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Some Effects of Alcohol on Eyewitness Memory

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Male volunteers (N = 120) in small groups of 5 to 10 watched a staged theft involving live actors. Some (n = 47) were under the influence of alcohol (average blood alcohol level of .10) at the time. Some subjects (n = 58) were interviewed immediately after the event, and all were interviewed 1 week later. The delayed interview included the presentation of a photospread that either did or did not contain the picture of the "thief." Alcohol suppressed the amount recalled during the immediate interview and both the amount and accuracy of recall after the 1-week delay. Alcohol had no influence on the ability of witnesses to recognize the thief's picture. When the thief's picture was not present in the photospread, however, alcohol increased the rate of false identifications. An immediate interview substantially improved the amount of information subjects were able to recall 1 week later.

Over the past 20 years, research on eyewitness issues has become a major part of the investigative enterprise focusing on human memory. This area of activity has produced sufficient research to require several texts (e.g., Loftus, 1979; Wells & Loftus, 1984; Yarmey, 1979) to summarize and interpret the findings. Until recently, most of the research on eyewitnesses was laboratory based, but field studies of actual witnesses have begun to appear (e.g., Cutshall & Yuille, 1989; Yuille & Cutshall, 1986; Yuille & Kim, 1987). To complete this field research with witnesses of actual crimes, it was necessary to review police files containing thousands of cases in search of those instances that suited our research needs. This police file review yielded some insight into the characteristics associated with witnesses of different types of crimes (cf. Yuille, 1986). One feature that emerged from our police file research is the frequency with which victims and witnesses are under the influence of drugs. The police reports suggested that alcohol, in particular, is a common feature in both the witnessing and commission of crimes. In fact, in some crimes (e.g., non-sexual assault) alcohol is involved more often than not. It is unfortunate that although alcohol is a frequent factor with real witnesses to crimes, the psychological literature on eyewitness behavior has ignored the possible influence of alcohol.

The initial attempt to study the influence of alcohol on witnesses used police files. A research team headed by John C. Yuille attempted to compile information about the extent of alcohol involvement in those who witnessed criminal acts through a systematic study of police files. This proved an impossible task. Police officers informed us that they often did not report (and perhaps sometimes were unaware of) drug involvement with a witness. Even when such involvement was reported, there was no standard to determine the amount of drug use, the delay since ingestion, and so forth. File-based research on the effects of alcohol on witnesses seemed then, and seems now, to be impossible. It was clear that a laboratory-based study of the effects of alcohol on eyewitness memory was necessary. The present study was conducted to achieve that purpose by exploring the effects of alcohol on the memory of student volunteers who witnessed a staged event.

Although there is no literature relating alcohol to eyewitness memory, there is an extensive literature on the effects of alcohol on a variety of standard measures of memory. Most of the research has concentrated on the short-term retention of verbal materials. For example, Parker, Birnbaum, and Noble (1976), using paired associate learning and picture recognition tasks, reported that alcohol disrupted the storage phase in two ways. First, alcohol consumption led to the use of inefficient associative strategies; second, it impaired consolidation. In fact, the proposal that the acute affects of alcohol are greater on storage than on retrieval has received considerable support (e.g., Hartley, Birnbaum, & Parker, 1978; Hastroudi, Parker, DeLisi, Wyatt, & Mutter, 1984; Jones & Jones, 1976). More recent research has placed less emphasis on disruption of consolidation and focused on the effect that alcohol has during acquisition. Hastroudi, Parker, DeLisi, and Wyatt (1983) concluded that the detrimental effects of alcohol on memory are localized in the elaborative processes (elaboration of information at the time of learning) that are impaired by the drug. Thus, administration of alcohol before learning will impair memory, but its administration after acquisition or at the time of retrieval does not impair (e.g., Parker et al., 1980). This asymmetrical state-dependent effect of the drug has received considerable attention (e.g., Eich, 1980).

