1994

Effects of Alcohol and Expectancy Upon Episodic Memory in Individuals Reporting Alcoholic Blackouts

W. R. Miller

Paula T. Hertel
Trinity University, phertel@trinity.edu

C. Saucedo

R. K. Hester

Publication Details

Experimental and Clinical Pyshcopharmacology

Repository Citation

Miller, W.R., Hertel, P., Saucedo, C., & Hester, R.K. (1994). Effects of alcohol and expectancy upon episodic memory in individuals reporting alcoholic blackouts. *Experimental and Clinical Psychopharmacology, 2*(2), 161-166. doi: 10.1037/1064-1297.2.2.161

Experimental and Clinical Psychopharmacology
1994, Vol. 2, No. 2, 161–166

1064-1297/94/$3.00

Effects of Alcohol and Expectancy on Episodic Memory in Individuals Reporting Alcoholic Blackouts

William R. Miller, Paula Hertel, Carlos Saucedo, and Reid K. Hester

In a within-subject placebo design, 10 heavy drinkers reporting alcoholic blackouts showed significant decrements in episodic memory when receiving alcohol but not on days when a placebo was given. Parallel deficits were observed on recall and recognition measures. On placebo days, self-ratings of intoxication were related to the degree of observed performance decrement. Memory deficits appear to be primarily pharmacologic rather than expectancy effects of drinking.

Memory blackouts are a common symptom of alcohol abuse, but they are not a normative experience among drinkers (Meilman, Stone, Gaylor, & Turco, 1990; Wells, Bushnell, Joyce, Oakley-Browne, & Hornblow, 1991). Surprisingly little experimental research has been devoted to this interesting memory anomaly (Goodwin, 1971; Goodwin, Crane, & Guze, 1969; Sweeney, 1989, 1990). Blackouts appear to be related to the well-established deficits in short-term memory (STM) observed during periods of acute intoxication, with decrements in retention of information presented during alcohol states attributable to inhibition of storage and consolidation processes (Hartley, Birnbaum, & Parker, 1978; Lisman, 1974; Miller, Adesso, Fleming, Gino, & Lauerman, 1978; Miller & Saucedo, 1983; Nathan, Goldman, Lisman, & Taylor, 1972). Precisely what accounts for the STM deficits is less clear. One study reported a relationship between history of blackouts and observed memory dissociation across states of intoxication (Kent et al., 1986), and alcohol state-dependent learning is a well-documented phenomenon (e.g., Lowe, 1984). However, attempts to explain STM effects in general, and blackouts in particular, as phenomena of state-dependent learning have not been generally supported (Lisman, 1974; Miller et al., 1978; Saucedo, 1980; Young, 1979). Likewise, these effects have been hypothesized to result from alcohol-induced alterations in kind or quality of information processing, but research by Hartley et al. (1978) failed to support this explanation.

The importance of cognitive expectancy factors in influencing alcohol-induced behavioral effects has been recognized since the landmark study by Marlatt, Demming, and Reid (1973), which used a balanced placebo design. Numerous phenomena once attributed to the pharmacological actions of alcohol, including changes in sexual arousal, aggression, mood, and craving for alcohol, are now known to be partially if not primarily evoked by expectancy factors (Marlatt & Rohsenow, 1980). That such factors can influence cognitive performance has been demonstrated by Williams, Goldman, and Williams (1981), who found that subjects expecting alcohol but receiving tonic and subjects expecting tonic but receiving alcohol made more errors on cognitive tasks than did subjects in expectancy-congruent groups. Miller et al. (1978) used a balanced placebo design to study heavy drinkers' immediate and delayed recall of serial lists. They reported no effects of expectancy on memory but a clear influence of moderate alcohol doses on storage of information. The investigators did not, however, report data to suggest whether their expectancy deception had been successful, a critical consideration because the balanced placebo manipulation has been found to be highly

William R. Miller, Paula Hertel, Carlos Saucedo, and Reid K. Hester, Department of Psychology, University of New Mexico.

