Alcoholism: Clinical and Experimental Research

Vol. 42, No. 10
October 2018

Explicit Attitudes, Working Memory Capacity, and Driving After Drinking

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Background: Attitudes toward driving after drinking are strongly predictive of drinking and driving behavior. This study tested working memory capacity (WMC) as a moderator of the association between attitudes and drinking and driving behavior. Consistent with dual process models of cognition, we hypothesized that the association between perceived danger and drinking and driving would be stronger for individuals with higher WMC.

Methods: Participants (N = 161) enrolled in larger alcohol administration study were randomly assigned to an alcohol (n = 57), placebol (n = 52), or control (n = 52, not included) beverage condition. Past-year frequency of driving after drinking and WMC were assessed at baseline. Attitudes were assessed by asking participants to rate the perceived danger of driving at their current level of intoxication twice on the ascending limb (AL1, AL2), at peak breath alcohol concentration (BrAC), and twice on the descending limb (DL1, DL2).

Results: Analyses across the BrAC curve indicated that the hypothesized interaction was observed for the alcohol but not placebo condition. Analyses for each assessment point indicated that the interaction was significant for the ascending limb and peak BrAC. In the alcohol condition, for those higher in WMC, lower perceived dangerousness was strongly associated with increased driving after drinking (AL1: incident rate ratios [IRR] = 5.87, Wald's χ^2 = 12.39, p = 0.006, 95% CI [2.19, 15.75]; AL2: IRR = 8.17, Wald's χ^2 = 11.39, p = 0.001, 95% CI [2.41, 27.66]; Peak: IRR = 5.11, Wald's χ^2 = 9.84, p = 0.002, 95% CI [1.84, 14.16]). Associations were not significant at low WMC.

Conclusions: Results suggest that individuals higher in WMC are more likely to act consistently with their explicit attitudes toward drinking and driving. Findings may have implications for existing drinking and driving interventions and suggest the potential for novel interventions targeting implicit associations or WMC.

Key Words: Drinking and Driving, Alcohol Administration, Explicit Attitudes, Working Memory Capacity, Dual Process Models.

DRINKING AND DRIVING represents a serious public health concern in the United States, contributing substantially to traffic accidents and fatalities (National Highway Traffic Safety Administration, 2015). While an overwhelming majority view drinking and driving as a major threat to public safety (Drew et al., 2010), 28.7 million adults still report driving after drinking on at least 1 occasion per year (Substance Abuse and Mental Health Services Administration, 2014). Previous studies have found that attitudes toward drinking and driving, assessed while sober and intoxicated, are strongly associated with drinking and driving behavior (e.g., Amlung et al., 2014; Morris et al., 2014). However, individual differences likely moderate the association between drinking and driving attitudes and behavior, and this may partially account for the discrepancy between the high prevalence of driving after drinking and widely held negative views toward it. Consistent with dual process models of cognition (e.g., Hofmann et al., 2008), the present study tested working memory capacity (WMC) as a moderator of intoxicated attitudes toward drinking and driving.

Research has identified a strong association between drinking and driving attitudes and behavior. Across multiple studies, lower perceived dangerousness of driving after drinking has been associated with increased odds of doing so (Bingham et al., 2007; Fairlie et al., 2010; Grube and Voas, 1996; McCarthy and Pedersen, 2009; McCarthy et al., 2007; Morris et al., 2014). Perceived danger has also been found to mediate the association between trait impulsivity and drinking and driving (Treloar et al., 2012). Acute alcohol intoxication appears to moderate the association between drinking and driving attitudes and behavior by impairing judgments of risk. In a previous study (Morris et al., 2014), we found that perceptions of dangerousness assessed during intoxication were associated with increased willingness to drive and higher rates of self-reported drinking and driving behavior, over and above perceptions reported while sober. A subsequent study (Amlung et al., 2014) replicated these results and found that, on the descending limb, participants reported lower perceived dangerousness of driving and

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Received for publication March 1, 2018; accepted July 27, 2018.

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DOI: 10.1111/acer.13856

increased willingness to drive compared with the ascending limb, suggesting acute tolerance of this effect. These findings indicate that perceived dangerousness is an important determinant of drinking and driving, but that its effect may be conditional on other variables.