The alcohol and memory literature suggests that witnesses under the influence of moderate amounts of alcohol may have impaired elaborative processes and thus acquire less information about an event. However, this research has depended on the use of simple verbal and pictorial materials. One study

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found no relationship between eyewitness recall and standard measures of verbal learning (Yuille & Cutshall, 1985). Thus, memory for more complex events, those with an inherent structure, may be less susceptible to interference from alcohol. Some support for this hypothesis is found in a study by Lowe (1981) that used a more complex learning task (memorizing a map and associated verbal instructions). Lowe reported no effect of moderate doses of alcohol. The effect of alcohol on eyewitness recall remains speculative.

Alcohol in large doses has a profound effect on memory. Several studies have reported severe amnesia associated with intoxication in alcoholics (e.g., Goodwin, Othmer, Halikas, & Freeman, 1970; Lisman, 1974; Tarter & Schneider, 1976). The present study is not concerned with heavy doses of alcohol or the effects of its chronic abuse (although both of these effects are of forensic interest). Instead, the present focus was on the acute effects of a moderate dose of alcohol on eyewitness memory in nonalcoholic populations.

Several considerations prompted the need to test the memory of witnesses both under the influence of alcohol and in the sober state. First, the alcohol and memory literature has implicated alcohol as an agent that disrupts storage. Comparing memory of witnesses while they are impaired with their memory while sober would address some effects that alcohol might have on retrieval. Thus, some of the subjects in this study were given a recall test while they were still under the influence of alcohol. However, an immediate recall test provides an opportunity for retrieval practice. Retrieval practice (i.e., an immediate recall opportunity after the critical event) has been shown to improve later recall in both standard memory research (e.g., Yuille, 1973) and eyewitness research (Yuille & Cutshall, 1985). To explore the possible role of retrieval practice, some subjects, both sober and impaired at the time of the event, were only interviewed 1 week after witnessing the event.

This was a study of the effects of alcohol on memory and not a study of state-dependent memory. Thus, the experimental condition of testing some subjects a week later under the influence of alcohol was not included. Such a manipulation is not of forensic relevance.

The study additionally provided an opportunity to examine the influence of alcohol on recognition memory. At the end of the delayed interview, 1 week after the event, each subject was shown a photospread to determine whether he could recognize the "thief." Wells (e.g., Wells, 1984; Wells & Turtle, 1987) has pointed out that from a research perspective it is essential to include a blank photospread in any study of eyewitness recognition memory. The blank photospread, one not containing a picture of the culprit, often reveals experimental effects that a standard photospread does not. In the present study, some subjects saw a lineup including the thief, whereas others were provided with a blank photospread.

To summarize, three groups—an alcohol, a placebo, and a standard control—witnessed, in small groups, a staged crime (a theft) involving live actors. After the crime the memory of half of the subjects was assessed through a free-recall interview. All the subjects were tested in the sober state 1 week after the original event. At the end of the second interview each subject was provided with a photospread. Some photospreads contained the picture of the thief, and others did not.

Method

Subjects

The participants were recruited through advertisements posted on a university campus. The ads asked for volunteers 19 years of age or over to participate in a study of the effects of alcohol on memory. Very few women volunteered for the study; therefore, the final sample was restricted to men. Each subject completed a medical questionnaire and signed a form indicating previous use of alcohol. All subjects had to have had previous experience with alcohol.

The total number of subjects who completed the testing was 120. The average age was 21.2 years (the legal drinking age in British Columbia is 19 years). Each subject was paid $5 upon completion of the study.

Design

This experiment involved a $3 \times 2 \times 2$ between-subjects design. The first factor concerned drug ingestion, involving an alcohol group (n = 47) and two control groups. One control group was led to believe they were ingesting alcohol (placebo, n = 46), whereas the other was a standard control (n = 27). The second factor involved the presence or absence of an interview immediately after the crime. An immediate interview was given to 58 subjects, and all participants were interviewed 1 week after the crime. The third factor concerned the constitution of the photospread that was shown at the end of the second interview. For some subjects the picture of the thief was included in the photospread. The other subjects saw a photospread that did not include a picture of the thief.