Correspondence concerning this article should be addressed to William R. Miller, Department of Psychology, University of New Mexico, Albuquerque, New Mexico 87131. Electronic mail may be sent via Internet to wrmiller@bootes.unm.edu. or via Bitnet to wrmiller@unmb.

susceptible to procedural variations (Marlatt & Rohsenow, 1980).

The present study used a within-subject design to examine the effects of alcohol and expectancy on delayed recall and recognition tasks for problem drinkers with a clinical history of alcoholic blackouts. We attempted to construct a laboratory analogue of the blackout phenomenon using higher blood alcohol levels than have been used in prior research and to study specific parameters of resulting acute deficits in memory performance.

Method

Subjects

Volunteer subjects who had been experiencing alcoholic blackouts were solicited through local news media. Subjects were required to meet the following criteria: (a) proof of legal drinking age; (b) absence of medical history contraindicating acute alcohol consumption, including actual or possible pregnancy (Miller & Caddy, 1977); and (c) current heavy drinking pattern such that blood alcohol concentration (BAC) of 150 mg% (mg alcohol/100 ml blood) was not unusual; and (d) history of partial or total blackouts.

A total of 8 women and 2 men applied and were accepted for the study, with mean age of 29.5 years (range = 22–51) and mean education of 15.4 years (range = 12–20). The subjects reported having had life problems related to drinking for the past 10.8 years, with the first blackout having occurred 11.9 years ago on the average. Subjects were predominately periodic drinkers, with mean consumption of 62.4 standard drinks (31.2 oz or 0.94 L of absolute ethanol) per month (Miller, Heather, & Hall, 1991) and an average peak BAC of 214 mg% during a typical drinking episode (computer estimated; Markham, Miller, & Arciniega, 1993). They reported having had five blackouts during the past 6 months and achieved a mean score of 11.9 on the Michigan Alcoholism Screening Test (Selzer, 1971).

Procedure

Following an initial screening interview and statement of informed consent, each subject participated in four individual experimental sessions scheduled at the same hour over 4 consecutive days. Subjects were asked to keep their sleeping and eating patterns constant during this period of time and to refrain from drinking before or after experimental sessions. To ensure sobriety at the beginning of each session, breath tests were administered using an Intoximeter (Intoximeters, Inc., St. Louis, MO). No breath alcohol was detected in any subject before any experimental session. Subjects volunteered their time in response to a newspaper request and were not paid for participation.[1]

Session 1. Session 1 served as the alcohol condition for all subjects. Following an initial breath test, the first of four drinks was served. Each drink consisted of 0.5 g of absolute ethanol per kilogram of subject's body weight, mixed with 10 oz (0.3 L) of tonic water flavored with lime juice, a proportion found during pilot testing to mask the amount of alcohol in the drink. The subjects were asked to consume this drink within 10 min; then they listened to instrumental music for an additional 10-min waiting period. All subjects were told that they would be consuming alcohol in this session but were not told the amount to expect. Drinks were mixed in the subjects' presence by pouring from tonic and Everclear bottles. Following the waiting period, the subjects were presented with the first of 4 lists of eight words each, selected from Paivio, Yuille, and Madigan's (1968) norms as high in frequency, imagery, and association value. A total of 12 lists were constructed, 4 of which were used during each of three acquisition sessions. List order was held constant within session blocks. However, the 4-list blocks were counterbalanced across sessions. We presented the words using a Kodak (Eastman Kodak, Rochester, NY) carousel projector equipped with a timed exposure tachistoscope, presenting one word per slide with 2-s exposure and 4-s interstimulus interval. During the inter-

[1] All experimental procedures were reviewed and approved by the Human Research Review Committee of the College of Arts and Sciences of the University of New Mexico. Supervised transportation arrangements were made in advance for each volunteer subject to be driven home following Sessions 1 and 2. Because of changes in consensus research protocols for the administration of alcohol to human subjects since these data were collected in 1979, subjects in all subsequent studies have been detained in the laboratory until all alcohol has been cleared from their bloodstreams.

stimulus interval, the subjects recited the word just presented to ensure attention and immediate registration of the stimulus. Following presentation of the first list, the subjects were given another breath test and were asked to estimate their present level of intoxication on a scale of 0 to 100. Subjects were prevented from seeing their actual BAC readings. The entire procedure was then repeated with another drink, waiting period, list presentation, and BAC test until four such trials had been completed. Subjects were asked not to rehearse words between lists or sessions.