An individual differences perspective on dual process theories of cognition (Barrett et al., 2004) suggests that variability in executive functioning may alter the association between drinking and driving attitudes and behaviors. Although the scope and terminology of different dual process models vary, nearly all make a distinction between 2 semi-independent systems: an automatic "impulsive" system and a more controlled, "reflective" system (Metcalfe and Mischel, 1999; Sloman, 1996; Smith and DeCoster, 2000; Strack and Deutsch, 2004). Relevant to the present investigation, the reflective system is responsible for overcoming impulsive processes by generating judgments and decisions based on explicit attitudes and beliefs (Strack and Deutsch, 2004). These processes are largely dependent upon executive functions (e.g., WMC, behavioral inhibition, set shifting; Miyake et al., 2000), as significant cognitive resources are required for the reflective system to restrain behavior. Individuals vary in their executive functioning abilities, and these individual differences can be reliably assessed with neuropsychological measures (Conway et al., 2005).

WMC, a limited capacity executive function responsible for maintaining information in an active state for further processing, is a central construct in many dual process models of cognition (Engle, 2002). Barrett and colleagues (2004) proposed that individual differences in WMC moderate the effects of automatic and controlled processes on goal-directed behavior. Their model proposes that individuals with higher WMC possess more goal-directed attentional resources, allowing them to maintain explicit cognitions in active memory and to call upon more information when making decisions in the presence of conflicting goals. Empirical studies support the moderation of attitude/behavior associations across a number of domains. In a series of studies, Hofmann and colleagues (2008) found that explicit beliefs and goals were more influential in determining goal-directed behaviors (e.g., sexual interest behaviors, aggression, consumption of palatable food) for those higher in WMC. The converse was found for automatic traits and attitudes, with individuals lower in WMC exhibiting a stronger association between implicit attitudes and behavior.

A similar pattern of results has been observed in addiction psychology (Wiers and Stacy, 2006b), and major theories of addiction have posited a moderating role for executive control in substance involvement (Koob and Le Moal, 2008; Robinson and Berridge, 2008), and alcohol use more specifically (e.g., Finn, 2002). Empirical findings have also demonstrated that implicit associations more strongly predict nicotine (Grenard et al., 2008) and alcohol use in at-risk adolescents (Grenard et al., 2008; Thush et al., 2008) and in young adults (Houben and Wiers, 2009) with lower scores on measures of WMC. Conversely, explicit beliefs more strongly predicted alcohol use in adolescents with relatively higher WMC (Thush et al., 2008).

The current study extends this model by testing whether WMC alters the association between explicit attitudes and drinking and driving behavior. This study was a secondary analysis of data collected in a double-blind, placebo-controlled alcohol administration experiment primarily designed to test risk factors for driving after drinking and behavioral economic demand and craving for alcohol following a laboratory alcohol administration procedure (Amlung et al., 2015). The present study tested WMC as a moderator of the association between intoxicated perceptions of dangerousness and drinking and driving behavior. Consistent with dual process models of cognition, we hypothesized that individuals with higher WMC would be more likely to act consistently with their explicit beliefs about the danger of drinking and driving. Therefore, the association between intoxicated perceived danger and drinking and driving would be stronger for such individuals, relative to their lower-WMC counterparts.

MATERIALS AND METHODS

Participants

Participants were recruited from a large, Midwestern University and the surrounding area via fliers and university informational listserv emails. Participants had to be at least 21 years of age and report having consumed 5 or more drinks (4 or more for women) on 1 occasion in the past 6 months. Exclusion criteria included self-reported medical, psychiatric, or substance use disorders, medications with which alcohol use is contraindicated, history of a flushing reaction to alcohol, pregnancy/nursing, and body mass index >30 kg/m^2. Due to the sensitive nature of the information collected in this study (i.e., potentially illegal drinking and driving behavior), we provided participants with ample information about measures (e.g., secure data storage and de-identification) taken to ensure their confidentiality. Participants were provided information both prior to completing the phone screening interview and again during the informed consent process. All procedures were reviewed and approved by the Institutional Review Board of the University of Missouri.

