Published in final edited form as:

Addict Behav. 2011 August ; 36(8): 886–889. doi:10.1016/j.addbeh.2011.03.012.

Acute Alcohol Effects on Narrative Recall and Contextual Memory: An Examination of Fragmentary Blackouts

Reagan R. Wetherill, Ph.D.^{a,*} and Kim Fromme, Ph.D.^b

^a University of California San Diego, Department of Psychiatry, San Diego, CA

^b University of Texas at Austin, Department of Psychology, Austin, TX

Abstract

The present study examined the effects of alcohol consumption on narrative recall and contextual memory among individuals with and without a history of fragmentary blackouts in an attempt to better understand why some individuals experience alcohol-induced memory impairments whereas others do not, even at comparable blood alcohol concentrations (BACs). Standardized beverage (alcohol, no alcohol) administration procedures and neuropsychological assessments measured narrative recall and context memory performance before and after alcohol consumption in individuals with ($n = 44$) and without ($n = 44$) a history of fragmentary blackouts. Findings indicate acute alcohol intoxication led to impairments in free recall, but not next-day cued recall. Further, participants showed similar memory performance when sober, but individuals who consumed alcohol and had a positive history of fragmentary blackouts showed greater contextual memory impairments than those who had not previously experienced a fragmentary blackout. Thus, it appears that some individuals may have an inherent vulnerability to alcohol-induced memory impairments due to alcohol's effects on contextual memory processes.

1. INTRODUCTION

Alcohol-induced blackouts, or memory loss for a drinking episode without the loss of consciousness, are classified as en bloc or fragmentary depending on the duration and extent of alcohol-induced memory loss (Goodwin, Crane, & Guze, 1969). En bloc blackouts involve memory loss for all events during a distinct period of time and typically occur at high blood alcohol concentrations (BACs). Fragmentary blackouts (FBs) are episodes of partial memory loss that is resolved with contextual cues. FBs occur more frequently than en bloc blackouts (White, Signer, Krause, & Swartzwelder, 2004), but neither type occurs until BACs are greater than .06%.

Although alcohol-induced memory impairments can occur after just two drinks (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2004), not all individuals who consume alcohol experience blackouts (Hartzler & Fromme, 2003). Even at comparable BACs, some individuals experience alcohol-induced blackouts whereas others do not, suggesting an inherent vulnerability to alcohol-induced memory impairments (Nelson et al.,

© 2011 Elsevier Ltd. All rights reserved.

Please send correspondence to: Reagan R. Wetherill, Ph.D., University of California San Diego, Department of Psychiatry, San Diego, CA. Phone: (858) 822-3995, Fax: (858) 822-3933, rwetherill@ucsd.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

2004). In an alcohol administration study, individuals who reported experiencing a FB in the past year were more vulnerable to alcohol's effects on memory than individuals without a history of FBs (Hartzler & Fromme, 2003). Although compelling, this research was limited in a number of ways. Most importantly, a one-time assessment of blackouts was used, inclusion criteria did not consider prior BACs achieved, and next day memory performance was not assessed.

The current study improves upon previous research by including a longitudinal assessment of alcohol use and blackout histories and by examining alcohol's effects on narrative and contextual recall both acutely and the day after drinking. Using longitudinal data, we identified individuals who reported at least one FB in the past year (FB+) and those who reported never experiencing a FB (FB-). Individuals were matched on alcohol use, but differed in FB histories. Consistent with previous research, we predicted no differences in memory performance between FB+ and FB- individuals when sober, however after alcohol consumption, FB+ individuals would show greater impairment in narrative and contextual memory. Because alcohol-induced FBs involve deficits in free recall but not cued recall, FB+ participants were expected to display greater deficits in next-day free recall, but not cued recall after the alcohol session.

2. METHODS

2.1. Participant Selection and Recruitment

Participants were recruited from a sample of 2,245 individuals participating in a longitudinal study of alcohol and behavioral risks at a large public university (for additional recruitment details, see Corbin, Fromme, & Vaughn, 2008). Four years of longitudinal data were used to screen 21–23 year-old participants for the following inclusion criteria: endorsement of at least one instance of drinking three or more drinks in the past three months, drinking to an estimated BAC of at least .06% based on gender, number of drinks and duration of drinking episode, no reported symptoms of substance dependence, head injury, and/or contraindications to alcohol ingestion. The FB+ sample reported at least one alcohol-induced FB during the previous year; the FB- sample denied ever experiencing an alcohol-induced FB. The final sample (N = 88; 50% female) was 38% Caucasian, 15% Asian, 12.5% Hispanic, 3% African American, and 31.5% who identified as mixed or other ethnicity.