Session 2. Subjects were instructed that they would again be consuming alcohol during Session 2 with the amount of alcohol unspecified. Before administration of the first drink, the subjects were asked to recall the 32 words presented during the previous session and to report whether a blackout had occurred. After this free-recall test, the subjects were presented with a forced-choice recognition test and asked to select words seen the previous day from a longer list containing other words never presented but similarly high on all normative criteria. Following this test, the procedure for Session 1 was repeated with timing of drinks and list presentations determined by subjects' actual schedules during Session 1. Drinks were again mixed in the subjects' presence, but this time the Everclear bottle contained water so that no alcohol was served. Breath test and intoxication ratings were repeated as before. Thus Session 2 constituted a placebo condition.

Session 3. On this sober day, we replicated the conditions of Session 2 except that subjects were told (correctly) that they were receiving only tonic water. Recall and recognition tests of Session 2 lists preceded the first drink of Session 3.

Session 4. This was a brief session consisting of a breath test, recall test, and recognition test of Session 3 lists and a debriefing.

Results

Effectiveness of Expectancy Instructions

During Session 1, mean intoxication ratings following each of the four drinks were 13, 35, 49, and 59, corresponding to mean BAC levels of 34, 84, 133, and 172 mg%, respectively. Final BAC ranged from 128 to 228 mg%. Mean intoxication ratings during Session 2 (placebo) were 8, 17, 22, and 26, respectively, with peak intoxication ratings ranging from 5 to 70. Two subjects voiced suspicions spontaneously that they had received no alcohol during Session 2, but this was not confirmed by the experimenter until Session 4 had been completed.

Memorial Performance

The mean number of list items recalled or recognized under each experimental condition are shown in Figure 1. Multivariate analyses of variance for repeated measures revealed the following results.

First, the interaction of lists with the comparison of alcohol versus placebo and sober condition was significant both for recall, Θ (1.0, 0.5, 1.5) = .941, $p < .002$, and for recognition measures, Θ (1.0, 0.5, 1.5) = .838, $p < .020$. For each retention measure, this interaction was partitioned by examining the simple main effects of lists within each treatment condition. Recall and recognition both declined significantly across lists within the alcohol condition: recall, Θ (1.0, 0.5, 1.5) = .926, $p < .003$; recognition, Θ (1.0, 0.5, 1.5) = .820, $p < .026$. Within the placebo and sober conditions, however, the main effects of lists were not significant, suggesting a relative lack of proactive inhibition for these tasks. Thus, the alcohol condition alone produced a reliable decline in memorial performance of both kinds.

Second, the performance difference between placebo and sober conditions in recalling words from the fourth list did not reach significance. Likewise, the difference between placebo and sober conditions, collapsing across lists, was not significant, nor did this difference reliably interact with lists. Thus, performance of subjects in the placebo and sober conditions can be considered to be equivalent, with each subject serving as her or his own control.

Third, tests of within-subject correlation of fourth-list retention decrements (sober minus placebo) with final self-ratings of intoxication were performed as one final method of examining for expectancy effects upon memory. Ratings were negatively correlated with retention decrements, but the relationship was reliable only for the decrement in recall, $F(1, 6) = 6.24$, $p < .047$, $MS_e = 8.455$.