One hundred and sixty-one participants were randomly assigned to an alcohol (n = 57), placebo (n = 52), or control (n = 52) beverage condition. Three participants in the alcohol condition were terminated from the study after becoming ill. Because participants in the control condition knew their drinks did not contain alcohol, they reported low or no perceived danger of driving at all time points. These participants were therefore excluded from the present analyses. The final sample for this study (n = 106) was 48% female and 87% Caucasian, with a mean age of 22.88 years (SD = 2.99). This sample has been previously reported on in a study on behavioral economic demand and craving for alcohol (Amlung et al., 2015).

Measures

Demographics. Age, sex, race, income, and access to a car were assessed with a self-report questionnaire.

Alcohol Use. Past-month binge drinking (5/4 drinks within a 2-hour period for men/women) was assessed with forced-choice items from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) Task Force on Recommended Alcohol Questions (NIAAA, 2003).

Drinking and Driving Behavior. Drinking and driving frequency was assessed with an open-ended item administered prior to beverage consumption. Participants indicated the number of times in the past year that they drove after consuming 3 alcoholic drinks in a 2-hour period.

Working Memory Capacity. Individual differences in WMC were assessed with the automated version of the Operation Span Task (OSPAN; Unsworth et al., 2005), administered prior to beverage administration. The OSPAN is a complex span task requiring participants to solve math operations while trying to remember a sequence of letters. Participants were presented with repeated sets of math equations and were asked to indicate whether the presented result was true or false. Following each math problem, a letter flashed briefly on the screen. Participants were asked to remember the letters in the order in which they appeared while simultaneously answering the math problems as quickly and as accurately as possible. The OSPAN score was calculated by summing the number of correctly recalled sets. This automated version of the OSPAN task is widely used and demonstrates high internal consistency ($\alpha = 0.78$) and test–retest reliability ($\alpha = 0.83$; Unsworth et al., 2005).

Perceived Danger of Drinking and Driving. Explicit attitudes about driving after drinking were assessed by asking participants to rate the perceived dangerousness of driving after consuming alcohol (Grube and Voas, 1996). At multiple points following beverage consumption, participants rated how dangerous they thought it would be for them to drive "right now" on a visual analogue scale (VAS). Participants responded using a slider bar on a continuum from "0 (*not at all dangerous*)" to "100 (*very dangerous*)." These items were administered at predetermined target breath alcohol concentration (BrAC) measurements in the alcohol condition, and at equivalent times based on estimated BrAC in the placebo condition. To facilitate interpretation of incident rate ratios (IRRs), the intoxicated perceived danger variable was reverse-coded prior to analyses, such that higher IRRs indicate an expected increase in drinking and driving rate for every unit *decrease* in perceived danger.

Procedure

This study employed a double-blind between-subjects design in which each participant was randomly assigned to consume an alcoholic, placebo, or control beverage in a single session. Sessions began at 11:00 AM and were conducted in a neutral laboratory setting. Sessions were administered by 2 trained staff members. One staff member determined random assignment to beverage condition at the beginning of the session, prepared the beverages, and recorded BrAC results. The other staff member was blind to beverage condition and interacted with participants. Participants were asked to abstain from alcohol and drug use for 24 hours prior to the start of the session and to refrain from eating for 60 minutes prior to their appointment. At the beginning of the session, participants provided written informed consent and sobriety was verified (i.e., BrAC = 0.00 g%). One participant was excluded from participation for providing a positive BrAC at baseline. Female participants were asked to self-administer a urine pregnancy test in a private restroom; no positive test results occurred. Participants then completed questionnaires assessing demographic and drinking information, as well as other individual difference variables not relevant to the current study. WMC was assessed at this time. To control for stomach contents, participants consumed a light meal (15% of recommended daily caloric intake based on sex, height, and weight) approximately 90 minutes prior to beverage administration.

