Bulletin of the Psychonomic Society
1975, Vol. 6 (1), 49-50

Alcohol as the aversive stimulus in conditioned taste aversion

CATHERINE S. DAVISON
University of South Carolina, Columbia, South Carolina 29208

and

WILLIAM J. HOUSE
University of South Carolina at Aiken, South Carolina 29801

Multiple pairings of alcohol injections with saccharin-flavored water produced a long-lasting aversion to the normally preferred saccharin solution. Alcohol injections of 1.76 g/kg produced a strong aversion to saccharin-flavored water while injections of 1.17 g/kg produced only a moderate aversion. Single pairings of alcohol and saccharin-flavored water were not effective in producing an aversion.

The investigation of the biological factors in human alcoholism has relied rather heavily on experimentation with laboratory animals. It has proven difficult, however, to produce an animal analogue of alcoholism. A number of experimental animals, notably laboratory rats, do not show a preference for alcohol in a free-choice situation nor will rats voluntarily consume alcohol to the point of reaching an intoxicated state. Among the possible reasons for the failure of rats to consume large quantities of alcohol is an aversive pharmacological effect of intoxicants. The aversive pharmacological effects of alcohol were investigated by Lester, Nachman, and LeMagnen (1970). In this study, alcohol injections were paired with the presentation of a normally preferred saccharin solution. Alcohol injections were found to result in a conditioned aversion (i.e., lowered subsequent consumption) to saccharin only at very high doses (4.42 g/kg). The authors concluded that since alcohol was apparently aversive only at doses far above what an animal ingests in a free-choice situation, this aversiveness probably was not a factor limiting alcohol consumption.

Eckardt, Skurdal, and Brown (1974), employing multiple pairing of alcohol with a distinctive-taste substance, and both one-flavor and two-flavor tests, found that low doses of alcohol were effective in producing a conditioned taste aversion. The preference tests employed by these authors involved two flavors of Kool-Aid. Alcohol injections were paired with the "preferred" flavor, defined as the flavor with the highest total consumption in two 10-min preference tests. The strength and reliability of this preference is open to question since both flavors would likely have been preferred to water. The present experiment was conducted to test the effectiveness of relatively low doses of alcohol in producing a conditioned aversion to a highly preferred saccharin solution in a saccharin-water free-choice situation.

Roger W. Black sponsors this paper and takes full editorial responsibility for its content.

METHOD

Subjects and Procedure

Forty male rats, four groups of 10 each, were adapted to individual cages for 7 days. Two calibrated drinking tubes attached to each cage provided free access to water during this period. Dry laboratory chow was available ad lib throughout the experiment. On Days 8-11, water was available for 20 min each day to adapt the animals to a deprivation schedule. On Day 12, all four groups of rats were provided with a .1% (w/v) sodium saccharin solution during the 20-min drinking period. Five minutes following drinking, the rats were injected (IP) with either saline or alcohol. Rats in Group 1 received 1.7 g/kg of alcohol in a 14.7% alcohol solution. Group 2 animals received saline injections of equal volume. Group 3 received 1.2 g/kg of alcohol and Group 4 received saline injections equal in volume to those of Group 3.

Twenty-four hours following the injection (Day 13), all subjects were given a 24-h two-bottle (saccharin-water) preference test. Saccharin preference scores were computed for each animal by dividing saccharin consumption by the total fluid consumption for the 24-h period. No significant differences were observed between the groups and saccharin consumption, and alcohol injections were subsequently paired on Days 15, 17, 19, 21, 23, and 25. On the intervening days, all animals received 20 min access to water and no injections. Following the final injection day, 24-h saccharin-water preference tests were employed for 23 extinction days.

RESULTS

Within minutes after the injections, all alcohol-injected subjects showed definite effects of the alcohol. Locomotor activity was uncoordinated, and several subjects curled up and appeared to sleep. None were comatose, however, in that they were responsive to external stimuli such as an air puff. Observable differences between the animals receiving high and low doses of alcohol were slight. During acquisition (Figure 1), there were no significant differences in saccharin consumption among the groups nor were there

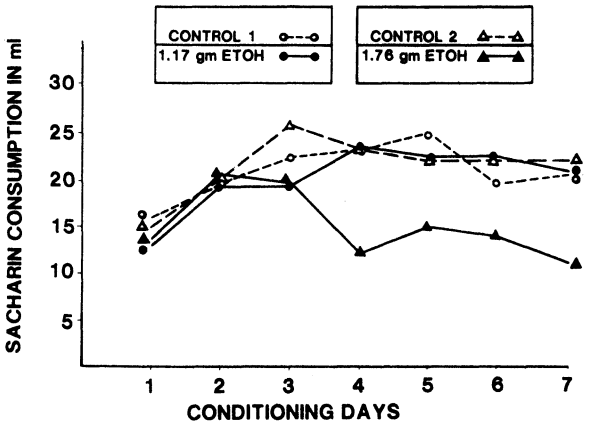

Figure 1. Saccharin consumption during acquisition.

any significant interactions among the effects of the drug (saline vs. alcohol), dose, or days. There was, however, a tendency for Group 1 animals to consume less saccharin than the other three groups during the last 4 days of acquisition, resulting from an increase in saccharin intake in Groups 2-4, rather than a decrease in Group 1. Figure 2 presents the results of the two-bottle preference tests administered during extinction. There were significant differences in saccharin consumption between the alcohol- and saline-injected animals ($F = 112.67$; $df = 1,36$; $p < .001$) and for the different doses ($F = 29.59$; $df = 1,36$; $p < .001$). Group 1 animals, which received the higher alcohol dosage, had the lowest saccharin preference scores, with Group 3 animals showing intermediate saccharin preferences. A significant Drug by Dose interaction suggests that dosage is a significant determinant of saccharin preference only among the animals receiving alcohol. There was a gradual increase in saccharin preference over days ($F = 5.2$; $df = 22,792$; $p < .001$), but this increase occurred only in animals given alcohol injections (Drug by Days interaction, $F = 4.0$; $df = 22,792$; $p < .001$).

