohol-induced heart rate acceleration? *Alcoholism: Clinical and Experimental Research*, 30, 1336-1348.