The alcohol group expected to receive alcohol and consumed 190-proof pure grain alcohol mixed with orange juice in a 3:1 ratio. Alcohol dose was calculated based on participants' total body water and time for consumption to produce a peak BrAC of 0.10 g% at approximately 60 minutes following onset of drinking (0.85 g/kg for men and 0.73 g/kg for women; Curtin and Fairchild, 2003). Total body water estimates were generated using age, sex, height, and weight (Watson et al., 1981). The placebo group expected to receive alcohol, but consumed a beverage consisting of orange juice with a small amount (6 ml) of alcohol floated on top. The total volume of the placebo beverage was equal to the volume of the alcoholic beverage had the participant been assigned to the alcohol group. For both groups, beverages were divided equally between 2 glasses. Participants were asked to consume each glass of beverage within 1 minute, with a 5-minute break between (e.g., Amlung et al., 2015). Perceived dangerousness of driving was assessed with a VAS, twice on the ascending limb (ascending limb [AL]1: mean BrAC = 0.077, mean time postdrink consumption = 38.52 minutes; AL2: mean BrAC = 0.089, mean time = 54.16 minutes), at peak intoxication (mean BrAC = 0.093, mean time = 67.97 minutes) and twice on the descending limb (descending limb [DL]1: mean BrAC = 0.087, mean time = 107.89 minutes; DL2: mean BrAC = 0.081, mean time = 144.63 minutes). Participants in the placebo group completed assessments based on estimated rate of change in BrAC (Watson et al., 1981).

The placebo beverage manipulation was verified by asking participants whether they believed they received alcohol during the session and how many standard drinks they thought they consumed. Participants were then thoroughly debriefed, and beverage group status was disclosed. Participants in the alcohol condition remained in the laboratory until their BrAC descended below 0.04 g% (NIAAA, 2005). Participants in the placebo group were allowed to leave following debriefing. Participants were compensated $12/h and were transported home in a prepaid taxi or with a friend.

Data Analysis

Generalized estimating equations (GEE) and generalized linear models (GzLM) were conducted using SPSS Statistics for Windows, version 23.0 (IBM Corp, 2015). For the GEE analysis, we modeled the 5 VAS assessments of perceived danger of driving (2 on the ascending limb [AL1 and AL2], 1 at peak BrAC, and 2 on the descending limb [DL1 and DL2]) as a within-subjects variable with an independent correlation structure. Follow-up analyses using GzLM were then used to test whether hypothesized interactions were significant for each time point. Finally, significant perceived danger × OSPAN interactions were probed by conducting GzLM analyses with OSPAN recoded at 1 SD above and below the mean. Perceived danger and OSPAN values were standardized to facilitate interpretation of interaction effects.

Given that the dependent variable, frequency of drinking and driving behavior, is distributed as a count, a negative binomial distribution was used. To account for potential overdispersion due to a high proportion of zero values, the dispersion parameter was estimated for these models. For all analyses, the dispersion parameter was greater than zero, indicating that the negative binomial distribution was more appropriate than the Poisson distribution.

RESULTS

Descriptive Statistics

On average, participants reported drinking alcohol approximately twice per week and consuming 3 to 4 drinks on a typical drinking day over the past month. Men and women reported similar patterns of past-month drinking frequency and quantity. Approximately 48% ($n = 45$) of the sample reported driving after consuming 3 alcoholic drinks within a 2-hour period over the past year ($M = 4.42$, SD = 8.99 occasions). As men were more likely than women to report driving after drinking in the past year (χ^2 (1, $N = 106$) = 6.47, $p = 0.01$), participant sex was included as a factor in primary study analyses. Participants in the alcohol and placebo groups were equally likely to report past year driving after drinking (χ^2 (1, $N = 106$) = 0.62, $p = 0.43$). For the manipulation check, participants in the alcohol group reported consuming a greater number of alcoholic drinks ($M = 3.50$, SD = 1.59) compared to the placebo group ($M = 1.53$, SD = 0.924; $t(103) = 7.71$, $p < 0.001$). Participants' mean OSPAN score was 43.70 (SD = 18.75, range 0 to 75), and there were no significant differences in scores based on condition ($t(1, N = 106) = -0.146$, $p = 0.88$) or gender ($t\,(1, N = 106) = 0.87$, $p = 0.39$).