Procedure

The subjects were tested in groups of 5 to 10 at a time. All the subjects within each of these groups were assigned to one drug condition (alcohol, placebo, or control). Those in the alcohol condition consumed three drinks (with 10 min allowed to consume each drink) composed of a mixture of fruit juice and 95% ethanol. The amount of ethanol was calibrated to supply 1.32 ml per kg of body weight.

The subjects in the placebo group consumed three drinks of fruit juice at 10-min intervals during a 30-min period. A thin layer of ethanol covered the surface of the juice in each drink so that it smelled and tasted of alcohol. The amount of alcohol consumed was too small to have measurable breathalyzer consequences.

The standard control group subjects simply proceeded with the experiment after a 30-min delay (they did not consume any liquids). Subjects in all three conditions watched videotapes of comedy shows during the waiting/drinking period.

After consuming their third drink, or after the end of the control subjects' 30-min wait, the group was told they were to witness a staged, live event. The subjects were cautioned to be quiet and to not interrupt the event. They were not told that they would later be interviewed about the event. The group then proceeded to another room, where they witnessed an event involving two actors. The room was furnished to represent an office. A woman, acting the role of a research assistant, was filing materials when an aggressive man burst into the room and demanded money for his participation in the study. She searched through the files for his form and then excused herself to consult her supervisor. During her absence the man, who acted drunk throughout the event, stole money from her purse and a tape recorder from her desk. He threw her purse in the garbage can and exited the room. The woman reappeared and then left in pursuit of the thief. The event was designed to be complex: Both actors wore unique clothing and used special vocabulary; also, there were a variety of unique objects in the room. Each event was videotaped to record any variations. The videotapes were later used as the basis for scoring subjects' recall.

After completion of the event some subjects were interviewed. Subjects in the alcohol, delayed interview condition were retained until some of the effects of the alcohol had diminished and then were dismissed. Subjects in the no-alcohol, delayed interview condition were dismissed. All the subjects returned for an interview 1 week after the event. Each interview was conducted individually and tape recorded. The interviewers followed a standard police interview format. The witness was asked to describe, in as much detail as possible, what had happened. After he had completed this free recall, he was asked to elaborate on the appearance of the two actors, the stolen objects, and the room in which the event occurred.

At the end of the delayed interview, each subject was shown a photospread consisting of eight pictures. Subjects in the thief present condition saw a photospread containing the thief 's picture and seven similar foils. In the thief absent condition the thief 's photo was replaced by a similar foil. The subject in each case was told that the thief 's picture might not be present. The subject was asked either to make a choice or to reject the photospread (i.e., indicate that the picture was not there). The subject provided a confidence rating of his photospread choice on a 7-point scale ranging from *a guess* (1) to *very confident* (7).

The tape-recorded interviews of the subject witnesses were transcribed and scored following a procedure developed by John C. Yuille and his co-workers (e.g., Yuille & Cutshall, 1986; Yuille & McEwan, 1985). This procedure parses each witness's account into action details and descriptive details. An action detail provides information about an action or event; a descriptive detail provides information about the appearance of a person or object. Each detail is examined to determine whether it is accurate, inaccurate, or unscorable. Unscorable details are those that cannot be assessed, such as information about the subjective state of the witness. Each correct or incorrect detail is assigned a score reflecting the amount of information it contains. This procedure is complex, but the nature of the quantification can be appreciated with a simple example. The detail "She wore a sweater" would receive a score of 1, whereas the detail "She wore a red sweater" would receive a score of 2.

The scorers were blind with respect to each subject's experimental condition. Extensive reliability checks employed in previous research using this scoring procedure (e.g., Yuille & McEwan, 1985) showed that it has an average interscorer reliability of .95. In the present study, a dozen transcripts were randomly selected to check scoring reliability. The interrater reliability was .96.

Results

Two members from the local detachment of the Royal Canadian Mounted Police gave breathalyzer tests to 12 of the alcohol subjects 20 min after the consumption of their third drink. The blood alcohol content ranged from .06 to .12 ml, with an average of .10. The legal definition of being impaired in Canada is a blood alcohol level of .08.