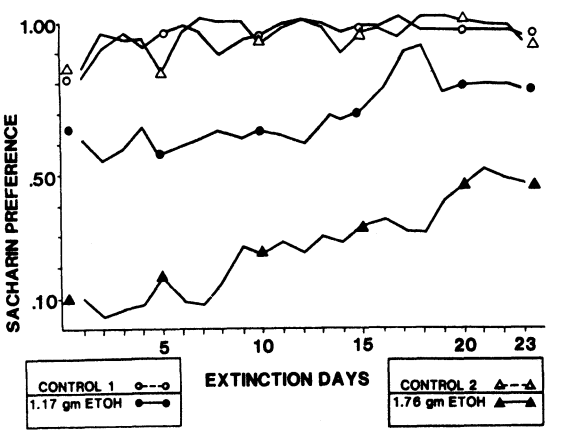

Figure 2. Saccharin preference during extinction.

DISCUSSION

The significant and long-lasting conditioned taste aversion observed in the present study suggests that alcohol does indeed have aversive pharmacological effects at relatively low doses. This aversiveness might interact with taste factors to limit voluntary consumption of alcohol in laboratory rats. Initial consumption of alcohol might be limited by taste factors with aversive pharmacological effects taking over if alcohol consumption increases. Consumption of a straight alcohol-water solution by rats is generally small, probably too small to produce aversive effects; and taste may be the primary limitation on consumption. The intake of a nonpreferred alcohol solution increases, however, when taste discrimination is dulled or when flavor is disguised (Black & Straub, 1973; Dicker, 1958), but a strong preference for alcohol still does not exist. The increased consumption of alcohol might be sufficient to produce aversive pharmacological effects which serve to limit further alcohol consumption. The average daily consumption in the Black and Straub study, for example, was over twice the 1.17 g/kg dose of alcohol found to be effective in producing conditioned taste aversion in the present study. Although the smaller dose of alcohol employed in the present study (1.17 g/kg) was effective in producing a conditioned taste aversion, it is only slightly large than a dose of alcohol (1 g/kg) found by Black, Albiniak, Davis, and Schumpert (1973) to be reinforcing in the rat. The 1.17 g/kg dose may be near the threshold for aversivensss in the rat, especially in view of the relatively wide individual variability in the formation of conditioned aversive saccharin that existed in the rats receiving 1.17 g/kg of alcohol ($\sigma^2 = .11$) that did not exist in the 1.76 g/kg group ($\sigma^2 = .01$). It is interesting to note, in this connection, that doses of alcohol below 1.2 g/kg serve as a behavioral stimulant but larger doses result in behavioral disruption (Buchalew & Cartwright, 1968). The possibility also exists that the drug could be aversive in one situation and reinforcing in another, even in identical doses. Cappel and LeBlanc (1973) found, for example, that doses of amphetamine sulfate which are reinforcing in a self-administration paradigm were effective in producing a conditioned taste aversion. The present study, in which alcohol was shown to have aversive pharmacological effects, confronts the animal with a situation quite similar to a free-choice alcohol consumption test. Consumption of a distinctly flavored substance, i.e., alcohol, is followed by a set of aversive pharmacological effects and may condition an aversion to alcohol just as an aversion to saccharin was produced in the present study.

REFERENCES

Black, R., Albiniak, T., Davis, M., & Schumpert, J. A preference in rats for cues associated with intoxication. Bulletin of the Psychonomic Society, 1973, 2, 423-424.

Black, R., & Straub, S. Self-selection of ethanol as wine by rats. Bulletin of the Psychonomic Society, 1973, 2, 217-218.

Buchalew, L. W., & Cartwright, G. M. Generalization and differential behavioral effects of five ethanol dosages in the albino rat. Psychological Reports, 1968, 3, 1151-1154.

Cappel, H., & LeBlanc, A. E. Punishment of saccharin drinking by amphetajine in rats and its reversal by chlordiazepoxide. Journal of Comparative and Physiological Psychology, 1973, 85, 97-107.

Dicker, S. E. The effects of methylpentynol on ethanol drinking and on water metabolism in rats. Journal of Physiology, 1958, 144, 138-147.

Eckardt, M., Skurdal, A., & Brown, J. Conditioned taste aversion produced by low doses of alcohol. Physiological Psychology, 1974, 2, 89-92.

Lester, D., Nachman, M., & LeMagnen, J. Aversive conditioning by ethanol in the rat. Quarterly Journal of Studies on Alcoholism, 1970, 31, 578-586.

(Received for publication April 14, 1975.)