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Shock Induced Alcohol Consumption in Rats: Role of Initial Preference[1]

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BOND, N. W. *Shock induced consumption in rats: Role of initial preference.* PHARMAC. BIOCHEM. BEHAV. 9(1) 39–42, 1978.—In three experiments it was found that the effects of inescapable unavoidable shocks upon alcohol intake were dependent upon the initial preference displayed by the animal. When animals displayed a low initial preference for alcohol (Experiment 1) shock stress led to an increase in daily alcohol intake. When animals displayed a high initial preference for alcohol due to the addition of a preferred flavour (Experiment 2) or forced acclimation (Experiment 3) shock stress led to a decrease in daily alcohol intake. It is suggested that alcohol is consumed as a function of the punishing and discriminative properties of the shocks, not to alleviate stress through its pharmacological properties.

Rats   Shock stress   Saccharin   Forced acclimation   Ethanol   Water   Body weight   Food intake

THE tension-reduction hypothesis has been one of the most prominent in attempting to account for the aetiology of moderate and excessive drinking, although much of the evidence has been equivocal [3,5]. However, two recent papers have established that inescapable shock can lead to self-selection of alcohol by rats [1,8]. For example, in a series of experiments, Anisman and Waller [1] demonstrated that while the continued presentation of shock was necessary to maintain the rats' preference for alcohol factors such as the predictability of shock, shock schedule and nutritional deficiency were relatively unimportant. Mills, Bean and Hutcheson [8] addressed themselves to the temporal nature of the enhanced preference for alcohol under conditions of shock stress and observed that the increases tended to occur immediately following the offset of shock.

One factor that has been ignored thus far is the rats' initial preference for alcohol. In this context it is interesting to note that most experiments have employed concentrations of alcohol which the rats were indifferent to or rejected prior to stress onset. Therefore Experiment 1 looked at the effects of unsignalled inescapable shocks on rats' preference for alcohol. The rats were housed continuously in the test environment with a choice between water and a 6% alcohol solution. This concentration was chosen on the basis of pilot work which indicated that the strain of rats employed were relatively indifferent to it. Further, this indifference could be changed to a preference by the addition of saccharin (Experiment 2) or forced acclimation (Experiment 3).

EXPERIMENT 1

Method

Subjects and apparatus. Ten male hooded rats of a laboratory-bred strain served as subjects. During the course of the experiment ten operant test chambers (Campden Instruments C1410) served as the animals' living quarters. They measured 34×36×28 cm and were mounted inside sound-attenuating chests. The floor of each chamber consisted of 16 bars spaced 1.3 cm apart (center to center) through which scrambled electric shock of 1.0 mA could be delivered. Occurrences of shock periods, shock durations and intershock intervals were controlled by electromechanical switches and timers. The left-hand lever had been removed from each chamber to allow the insertion of two drinking spouts 2 cm apart. Throughout the experiment one spout allowed access to water and the other spout allowed access to a 6% alcohol solution. The position of the fluids was alternated daily. A circular dish 8 cm in diameter was placed on the floor of the chamber and an aperture 5 cm in diameter allowed the animal access to powdered food. The dimensions of the dish were such that it was difficult for the animal to perch upon it and no animal was observed to escape the shock in this manner.

Procedure. The animals were habituated to the chambers for five days and were then randomly assigned to one of two groups. The Shock group then received a single 2 sec unsignalled inescapable shock every 30 min during alternate 12 hr periods. Shock periods began at 20.00 hr and ended at 08.00 hr. The Control group received no shock exposure. Food intake, fluid consumption and body-weight were recorded daily at 10.00 hr and the position of the two fluids was alternated at this time. The experiment was terminated after five days exposure to the shock condition.