2.2. Survey and Telephone Screening Measures

Participants provided demographic information, as well as, history of psychological/psychiatric treatment, ongoing medical treatment, and lifetime difficulty with day-to-day memory. The Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985) measured alcohol consumption and provided estimates of average frequency and quantity of alcohol consumption for a typical week during the previous three months. Negative alcohol-related consequences were assessed using the Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989). A single RAPI item ("During the past three months, did you suddenly find yourself in a place that you could not remember getting to?") served as a gross, initial screen for blackouts, and telephone interviews gathered additional information. Specifically, participants were asked: (1) "Have you awakened the morning after a good bit of drinking and found that you could not remember part of the evening before?" from the Young Adult Alcohol Problems Screening Test (YAAPST; Hurlbut & Sher, 1992) and modified items: (2) "After drinking heavily, have you ever experienced a period of time that you could not remember things you said or did?"; (3) "When you experienced difficulty remembering things you said or did while drinking, did you later remember when given cues or reminded?" to determine blackout type (i.e., fragmentary or en bloc).

2.3. Laboratory Measures

Working memory was assessed with the Wechsler Adult Intelligence Scale-III (Wechsler, 1997) Working Memory Index subtest and Digit Span Backwards. Using standard administration procedures by trained researchers, two sequences were presented for each number of digits (i.e., 2–8) and set size increased by one when at least one of the two sequences was successfully reproduced. Total number of successful reproductions was used in analyses.

Narrative recall was measured with the Logical Memory subtest of the Wechsler Memory Scale-III (Wechsler, 1997), which included immediate, delayed, and cued recall of details from two narratives. Administration procedures were modified so that one story was completed (immediate and 30-minute delay recall) before beverage intake, and a second different story was presented after beverage intake, followed by immediate and 30-minute delay free recall and cued recall. The day after the experimental session, participants were contacted and free and cued recalls were assessed for the second story.

Contextual memory was assessed with a computerized memory task (Dobbins, Foley, Schacter, & Wagner, 2002) of recollections for specific contextual details. Participants viewed a series of images (2 separate study trials of 64 items) and made semantic decisions (i.e., 8 blocks of 8 pleasant/unpleasant items and 8 blocks of 8 living/nonliving items) about individual items. Participants were then presented with three-alternative forced choice (3AFC) triplets consisting of a new item and items encoded under pleasant/unpleasant and living/nonliving orienting study blocks. The contextual memory task required selection of the item that was associated with a previous semantic orienting task (e.g., select the item that was earlier rated as “pleasant”).

2.4. Procedures

Potential participants from the longitudinal study were contacted by telephone and screened for eligibility. Of 105 eligible participants, 17 declined, and 88 (44 FB+, 44 FB–) were randomly assigned into alcohol or no alcohol conditions, scheduled for an evening laboratory session, and instructed to refrain from alcohol use for 24 hours and from eating a full meal for four hours prior to their scheduled appointment.

Participants provided informed consent, proof of legal drinking age, and a breathalyzer test to ensure .00% BrAC. Females self-administered hormonal pregnancy tests (no positive results). Participants completed self-report questionnaires and baseline memory tasks, and were taken to a simulated bar, where they consumed three beverages in 30 minutes (i.e. one drink per 10 minutes; volume determined by gender and body weight). Drinks for the alcohol condition contained a 3:1 ratio of mixer to vodka to target a .08% BAC, whereas those in the no alcohol condition received water. After a 30-minute alcohol absorption period, breathalyzer samples were recorded.

Participants completed the second WMS-III story followed by the contextual memory task. Alcohol and no-alcohol participants were yoked to control for alcohol absorption time differences. Upon completion, participants in the no-alcohol group were debriefed and compensated (\$5/hour); whereas participants who received alcohol were debriefed, paid up to \$30, and driven home by project staff once their BrAC dropped to .02%. Approximately 24 hours after the laboratory session, research assistants called participants to assess free and cued recall.