Perceived Danger × OSPAN Interaction

GEE were used to test whether WMC (OSPAN score) moderated the association of perceived danger on drinking and driving behavior, and whether this was consistent across beverage condition. The 3-way interaction of Perceived Danger × OSPAN × Beverage Condition was significant (Wald's $\chi^2 = 7.56$, $p = 0.006$, 95% CI [0.32, 1.88]). We then tested the 2-way Perceived Danger × OSPAN interaction within beverage condition. This interaction was significant for the Alcohol condition (Wald's $\chi^2 = 7.25$, $p = 0.007$, 95% CI [0.118, 0.747]), but not for the Placebo condition (Wald's $\chi^2 = 0.06$, $p = 0.81$, 95% CI [−1.89, 1.47]).

GzLM analyses were then conducted for each assessment time in the alcohol condition to test whether the Perceived Danger × OSPAN interaction was significant across the full range of the BrAC curve. The Perceived Danger × OSPAN interaction was significant for assessments on the ascending limb (AL1: Wald's $\chi^2 = 10.67$, $p = 0.001$; AL2: Wald's $\chi^2 = 9.85$, $p = 0.02$) and at peak BrAC (Wald's $\chi^2 = 9.05$, $p = 0.003$). However, interactions were not significant for either descending limb assessment (DL1: Wald's $\chi^2 = 0.16$, $p = 0.69$; DL2: Wald's $\chi^2 = 0.48$, $p = 0.49$).

We then probed the significant 2-way interactions observed for the ascending limb and peak assessments. IRRs were calculated from the negative binomial regression coefficient for perceived danger at ±1 SD from the mean of OSPAN. For AL1, the IRR at high OSPAN was 5.87 (Wald's $\chi^2 = 12.39$, $p = 0.006$, 95% CI [2.19, 15.75]; see Fig. 1*A*). This indicates that, for individuals relatively high in WMC, the rate of drinking and driving would be expected to increase by 5.87 times for each unit increase in (reverse-coded) perceived dangerousness. In contrast, at low OSPAN, the AL1 perceived danger IRR was 1.30, and was not significant (Wald's $\chi^2 = 0.66$, $p = 0.42$, 95% CI [0.690, 2.45]; see Fig. 1*A*). A similar pattern of results was found for AL2, with an IRR of 8.17 at high OSPAN (Wald's $\chi^2 = 11.39$, $p = 0.001$, 95% CI [2.41, 27.66]) and an IRR of 1.49 and nonsignificance at low OSPAN (Wald's $\chi^2 = 1.63$, $p = 0.20$, 95% CI [0.809, 2.73]; see Fig. 1*B*). Finally, for Peak, we observed an IRR of 5.11 at high OSPAN (Wald's $\chi^2 = 9.84$, $p = 0.002$, 95% CI [1.84, 14.16]) and an IRR of 1.28 and nonsignificance at low OSPAN (Wald's $\chi^2 = 0.65$, $p = 0.42$, 95% CI [0.700, 2.34]; see Fig. 1*C*).

DISCUSSION

Past studies have demonstrated that perceived danger of drinking and driving, assessed while sober and intoxicated, is strongly associated with drinking and driving behavior (Amlung et al., 2014; Morris et al., 2014). The present study replicated and extended these findings, demonstrating that this explicit attitude was more strongly associated with drinking and driving behavior for those high in WMC.[1] Consistent with dual process models of cognition (Hofmann et al., 2008), these findings suggest that individuals with higher WMC may be better able to attend to and act in accordance with their explicit attitudes about drinking and driving while intoxicated. Many drinking and driving prevention programs (e.g., mass media campaigns, sobriety checkpoints) aim to increase the perceived danger of, and likelihood of consequences from, engaging in this behavior. Such programs have produced positive outcomes (Goodwin et al., 2015; Shults et al., 2001), and the majority of individuals hold negative explicit attitudes about drinking and driving (Drew et al., 2010). Our results suggest that explicit attitudes, and behavior change efforts aimed at them, may have the largest impact on drinking and driving for those higher in WMC, as they may be more likely to act in accordance with these perceptions.