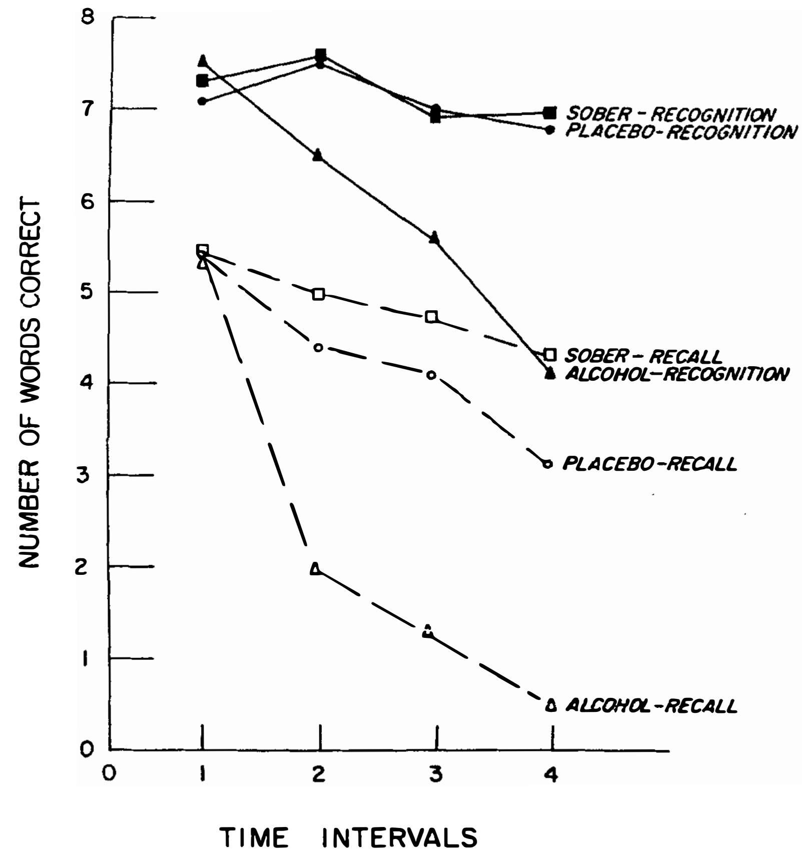

Figure 1. Number of correct responses on recall and recognition during alcohol, placebo, and sober experimental conditions.

Eight subjects reported that they had experienced a blackout during or following Session 1, whereas no subject reported having experienced a blackout with Session 2. The 2 subjects who reported no blackout in Session 1 achieved peak BAC values of 128 mg% and 156 mg%, the lowest final BACs for the sample.

Discussion

Consistent with prior research (Hartley et al., 1978; Lisman, 1974), we found memorial performance to decrease as a direct function of rising BAC. We observed a slight though not reliable deficit in recall (but not recognition) within the placebo condition relative to the sober condition, and the degree of this decrement was found to be significantly related to self-rating of intoxication during placebo treatment. This latter result provides limited support for the findings of Vuchinich and Sobell (1978) and of Williams et al. (1981), who reported cognitive performance decrements among subjects expecting but not receiving alcohol. Our findings are more consistent, despite procedural differences, with those of Miller et al. (1978), who found no effect of expectancy on recall. Although we obtained a small but nonsignificant difference in a within-subject design not asking subjects to recall lists immediately, Miller et al. (1978) used a between-subjects design and did require within-session rehearsal of to-be-remembered words. Such additional rehearsal may be sufficient to obviate any small differences due to expectancy (cf. Young, 1979). Several of our subjects reported anecdotally that they could override the effects of blackout if they "tried" while drinking.

The present findings also bear on the relative importance of storage versus retrieval deficits in alcoholic blackout. At first glance, the parallel deficits in recognition and recall are suggestive of a storage problem. Recall has been viewed (e.g., Crowder, 1976) as a two-stage process involving generation of complex search processes followed by a decision process applied to the result of the search. By the same reasoning, recognition is seen as a single-stage decision process applied to a memory representation that is automatically accessed through the presentation of the test item. Because, in our view, retrieval is not involved in the recognition process, large deficits in recognition performance indicate that storage of information was impaired. This is consistent with the conclusions of several previous investigators (Hartley et al., 1978; Miller et al., 1978).