3. RESULTS

3.1. Sample Description and Baseline Measures

Descriptive statistics were computed (see Table 1) and independent-sample *t*-tests and multivariate analysis of variance (MANOVA) assessed differences among FB+ and FB− individuals. No differences were found in age or lifetime memory difficulty (*t* values < 1.44, *p* values > .16). MANOVA revealed a significant multivariate effect, $F(1, 83) = 8.42, p < .001$; as well as univariate effects for alcohol-related problems, $F(1, 88) = 9.59, p < .003$ and past month incidence of blackouts, $F(1, 88) = 27.22, p < .001$. FB+ individuals indicated more alcohol-related problems from the RAPI (excluding the blackout item) and blackouts in the prior month than their counterparts. A 2 (fragmentary blackout history: FB+, FB−) X 2 (beverage condition: alcohol, no alcohol) between subjects MANOVA on baseline memory performance indicated no significant multivariate effects (*F* values, < 2.21, *p* values > .12). Thus, FB+ and FB− did not differ on memory processes while sober.

3.2. Beverage Challenge

BrACs were assessed at 30-minutes post-drinking and each 30-minute interval thereafter. Independent *t*-tests on BrAC prior to and during memory assessments revealed no differences between the FB+ and FB− groups, *p* values > .07.

Analyses next tested effects of alcohol and FB history on indices of narrative recall. A 2 (FB +, FB−) X 2 (alcohol, no alcohol) analysis of covariance (ANCOVA) on 30-minute delayed recall, with immediate recall as the covariate, indicated main effects of beverage, $F(1, 88) = 13.01, p < .001$, and FB history, $F(1, 88) = 15.01, p < .001$. Those who received alcohol and FB+ individuals recalled fewer narrative details at 30-minute delay, but there were no significant interaction effects. Next, two 2 X 2 (FB group, beverage) analyses of variance (ANOVA) on next-day narrative and cued recall revealed beverage effects for narrative but not cued recall of details (see Figure 1). Thus, individuals who consumed alcohol exhibited poorer 30-minute delay and next-day recall than those who did not consume alcohol.

A 2 X 2 (FB group, beverage) ANOVA assessed contextual memory using percent correct as the dependent variable. Analyses revealed significant effects for beverage condition, $F(1, 87) = 16.81, p < .001$, history of FBs, $F(1, 87) = 4.78, p < .03$, and the interaction between FBs and beverage condition, $F(1, 87) = 6.92, p < .01$. FB+ individuals who consumed alcohol performed worse on contextual recall than did other participants.

4. DISCUSSION

This study extended research on acute alcohol effects on memory processes in several ways. First, alcohol impaired delayed and next-day narrative recall, but not next-day cued recall, suggesting that information is available in memory but is temporarily inaccessible. Those with a history of fragmentary blackouts also performed more poorly on delayed recall than those with no prior blackouts. Neuroimaging research indicates that cued recall and free recall are associated with differential neural activation in distinct neural networks, sensory and conceptual (Habib & Nyberg, 2008; Salami et al., 2010). Together, these findings suggest that alcohol's differential effects on free and cued recall may be a result of alcohol altering neural activity in conceptual rather than sensory networks. Prior blackout experiences also appear to be related to impaired conceptual networks.

Whereas comparisons between FB+ and FB− individuals revealed no significant differences in memory performance while sober, differences emerged after alcohol consumption. Specifically FB+ individuals showed greater contextual memory impairments than FB− individuals after alcohol consumption. This may be due to alcohol interrupting contextual

information processing such that access and evaluation processes of remembering are impaired in FB+ individuals. In other words, when individuals who are prone to alcohol-induced blackouts engage in behaviors while intoxicated (e.g., travel from place to place), they are unable to remember the specifics of the event (e.g., how they got to and from a location). As such, contextual memory deficits may explain why FB+ individuals report difficulties in recalling where they were, who they were with, and what they were doing during blackout episodes.

Present findings should be considered in light of limitations. The moderate alcohol dose manipulation was not comparable to intoxication levels that frequently lead to blackouts. Nevertheless, even with the ethical restraints prohibiting the administration of alcohol to higher BACs, an average BrAC of .078% was sufficient to cause memory impairments that differentiated FB+ and FB− individuals. Further, future research should examine other memory tasks and cognitive mechanisms that may influence the occurrence of fragmentary blackouts.