Of the total number of interviews for the 120 subjects who completed the experiment, 4 of the immediate recall interviews and 1 delayed recall interview were lost because of recording failures. Also, 1 subject did not provide a confidence rating for his identification, and 2 subjects' identifications were lost. Thus, the number of subjects in each analysis varies slightly.

There were no reliable differences, either main effects or interactions, involving the placebo versus standard control groups on any dependent measures. Therefore, in the description of the results that follows, these two groups have been combined and are designated with the label *control*. The presence versus absence of the thief 's picture in the photospread was not relevant to the analysis of the recall scores. The analyses of the recall scores used the total amount recalled (excluding unscorable details) and the proportion correct as dependent measures. The analyses of the recall scores involved the use of 2×2 designs. The between-groups comparisons, which used the accuracy of recall from the delayed interview as the dependent measure, included the variables of drug (alcohol vs. no alcohol) and recall group (one previous recall vs. no previous recall). The mixed comparisons, which used the accuracy of recall from both interviews, included the variables of drug and recall trial (1st vs. 2nd recall), the latter being a repeated factor.

Table 1
Mean Number and Proportion Correct of Recalled Details as a Function of Interview and Alcohol

	Immediate		Delayed		Delayed only	
Condition	Total	Accuracy	Total	Accuracy	Total	Accuracy
Alcohol	80.04	.908	90.38	.883	72.32	.874
n	22		22		25	
SD	20.49	.045	20.11	.058	21.70	.036
Control	97.47	.925	109.74	.913	85.82	.909
n	31		35		37	
SD	25.86	.034	40.70	.049	22.02	.035

Groups Providing Two Recalls

The mean results of the interviews that could be scored are summarized in Table 1. The table provides the mean total number of scorable details for each group and the proportion of those details that were correct. The most apparent effect is that the witnesses under the influence of alcohol provided less scorable information than the controls, $F(1, 51) = 6.24$, $p < .05$. This pattern held for both the immediate and delayed interviews; that is, there was no interaction of alcohol and recall trial, $F(1, 51) = .06$, $p > .05$. Both groups of witnesses showed higher amounts of recall during the delayed as opposed to the immediate interview, $F(1, 51) = 8.39$, $p < .01$.

There were also differences in the accuracy of the recall. Alcohol reliably reduced accuracy of recall, $F(1, 51) = 4.44$, $p < .05$, although the differences were small. The control group provided recall that was 93% correct, and the alcohol group provided recall that was 91% correct. Delayed recall was slightly less accurate (.90) than immediate recall (.92), $F(1, 51) = 6.50$, $p < .05$.

The Comparison of One Versus Two Recalls

Table 1 also provides the mean scores for the subjects who provided only a delayed recall. This analysis involved a comparison of the delayed recall of the groups who had an immediate recall with those who did not. The total sample here was 119. Alcohol reduced delayed recall, $F(1, 115) = 9.26$, $p < .01$, and this effect did not interact with the number of recall tests, $F(1, 115) = .30$. The alcohol subjects recalled 80.78 scorable details, whereas the controls recalled 97.45 scorable details.

There is a striking contrast in the amount of delayed recall

Table 2
Photo Identification and Mean Confidence Ratings

	Alcohol				Control			
Identification	Confidence	*SD*	%	*n*	Confidence	*SD*	%	*n*
Present, correct	6.10	0.9	91	20	6.03	1.2	89	31
Present, incorrect	3.50	2.1	9	2	5.00	1.4	11	4
Absent, correct	5.86	1.0	61	14	6.16	1.5	76	25
Absent, incorrect	3.56	1.6	39	9	6.00	0.9	25	8

between the subjects who had an immediate interview and those who did not, $F(1, 115) = 17.04$, $p < .01$. An immediate interview resulted in 24.99% higher delayed recall in the alcohol subjects and 27.87% higher delayed recall in the control subjects. There was no effect of an immediate interview on the accuracy of delayed recall, $F(1, 115) = .62$.