Results and Discussion

Table 1 shows the means and standard deviations for body-weight, food and fluid consumption for each of the two

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TABLE 1

MEANS AND STANDARD DEVIATIONS FOR BODY-WEIGHT, FOOD AND FLUID CONSUMPTION (EXPERIMENT 1)

Group	Weight (g)	Food (g)	Water (ml)	Alcohol (ml)	Alcohol (g/kg)
Shock	355.9 ± 63.8	16.8 ± 5.0	8.9 ± 11.4	22.9 ± 10.7	3.83 ± 1.87
Control	361.6 ± 43.1	15.8 ± 4.7	24.9 ± 6.5	7.9 ± 4.8	1.25 ± .83

TABLE 2

MEANS AND STANDARD DEVIATIONS FOR BODY-WEIGHT, FOOD AND FLUID CONSUMPTION (EXPERIMENT 2)

Group	Weight (g)	Food (g)	Water (ml)	Alcohol (ml)	Alcohol (g/kg)
Shock	251.2 ± 27.8	15.7 ± 4.4	20.0 ± 14.4	10.8 ± 10.5	2.62 ± 2.62
Control	244.6 ± 17.9	14.4 ± 2.7	3.2 ± 2.4	28.6 ± 4.8	6.72 ± 1.47

groups over the five days of shock exposure. A t test (two-tailed) indicated that the Shock group drank more alcohol (expressed as g/kg) than the Control group (t=2.52; df=8, p<0.05). There were no significant differences in food consumption or body-weight.

The results of the present experiment replicate previous work [1,8] in demonstrating that rats will increase their consumption of alcohol when exposed to stress in the form of inescapable, unavoidable electric shocks. However, as in most previous studies, the Control rats drank less alcohol than water (cf. Table 1).

EXPERIMENT 2

Experiment 2 was designed to look at the effects of stress on alcohol consumption when the 6% alcohol solution was the preferred fluid under non-stress conditions. This was achieved by mixing the alcohol with a saccharin solution [9].

Method

The strain of rats, apparatus and procedure were identical to Experiment 1 except that the 6% alcohol solution was made up using a 0.4% saccharin solution as the base instead of water.

Results and Discussion

Table 2 shows the means and standard deviations for body-weight, food and fluid consumption for each of the two groups over the five days of shock exposure. First, note that adding saccharin to the 6% alcohol solution resulted in it becoming the preferred fluid. Specifically, the Controls consumed 90% of their daily fluid intake in the form of the alcohol/saccharin mixture. Importantly, a t test (two-tailed) indicated that the Shock group drank significantly less alcohol/saccharin (expressed as g/kg) than the Control group (t=2.73, df=8, p<0.05). There were no significant differences in body-weight or food consumption.

The results of Experiment 2 suggest that the effects of stress on alcohol consumption may be depended upon the initial preference displayed by the animal. Specifically, if the initial preference for alcohol is low, stress will lead to an increase in alcohol consumption. If it is high, stress will lead to a decrease in alcohol consumption. In this regard the present results are similar to those obtained when signalled inescapable shocks are superimposed upon a behavioural baseline such as operant lever-pressing. Specifically, high rate or highly preferred behaviours are more severely disrupted by the signalling stimulus than low rate or lesser preferred behaviours [2,7].

EXPERIMENT 3

One problem with Experiment 2 is that it introduced a confounding variable by adding saccharin to the alcohol. Thus, the effect observed may have resulted from the effects of stress on saccharin consumption rather than alcohol consumption. As such, it would seem appropriate to replicate Experiment 2 by employing a different technique to produce an increase in initial alcohol preference. Forced acclimation is one way of achieving this [9,11]. Specifically, if rats are forced to drink a low concentration of alcohol by making it the only fluid available, they will subsequently display an enhanced preference for such low concentrations of alcohol [11]. Therefore, the rats in Experiment 3 were preexposed to the 6% alcohol solution by making it the only fluid available in their home cages.

Method

The strain of rats, apparatus and procedure were identical to Experiment 1 except that the subjects were restricted to the 6% alcohol solution in their home cages for 25 days prior to the start of the experiment.

Results and Discussion

Table 3 shows the means and standard deviations for body-weight, food and fluid consumption for each of the two groups over the five days of shock exposure. Note that the forced acclimation led to an enhancement of alcohol preference. Specifically, the Controls consumed 71% of their daily fluid intake as alcohol. As predicted, a t test (one-tailed) indicate that the Shock group consumed less alcohol (ex-

TABLE 3

MEANS AND STANDARD DEVIATIONS FOR BODY-WEIGHT, FOOD AND FLUID CONSUMPTION (EXPERIMENT 3)

Group	Weight (g)	Food (g)	Water (ml)	Alcohol (ml)	Alcohol (g/kg)
Shock	359.2 ± 50.7	19.7 ± 1.7	21.0 ± 9.6	9.0 ± 7.8	1.40 ± 1.1
Control	347.8 ± 32.2	17.6 ± 3.0	9.6 ± 14.5	23.3 ± 12.7	3.85 ± 2.1

pressed as g/kg) than the Control group (t=2.04; df=8; p<0.05).