In contrast, the perceived danger of drinking and driving may be less influential for those lower in WMC. Dual process models (e.g., Hofmann et al., 2008), including those for alcohol- and drug-related behavior (Stacy and Wiers, 2010), posit that the behavior of low-WMC individuals is more influenced by implicit cognitive processes. Drinking and driving interventions may benefit from incorporating strategies designed to either target implicit cognitions or increase levels of executive functioning. The latter may be of particular importance in heavy-drinking drinking and driving recidivists, many of whom exhibit clinically significant cognitive (Glass et al., 2000; Ouimet et al., 2007) and decision-making (Bouchard et al., 2012) deficits. A substantial body of research has identified 2 such techniques—cognitive bias modification and cognitive control training—that show

[1]Previous research has distinguished between attitudes assessed while sober using hypothetical vignettes and those assessed while intoxicated based on current impairment (e.g., Morris et al., 2014). The present study focuses only on perceptions of danger under intoxication. Supplementary analyses (not presented) were conducted using sober, hypothetical perceptions to test whether the observed interactions were specific to intoxicated perceptions. Results demonstrated that none of the observed interactions were significant when sober assessments of danger were included. Additionally, study analyses were conducted including sober perceptions of danger as a covariate, and this did not alter the pattern of significant interactions. These analyses and results are available, by request, from the corresponding author.

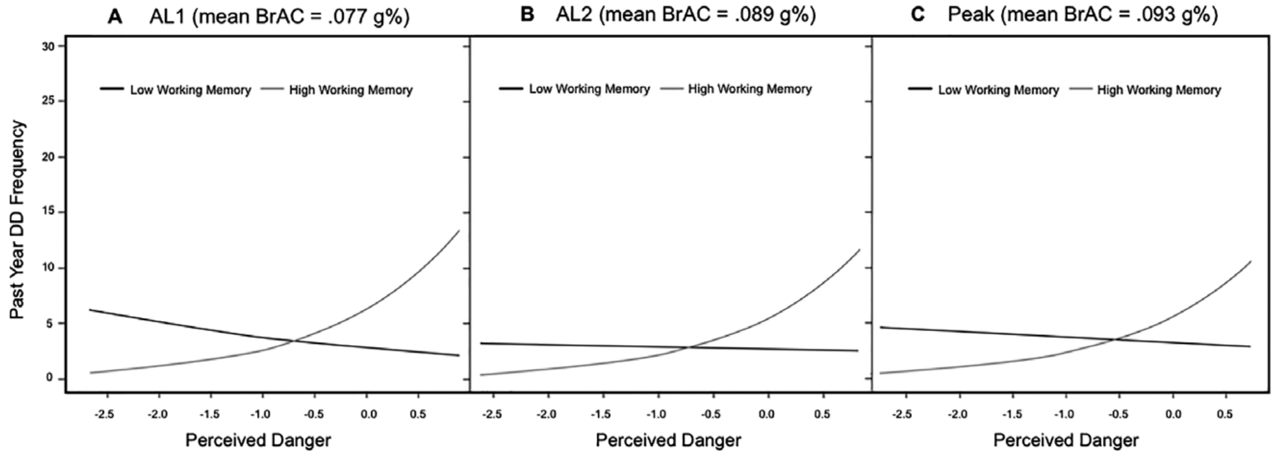

Fig. 1. Interaction of perceived danger and OSPAN predicting drinking and driving frequency. Perceived danger variable is reverse-coded and standardized. High and low OSPAN values are ±1 SD.

promise for improving treatment outcomes for a variety of disorders and behaviors, including alcohol and substance use (Wiers et al., 2013), via cognitive and behavioral mechanisms. In particular, emerging evidence suggests that working memory training may enhance attentional control, although the scope and duration of potential benefits remains unclear (e.g., Shipstead et al., 2012). Evidence for the effectiveness of cognitive bias modification (e.g., automatic action tendency retraining) is also mixed, with several recent studies reporting null results in non—treatment-seeking young adult populations with low motivation to change behavior (Leeman et al., 2018; Lindgren et al., 2015; for a discussion of this issue, see also Wiers et al., 2018). Nonetheless, adapting these methods to drinking and driving and incorporating them into existing intervention programs could potentially increase the effectiveness of such programs for individuals with more severe alcohol use histories or those who are seeking treatment to reduce alcohol use or alcohol-related negative behaviors.