Alcohol negatively affected the accuracy of the delayed recall, $F(1, 115) = 14.89$, $p < .01$. However, the effect was small, with the control groups averaging .91 correct and the alcohol witnesses averaging .88 correct. This effect did not interact with the number of previous recalls, $F(1, 115) = .07$.

Photo Recognition

A four-way log-linear analysis in which the dichotomous variables were accuracy of photo identification, consumption of alcohol, presence or absence of thief, and interview type revealed a significant partial association between the presence/absence of the thief's photo and accuracy of identification, $\chi^2(1, N = 114) = 6.867$, $p < .05$, $r_m = .245$. Other partial associations involving accuracy of identification and the number of recalls and alcohol were nonsignificant. For a brief introduction to the use and application of log-linear analysis, see Hosch, Leippe, Marchioni, and Cooper (1984).

Table 2 provides a summary of the percentage of accurate and inaccurate photospread choices. Both control and alcohol subjects showed a high rate of accurate identifications when the photospread contained the thief's photo. Two 2 (alcohol vs. control) × 2 (incorrect vs. correct identification) contingency tables were constructed. One table involved data from subjects who were shown the photospread that contained the thief. The other involved data from subjects who were shown the photospread that did not contain a photo of the thief. A chi-square test revealed no significant differences between subjects who had consumed alcohol and those who had not, $\chi^2(1, N = 58) = .296$, $p > .05$, when the photospread contained the thief. However, when the photospread did not contain the thief's photo, both groups showed greater error rates. Although this tendency was stronger for subjects who had consumed alcohol prior to the event, the effect of alcohol was not significant, $\chi^2(1, N = 59) = 1.092$, $p > .05$. These results confirm those obtained by the log-linear analysis.

One method of examining the difference in photospread recognition rates as a function of alcohol is to use the diagnosticity index developed by Wells and Lindsay (1980). This index is a ratio that can represent the consequences of making a choice (i.e., comparing correct choices when the perpetrator's picture is present with an incorrect choice when his picture is absent). The diagnosticity index is 3.7 for the controls and 2.4 for the alcohol subjects. This means that whereas the control subjects were 3.7 times more likely to be accurate than inaccurate in making a choice, the alcohol subjects were only 2.4 times more likely to be accurate than inaccurate (based on the assumption that the prior probability that the perpetrator was present was .50).

Table 2 also contains the average confidence ratings for each condition. Overall, confidence and accuracy were correlated .406. Subjects who had consumed alcohol provided lower confidence ratings ($M = 5.40$) than subjects who had not consumed alcohol ($M = 6.01$). A 2 (ingestion of alcohol) × 2 (accuracy of photospread choice) × 2 (one vs. two recalls) × 2 (presence of the thief's photo) analysis of variance (ANOVA) revealed that this effect of alcohol on confidence was significant, $F(1, 112) = 4.54$, $p < .05$. Subjects who made a correct photospread choice reported an average confidence rating of 6.06, whereas subjects who did not make a correct choice provided an average rating of 4.65. This difference was also significant, $F(1, 112) = 19.68$, $p < .01$.

There was also a significant interaction between alcohol and accuracy of identification, $F(1, 112) = 8.24$, $p < .05$. The confidence ratings of subjects who made a correct photospread choice did not change much as a function of alcohol: Subjects who consumed alcohol reported an average rating of 6.00 and subjects who did not reported an average rating of 6.09. However, when an incorrect photospread choice was made, subjects who had not consumed alcohol reported a mean confidence rating of 5.67. Subjects who had consumed alcohol reported a mean rating of 3.55. Alcohol was associated with a higher correlation between accuracy and confidence ($r = .596$ when the perpetrator was present and .711 when absent) compared with the controls ($r = .375$ and .067, respectively). There were no other significant effects or interactions in this analysis.