References

- Collins RL, Parks GA, Marlatt GA. 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*. 1985; 53:189–200. [PubMed: 3998247]
- Corbin WR, Vaughn EL, Fromme K. Ethnic differences and the closing of the sex gap in alcohol use among college-bound students. *Psychology of Addictive Behaviors*. 2008; 22:240–248. [PubMed: 18540721]
- Dobbins IG, Foley H, Schacter DL, Wagner AD. Executive control during episodic retrieval: Multiple prefrontal processes subserve source memory. *Neuron*. 2002; 35:989–996. [PubMed: 12372291]
- Goodwin DW, Crane JB, Guze SB. Alcoholic blackouts : A review and clinical study of 100 alcoholics. *American Journal of Psychiatry*. 1969; 126:191–198. [PubMed: 5804804]
- Habib R, Nyberg L. Neural correlates of availability and accessibility in memory. *Cerebral Cortex*. 2008; 18:1720–1726. [PubMed: 18033765]
- Hartzler B, Fromme K. Fragmentary blackouts: their etiology and effect on alcohol expectancies. *Alcoholism: Clinical and Experimental Research*. 2003; 27:628–637.
- Hurlbut SC, Sher KJ. Assessing alcohol problems in college students. *Journal of American College Health*. 1992; 41:49–58. [PubMed: 1460173]
- Nelson CB, Heath AC, Bucholz KK, Madden PA, Fu Q, Knopik V, et al. Genetic epidemiology of alcohol-induced blackouts. *Archives of General Psychiatry*. 2004; 61:257–263. [PubMed: 14993113]
- Salami A, Eriksson J, Kompus K, Habib R, Kauppi K, Nyberg L. Characterizing the neural correlates of modality-specific and modality-independent accessibility and availability signals in memory using partial-least squares. *NeuroImage*. 2010; 52:686–698. [PubMed: 20420925]
- U.S. Department of Health and Human Services, National Institute on Alcohol Abuse and Alcoholism. Alcohol's damaging effects on the brain. (Alcohol Alert No. 63). Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Alcohol, Drug Abuse, and Mental Health Administration; 2004.
- Wechsler, D. Wechsler Adult Intelligence Scale. 3. San Antonio, TX: The Psychological Corporation; 1997.
- Wechsler, D. Wechsler Memory Scale. 3. San Antonio, TX: The Psychological Corporation; 1997.
- White HR, Labouvie EW. Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol*. 1989; 50(1):30–37. [PubMed: 2927120]
- White AM, Signer ML, Krause CL, Swartzwelder HS. Experiential aspects of alcohol-induced blackouts among college students. *American Journal of Drug and Alcohol Abuse*. 2004; 30(1): 205–224. [PubMed: 15083562]

Figure 1.

Performances on Recall of Narrative Details After Beverage Challenge

Notes. FB+ = Fragmentary blackout history positive; FB- = Fragmentary blackout history negative; Alc = Alcohol session; No Alc = No alcohol session.

Table 1**Study 1 Sample Description and Group Comparisons**

	Overall Sample <i>M</i> (<i>SD</i>)	FB + <i>M</i> (<i>SD</i>)	FB – <i>M</i> (<i>SD</i>)
Age	21.62 (0.51)	21.58 (0.49)	21.66 (0.53)
Drinking Quantity	3.83 (2.18)	4.25 (1.98)	3.38 (2.29)
Drinking Frequency	2.88 (1.51)	3.18 (1.45)	2.57 (1.52)
Drinks – Maximum	9.30 (5.47)	10.16 (5.44)	8.43 (5.42)
Alcohol Problems*	4.13 (4.87)	5.66 (5.54)	2.59 (3.53)
BAC prior to memory tasks			
Immediate recall	0.074 (0.005)	0.075 (0.006)	0.074 (0.003)
30-minute delay recall & source memory	0.079 (0.004)	0.078 (0.003)	0.080 (0.005)
	% endorsed	% endorsed	% endorsed
Lifetime Difficulty With:			
Names of Objects	7.9	11.1	4.5
Names of People	47.2	48.9	45.5
Things Said or Done	13.5	17.8	9.1
Names of Places	2.2	0.0	4.5
Important Events	5.6	6.7	4.5
Tasks to Complete	12.4	11.1	13.6

Notes.

* reflects statistically significant group differences at $p < .05$. BAC = blood alcohol concentration. FB = fragmentary blackouts. Drinking quantity ranges from 0 to ∞ . Drinking frequency ranges from 1 to 7. Alcohol problems = total RAPI score excluding the blackout item.