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Taste Aversion Learning and Schedule-induced Alcohol Consumption in Rats

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CORFIELD-SUMNER, P. K. AND N. W. BOND. *Taste aversion learning and schedule-induced alcohol consumption in rats.* PHARMAC. BIOCHEM. BEHAV. 9(6) 731–733, 1978.—Twelve hungry rats were exposed to the intermittent delivery of food with a 5% (v/v) ethanol solution freely available. All developed high levels of schedule-induced alcohol polydipsia within ten 1-hr sessions. Immediately following the eleventh session half of the animals received an intraperitoneal injection of lithium chloride (experimental group) and the other half received an injection of sodium chloride (control group). Their alcohol intakes did not differ during the twelfth session and so the treatments were repeated following the thirteenth session. During the fourteenth session, the experimental group drank very little alcohol compared to the control group, indicating that they had learned a taste-aversion to the alcohol in only two conditioning trials. These results extend previous work on the role of taste aversion in suppressing alcohol intake by demonstrating that the technique can be used to suppress schedule-induced alcohol polydipsia as well as thirst-motivated alcohol intake.

Rats Alcohol Polydipsia Taste-aversion

IF FOOD-DEPRIVED rats are exposed to an intermittent schedule of food reinforcement, they will consume excessive amounts of water. For example, Falk [3] has reported that rats' water-intake during a 3.17-hr session may be 3 or 4 times their normal *daily* intake and he has termed this phenomenon "schedule-induced polydipsia." The same technique can also be used to induce excessive alcohol consumption in rats [7]. Indeed, spaced feeding can rapidly establish alcohol as a positive reinforcer [8] and has been shown to induce physical dependence [4]. As such, it may be seen as a potential animal model of human alcoholism [6]. While there are some doubts about the *elective* aspect of the rats' alcohol consumption under these conditions [5], there is little doubt about its *excessive* aspect [6].

Given the fact that intermittent feeding induces excessive alcohol consumption in food-deprived rats, it is pertinent to ask what techniques might be used to reduce it. Revusky and Taukulis [11] have noted the similarity between chemical aversion therapy for alcoholism and the taste aversion paradigm in animals. Further, it has been demonstrated that thirst-motivated animals, consuming alcohol as their only source of fluid, will reduce their intake of alcohol if it is paired with illness induced by radiation [9] or an injection of lithium chloride [11]. The present study therefore investigated the effects of pairing schedule-induced alcohol consumption with an injection of lithium chloride (LiCl). There is some controversy in the literature regarding the effectiveness of taste-aversions in reducing schedule-induced polydipsia [1,12]. The present study also attempted to throw some light on this problem.

METHOD

Animals

Twelve 120-day-old male hooded rats of a laboratory-bred strain served in the experiment. All were maintained at approximately 85% of their pre-experimental weights which ranged from 340 to 365 g. They were housed individually and water was always available in their home cages.

Apparatus

The apparatus consisted of standard two-lever operant test chambers (Campden Instruments C1410) housed in sound- and light-proof outer cubicles. Food in the form of 45 mg pellets (Campden Instruments) could be dispensed to the animals through the chutes which were positioned in the center bottom of the front walls. In each chamber the left

[1]This research was carried out while Nigel Bond was on study-leave at Birmingham University. The authors wish to thank Professor P. L. Broadhurst for the use of valuable facilities and for his encouragement and advice throughout this period. Reprints may be obtained from Nigel Bond.

hand lever had been removed and a bottle was positioned behind the front panel so that the spout was hung approximately 5 mm behind the resulting hole. When the rats were placed in the chambers they could reach through the holes to lick the spouts. Ten watt house lights illuminated the chambers during experimental sessions. The experiment was automated by means of conventional electromechanical switches and timers.

Procedure

The rats were given two 1-hr sessions in the chambers to allow them to adapt to the novel environment. During these sessions a few food pellets were placed in the food chutes and the bottles contained a 5% (by volume) ethanol solution.

The first conditioning trial took place on Day 11 (conditioning day 1). Immediately after the experimental session the animals were divided into two groups matched for alcohol intake. The experimental group (N=6) then received an intraperitoneal (IP) injection of 10 ml/kg of .3M lithium chloride (LiCl) and the control group received an IP injection of 10 ml/kg of .3M sodium chloride (NaCl). All animals were then returned to their home cages and their water was removed for a period of 6 hr. At the end of this period all the animals were given their daily food ration and again placed on free water.

Day 12 served as a rest and recovery day, all animals receiving their daily food ration in their home cages.

On Day 13 (test day 1) the animals were tested for their aversion to alcohol by being placed in the experimental chambers with the intermittent food schedule in operation and with the 5% ethanol solution in the drinking bottle.

On Day 14 (conditioning day 2) the procedure outlined for Day 11 was repeated, i.e., the experimental group was injected with LiCl and the control group with NaCl, immediately after the experimental session.

Day 15 served as a rest and recovery day, all animals receiving their daily food ration in their home cages.

On Day 16 (test day 2) the animals were again tested for their aversion to the 5% ethanol solution.