Another approach to recognition and recall provided by the theory of encoding specificity (Tulving, 1968) argues, however, that similar processes are involved in both. Items are assumed to be stored together with their contexts. A recall test requires item retrieval given certain contextual cues, whereas recognition requires context retrieval given item cues, each before the decision phase is initiated. In the present study, the changes in context from input to testing primarily involved changes in the state of the organism (i.e., intoxicated vs. sober). Therefore, the deficit in recognition performance may indicate failure to retrieve the context under which the items were viewed. Clearly this explanation would not eliminate the possibility of a storage locus for the effects. Although we required subjects to repeat the items at the moment of input, we could not guarantee that similar organizational or integrative processes were in operation across experimental conditions (although Hartley et al., 1978, failed to find such differences in processing during alcohol states). Thus, it is possible that inability to retrieve the appropriate context for recognition items may have resulted from inferior interitem and context organization. This possibility, combined with the superior performance of intoxicated subjects on recognition versus recall measures (cf. Gerrein & Chechile, 1977; Rosen & Lee, 1976), suggests that both storage and retrieval effects may contribute to the retention deficits underlying the blackout phenomenon.

Similarly, the concept of transfer-appropriate processing (Morris, Bransford, & Franks, 1977) suggests a more complex mechanism than simple shallowness of processing as a function of intoxication. In this view, the durability of memory traces is related to one's goals and focus at the time of acquisition—what one desires to learn—a process likely to be influenced by intoxication.

Whatever the process by which it occurs, it appears that blackout is generated primarily, if not exclusively, by the pharmacological properties of alcohol and that expectancy effects make a relatively small contribution to postintoxication amnesia. It remains to be determined precisely which aspects of pharmacologic intoxication account for this interesting and important clinical phenomenon.

References

Crowder, R. G. (1976). *Principles of learning and memory.* Hillsdale, NJ: Erlbaum.

Gerrein, J. R., & Chechile, R. A. (1977). Storage and retrieval processes of alcohol-induced amnesia. *Journal of Abnormal Psychology, 86,* 285–294.

Goodwin, D. W. (1971). Blackouts and alcohol-induced memory dysfunction. In N. K. Mello & J. H. Mendelson (Eds.), *Recent advances in studies of alcoholism.* Washington, DC: U.S. Government Printing Office.

Goodwin, D. W., Crane, J. B., & Guze, S. B. (1969). Phenomenological aspects of the alcoholic "blackout." *British Journal of Psychiatry, 155,* 1033–1038.

Hartley, J. T., Birnbaum, I. M., & Parker, E. M. (1978). Alcohol and storage deficits: Kind of processing? *Journal of Verbal Learning and Verbal Behavior, 17,* 635–647.

Kent, T. A., Gunn, W. H., Goodwin, D. W., Jones, M. P., Marples, B. W., & Penick, E. C. (1986). Individual differences in state-dependent retrieval effects of alcohol intoxication. *Journal of Studies on Alcohol, 47,* 241–243.

Lisman, S. A. (1974). Alcohol "blackout": State-dependent learning? *Archives of General Psychiatry, 30,* 46–53.

Lowe, G. (1984). Alcohol and state-dependent learning. *Advances in the Biosciences, 47,* 69–79.

Markham, M. R., Miller, W. R., & Arciniega, L. (1993). BACCuS 2.01: Computer software for quantifying alcohol consumption. *Behavior Research Methods, Instruments, and Computers, 25,* 420–421.

Marlatt, G. A., Demming, B., & Reid, J. B. (1973). Loss of control drinking in alcoholics: An experimental analogue. *Journal of Abnormal Psychology, 81,* 233–241.