The results of Experiment 3 replicate those of Experiment 2 in indicating that if alcohol is the preferred fluid prior to the onset of stress, then stress will lead to a diminution of alcohol intake. Further, they extend them by demonstrating that the means of brining about the initial preference may be relatively unimportant. That is, the effect is obtained whether it is due to the addition of a preferred flavour (Experiment 2) or forced acclimation (Experiment 3).

GENERAL DISCUSSION

The present results suggest that the effects of stress upon alcohol intake may be dependent upon the initial preference displayed by the animal. Most previous studies [1,8] and Experiment 1 employed animals displaying a low initial preference for alcohol and found that stress in the form of unsignalled inescapable electric shocks led to an increase in daily alcohol intake. Experiments 2 and 3 employed animals displaying a high initial preference for alcohol and found that shock stress led to a decrease in daily alcohol intake. One might argue that this was due to a ceiling effect, i.e., the animals were consuming so much alcohol prior to shock onset that no further increase could be obtained. This is unlikely for two reasons. First, the mean amounts consumed by the Control animals in Experiments 2 and 3 were not remarkable, being 6.7 g/kg and 3.9 g/kg, respectively. Quite clearly the animals could have consumed more. Second, an actual decrease in consumption was obtained in both experiments. As such, we are left with the problem of explaining how such contrasting effects can arise. Previous authors have sought to account for the increased consumption of alcohol during shock stress by suggesting that the alcohol modifies the consequences of stress due to its pharmacological properties [1,8]. However, such a theory cannot account for the present findings where the shock stress led to a decline in alcohol consumption and an increase in water consumption. Clearly, if alcohol were being consumed to bring about tension-reduction one would expect that stress would have little effect on alcohol intake if it were already at a high level since it would still serve the purpose of reducing the aversive consequences of shock.

An alternative account is that the delivery of the shocks may result in an adventitious punishment contingency. That is, given two sources of fluid, the more preferred is also the more probable and thus the more likely to be associated with the delivery of the shock. This may account for the decrease in intake of the preferred fluid, whether it be water or alcohol. However, one is still left with the problem of accounting for the enhanced consumption of the nonpreferred fluid. It has been reported that the enhancement of alcohol intake was confined to the immediate postshock period and that this might be due to the shock becoming a discriminative stimulus for the onset of a shock-free period serving to signal drinking [8]. Since consumption of the preferred fluid may have been suppressed, as outlined above, then the shock-free period will serve to signal consumption of the nonpreferred fluid. Anisman and Waller [1] had previously tested this hypothesis by employing a random shock schedule and still obtained an increase in alcohol intake, evidence against a discriminative interpretation. However, random schedules are rarely random and usually the occurrence of the scheduled event predicts an event-free period, even if it does not predict its precise duration [6]. As such, one might still be able to account for the disparate effects of stress on alcohol preference by a combination of the discriminative and punishment hypotheses as outlined above.

Previous studies [1,8] have reported small declines in weight following the onset of shock periods. Decreases also occurred in the present study, but the large standard deviations meant that they did not lead to significant differences between the Shock and Control groups in any of the experiments. Some authors [4,10] have pointed out that the increase in alcohol intake during shock periods may be due to the rats increasing their caloric intake to compensate for this weight loss. If this were the sole cause one could argue that the Shock groups should also show an increase in food intake compared to the Control groups. Inspection of each of the three Tables indicates that this was not the case.

In conclusion, the present findings indicate that the effects of shock stress on alcohol preference are dependent upon the initial preference displayed by the animal. Specifically if the baseline intake of alcohol is low stress will lead to its enhancement, if it is high stress will lead to its diminution. Certainly, the view that alcohol is consumed to alleviate stress through its pharmacological properties is not supported.

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