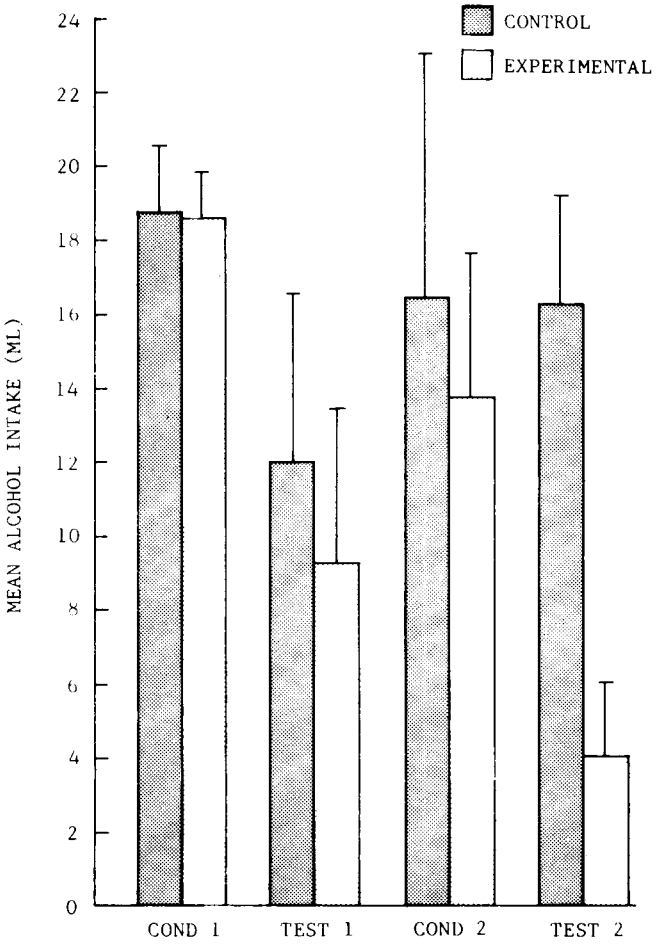

FIG. 1. Mean alcohol intake in ml for both the experimental and control groups on each of the conditioning days and test days. The standard deviations are indicated by the vertical lines.

RESULTS

Mean alcohol intakes for each group are shown in Fig. 1. All of the animals developed a pattern of behaviour which consisted of taking each pellet as it was delivered and then going immediately to the alcohol spout and drinking. Further, taking into account the session length, they exhibited levels of alcohol intake comparable to those reported previously (cf. [6]). Therefore, given the patterning of their drinking and the amounts they consumed, one can conclude that the animals displayed schedule-induced alcohol polydipsia.

On test day 1 (T1) both groups showed a significant decrease in alcohol intake compared to conditioning day 1 (C1) ($t=0, p<0.05$ in both cases). However, while the experimental group evidenced a lower alcohol intake than the control group, this difference was not significant ($U=8, p>0.05$). Nor was there a significant difference between the two groups on conditioning day 2 (C2) ($U=13, p>0.05$).

On test day 2 (T2) the control group showed no change in alcohol intake compared to the initial conditioning day (C1) ($t=2, p>0.05$). In contrast, the experimental group evidenced a significant decline in alcohol intake compared to conditioning day 1 (C1) ($t=0, p<0.05$) and animals in this group consumed significantly less alcohol on test day 2 (T2) than the control group ($U=0, p<0.01$).

DISCUSSION

The present results demonstrate that schedule-induced alcohol consumption can be suppressed by employing the taste-aversion paradigm. It required only two pairings of the taste of alcohol and illness (injection of lithium chloride) to markedly reduce subsequent alcohol consumption. Moreover, it was demonstrated using the relatively insensitive one-bottle test [2]. As such, the present results provide some support for the findings of Bond and Corfield-Sumner [1] who found a marked reduction in schedule-induced saccharin consumption following one pairing of the saccharin with illness. In the Bond and Corfield-Sumner study the saccharin was a novel taste, whereas in the present study the taste of alcohol was "familiar" in that the animals had been exposed to it previously for ten 1-hr sessions. Yet, despite the fact that familiarity with the flavour to-be-conditioned has been shown to reduce the degree of the subsequent aversion [10], a taste aversion was readily conditioned to the alcohol. However, since a 5% concentration of alcohol is

itself aversive to rats, the question of whether schedule-induced consumption of a "familiar" flavor can be disrupted by the taste aversion technique remains to be answered.

The present results also extend previous work on the role of taste-aversions in suppressing alcohol intake by demonstrating that the technique can be used to suppress schedule-induced alcohol polydipsia as well as thirst-motivated alcohol intake [9,11]. Given the suggestion that schedule-induced polydipsia may provide a model of the excessive aspect of addictive behaviours such as alcoholism [6], then the present results are of theoretical interest in delineating a role for chemical aversion therapy in the treatment of alcoholism in humans.

In the present study, no attempt was made to determine whether the spaced-feeding technique had established alcohol as a positive reinforcer [8] and it is unlikely that physical dependence was obtained [4]. It would be of interest to see if animals who are physically-dependent and are working for alcohol will learn an aversion to alcohol if it is paired with illness, conditions more analogous to those found in the human alcoholic.

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