The results of the present study should be considered in the context of its limitations. Our results are consistent with dual process models, but we did not directly test whether implicit cognitions are more influential for those low in WMC. Although implicit measures have been developed for alcohol and other substances (Wiers and Stacy, 2006a,b), no measures have been developed to assess implicit cognitions specific to most alcohol-related problem behaviors, including driving after drinking. Developing a psychometrically sound measure of implicit cognitions about drinking and driving is an important next step in applying dual process models to this behavior and adapting interventions to target such cognitions.

We also found differences in the effect of WMC on drinking and driving between the ascending and descending limbs of the BrAC curve. WMC moderated the effect of attitudes toward driving after drinking on the ascending, but not the descending, limb. This finding is somewhat surprising, given that decisions to drive are often made on the descending limb, once the drinking episode has ended. However, because the dependent variable is a frequency count and not a measure of specific drinking and driving decisions, it is difficult to interpret the potential causes and meaning of this difference. One possibility for this pattern of results is that attitudes toward driving after drinking are so strongly predictive of engagement in the behavior on the descending limb that WMC does not have a substantial moderating effect during this phase. In other words, for individuals who view drinking and driving as dangerous, having high WMC may help to reduce risk for drinking and driving on the ascending limb, though perhaps not as strongly, or not at all, on the descending limb. Similarly, research suggests that acute tolerance of some capacities (i.e., motor impairment and subjective intoxication) but not others (i.e., inhibitory control and driving performance) contributes to decisions to drive after drinking on the descending limb (e.g., Weafer and Fillmore, 2012). Establishing the role of acute tolerance in the moderation of attitudes by WMC is another important future direction for understanding risk factors for drinking and driving behavior.

Several features of the sample and design of the present study also pose limitations. The study enrolled primarily Caucasian young adults from 1 geographic location, potentially limiting generalizability of findings. Additionally, the data used in the present study were collected in a larger alcohol administration project designed to assess risk factors for drinking and driving and behavioral economic demand and craving for alcohol (Amlung et al., 2015). As result, we selected measures designed to assess predictors and outcomes as efficiently as possible, given the timing constraints associated with alcohol administration procedures. This approach, despite its benefits, is associated with several limitations. The study was conducted in a laboratory setting, rather than in a natural environment where decisions to drive after drinking are typically made. We used a retrospective count of recent drinking and driving events as a dependent variable. Though not uncommon in the literature (e.g., Bingham et al., 2007; Fairlie et al., 2010), this is a very brief measure of a complex behavior, and it is unable to capture nuanced details of drinking and driving episodes. In addition, this item relies on self-report and may be influenced by response and recall biases. Our measure of attitudes toward drinking and driving is similarly brief, and specifically addresses 1 facet (i.e., perceived dangerousness) of attitudinal influences on drinking and driving. Incorporating other indices of attitudes beyond items assessing perceived dangerousness at various BACs would enhance our understanding of WMC's ability to moderate attitudes more broadly. Another limitation is that WMC was tested only prior to beverage administration, while participants were sober. Relatively few studies have tested the effects of acute alcohol consumption on WMC, and those that have found mixed results (e.g., Finn et al., 1999; Weissenborn and Duka, 2003), and increasing understanding of individual difference variables that moderate alcohol's effects on WMC is an important future direction.

Conducting a similar study using prospective assessments of drinking and driving would resolve these issues and help to establish these variables as predictors of drinking and driving. One avenue of future research is the use of ambulatory assessment methods, including ecological momentary assessment (EMA; e.g., Shiffman et al., 2008), to measure drinking and driving cognitions and behavior as they occur in a naturalistic context. The use of EMA to study drinking and driving has the potential to both increase generalizability and external validity of findings, and may also help to disentangle within- and between-person effects of cognitions on drinking and driving behavior.

In summary, this study is the first to demonstrate that the role of explicit attitudes in drinking and driving behavior may vary by WMC. Individuals with higher WMC were more likely to act consistently with their attitudes toward drinking and driving than those relatively lower in WMC. Further research is necessary to determine whether the behavior of low-WMC individuals is more strongly driven by implicit cognitions or by other compelling factors.

ACKNOWLEDGMENTS

This research was supported by grants R01 AA019546 (DMM) and T32 AA013526 (PI KJ Sher) from the National Institute on Alcohol Abuse and Alcoholism, Rockville, Maryland, USA. The authors declare that there are no conflicts of interest to report.

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