Discussion

The results of this study provide a clear indication that alcohol has an effect on eyewitness memory. Although the level of intoxication used here was mild, it produced consistent effects. Immediately after the event the control witnesses recalled 20.56% more information than those under the influence of alcohol. The accuracy of the information recalled was high in both alcohol and control groups, although slightly lower when alcohol was consumed. Because the recall was obtained immediately after the event and the alcohol subjects were still under

the influence of alcohol, two, not mutually exclusive possibilities suggest themselves as reasons for the lower recall. First, the alcohol may have interfered with the original experience. Second, alcohol may have disrupted retrieval processes at the time of recall. These two options are pursued below. It is important to note that if there are state-dependent memory effects associated with alcohol in this type of situation, they cannot be used to explain the reduced immediate recall of the alcohol group. These witnesses were tested in the same state as they witnessed the event. Thus, their poorer recall relative to the controls cannot be attributed to state-dependent effects.

One week after the event the poorer recall associated with the alcohol subjects persisted. The control subjects recalled more whether there had been an immediate interview (32.47% more) or not (19.67% more). Because the alcohol subjects were no longer under the influence of the drug at the time of the second recall, it is possible that state-dependent effects could account for these delayed differences. However, it is difficult to accept this possibility in the case of subjects who had the immediate interview because the size of the control subjects' recall advantage remained the same at both immediate and delayed interviews. That is, the same size of recall deficit occurred whether alcohol was present or absent.

Returning to the two options of the locus of the alcohol effect in this study, the delayed recall results help to rule out the retrieval interference option. Because the lower recall of the alcohol subjects persisted in the absence of the drug, the results appear to support the suggestion that alcohol reduced recall by interfering with the original perception and coding of the event. Certainly, the alcohol subjects appeared more distracted than the controls during the event and may have simply paid less attention to it.

If alcohol interferes with the coding of a complex experience, it is likely that the present results have underestimated the effects that a similar level of intoxication would have in a real context. In this study the subjects were warned that the event would occur and were instructed to attend to it. Thus, the present conditions were optimal for the witnesses to devote their full attention to the event. In spite of these conditions, alcohol interfered with attention. In real contexts one would expect that the interfering effect of alcohol might be greater than that recorded here.

Alcohol had no effect on the ability of witnesses to identify correctly a picture of the thief 1 week later. However, alcohol did influence the number of incorrect choices when the thief 's picture was not included in the photospread. This pattern is consistent with the hypothesis that the effect of alcohol in this study was on the attention devoted to the event. If the alcohol subjects had paid less attention to the event, they would, at the time of facing the blank photospread, have had less confidence about their rejection of the photospread. Knowing that they had been under the influence of alcohol and uncertain about whether the thief 's picture was present, the alcohol subjects were more likely to make a choice from the blank photospread. This assertion is given support by the confidence ratings. The alcohol group provided lower confidence ratings than the controls with the blank lineup. However, the alcohol subjects who correctly identified the thief 's picture were as confident as the controls. These results confirm Wells's (e.g., Wells & Turtle, 1987) assertion that a blank lineup is of more interest from a research perspective than one containing the suspect's picture.

The results of this study reinforce the role of retrieval practice in improving delayed recall, and they extend this effect to subjects under the influence of alcohol. The alcohol subjects who had an immediate interview recalled almost 25% more information during the delayed recall than the alcohol subjects who did not have an immediate interview. There was no effect of the immediate interview on the accuracy of the delayed recall. The retrieval practice effect was so strong that the alcohol subjects who had an immediate recall recalled more information a week later (5.33% more) than the controls who did not give an immediate recall. These results indicate that retrieval practice resulted in no forgetting of a complex event over a week delay. This was true even if the witness was under the influence of alcohol at the time of the original event and the first interview. It also appears that retrieval practice was effective in preventing the loss of accuracy of descriptive information otherwise associated with alcohol over a 1-week delay.

Given the artificial nature of the event in this study, any generalizations to "real-world" settings are tenuous. The strong retrieval practice effect suggests that police may wish to consider interviewing witnesses as soon as possible after an event, even if (in fact, especially if) they are under the influence of alcohol. Even under the influence of the drug, an immediate interview appears to preserve both the amount and accuracy of recall. This tentative recommendation is restricted to moderate levels of consumption of alcohol, similar to that used in this study.

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