Marlatt, G. A., & Rohsenow, D. J. (1980). Cognitive processes in alcohol use: Expectancy and the balanced placebo design. In N. K. Mello (Ed.), *Advances in substance abuse: Behavioral and biological research* (Vol. 1, pp. 159–199). Greenwich, CT: JAI Press.

Meilman, P. W., Stone, J. E., Gaylor, M. S., & Turco, J. H. (1990). Alcohol consumption by college undergraduates: Current use and 10-year trends. *Journal of Studies on Alcohol, 51,* 389–395.

Miller, M. E., Adesso, V. J., Fleming, J. P., Gina, A., & Lauerman, R. (1978). The effects of alcohol on the storage and retrieval processes of heavy social drinkers. *Journal of Experimental Psychology: Human Learning and Memory, 4,* 246–255.

Miller, W. R., & Caddy, G. R. (1977). Abstinence and controlled drinking in the treatment of problem drinkers. *Journal of Studies on Alcohol, 38,* 986–1003.

Miller, W. R., Heather, N., & Hall, W. (1991). Calculating standard drink units: International comparisons. *British Journal of Addiction, 86,* 43–47.

Miller, W. R., & Saucedo, C. F. (1983). Assessment of neuropsychological impairment and brain damage in problem drinkers. In C. J. Golden, J. A. Moses, Jr., J. A. Coffman, W. R. Miller, & F. D. Strider (Eds.), *Clinical neuropsychology* (pp. 141–271). New York: Grune & Stratton.

Morris, C. D., Bransford, J. D., & Franks, J. J. (1977). Levels of processing versus transfer appropriate processing. *Journal of Verbal Learning and Verbal Behavior, 16,* 519–533.

Nathan, P. E., Goldman, M. S., Lisman, S. A., & Taylor, H. A. (1972). Alcohol alcoholics: A behavioral approach. *Transactions of the New York Academy of Sciences, 34,* 602–627.

Paivio, A., Yuille, J. C., & Madigan, S. A. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology Monographs, 76* (1, Pt. 2).

Rosen, L. J., & Lee, C. L. (1976). Acute and chronic effects of alcohol use on organizational processes in memory. *Journal of Abnormal Psychology, 85,* 309–317.

Saucedo, C. (1980). *The effects of alcohol state-dependent learning on an encoding variability task: Clinical and neuropsychological implications.* Unpublished doctoral dissertation, University of New Mexico.

Selzer, M. L. (1971). The Michigan Alcohol Screening Test: The quest for a new diagnostic instrument. *American Journal of Psychiatry, 127,* 1653–1658.

Sweeney, D. F. (1989). Alcohol versus Mnemosyne: Blackouts. *Journal of Substance Abuse Treatment, 6,* 159–162.

Sweeney, D. F. (1990). Alcoholic blackouts: Legal implications. *Journal of Substance Abuse Treatment, 7,* 155–159.

Tulving, E. (1968). When is recall higher than recognition? *Psychonomic Science, 10,* 53–54.

Vuchinich, R. E., & Sobell, M. B. (1978). Empirical separation of physiologic and expected effects of alcohol on complex perceptual motor performance. *Psychopharmacology, 60,* 81–85.

Wells, J. E., Bushnell, J. A., Joyce, P. R., Oakley-Browne, M. A., & Hornblow, A. R. (1991). Preventing alcohol problems: The implications of a casefinding study in Christchurch, New Zealand. *Acta Psychiatrica Scandinavica, 83,* 31–40.

Williams, R. M., Goldman, M. S., & Williams, D. L. (1981). Expectancy and pharmacological effects of alcohol on human cognitive and motor performance: The compensation for alcohol effect. *Journal of Abnormal Psychology, 90,* 267–270.

Young, L. D. (1979). Alcohol state-dependent effects in humans: A review and study of different task responses. *British Journal of Alcohol and Alcoholism, 14,* 100–105.

Received September 28, 1993
Accepted December 8, 1993 ■