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BRIEF COMMUNICATION

Schedule Induction and Sweetness As Factors in Ethanol Consumption And Preference by Rats[1]

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GILBERT, R. M. *Schedule induction and sweetness as factors in ethanol consumption and preference by rats.* PHARMAC. BIOCHEM. BEHAV. 8(6) 739–741, 1978. The separate and joint effects of spaced feeding of small portions of the daily food ration (schedule induction) and sweetening of one or the other fluid by 0.2% sodium saccharin on the consumption and selection of water and a 5% ethanol solution were examined in three groups of four male, hooded rats. Fluids were available simultaneously throughout 50-min sessions during which 50 Noyes 45-mg pellets were available either altogether at the beginning of each session or singly at 60-sec intervals. Water was available in home cages. Each group experienced a different sequence of procedures that provided alternation and replication of critical conditions. Sweetening increased consumption of the sweetened fluid and suppressed consumption of the unsweetened fluid. Spaced feeding raised consumption of the preferred fluid. Exceptionally high levels of consumption were recorded when one or the other fluid was sweetened and food presentation was intermittent.

Ethanol consumption Schedule induction Sweetness

CONSUMPTION of an ethanol solution by food-restricted rats can be increased by sweetening the solution [2,10], and by spaced feeding of small portions of the daily food ration [1, 4, 6], a procedure also known as schedule induction. It would be useful to experimenters wishing to induce rats to drink large amounts of ethanol to establish whether sweetening and spaced feeding together provide greater augmentation of ethanol intake than either alone. The one pertinent study, by Samson and Falk [10], found that sweetening by saccharin further increased intake that had already been augmented by spaced feeding. Samson and Falk's data present two difficulties in interpretation. The first is that sweetening alone did not elevate ethanol consumption, contrary to other data on the effects of sweetening [2], and on the effects of adding other acceptable flavors to ethanol [7]. The second difficulty is that Samson and Falk did not remove saccharin once it had been added. These two difficulties cause doubt as to whether the reported further elevation of ethanol intake during spaced feeding was the result of addition of saccharin.

The following study was performed to determine the separate and joint effects of sweetening and the schedule-induction procedure on ethanol consumption by rats. A choice of water and ethanol solution was always available, because of the greater utility of data on fluid choices than data from consumption of one fluid [3, 7, 8]. Choice of fluids under the schedule-induction procedure has been found to be labile [3], and strongly influenced by the relative palatability of the available fluids [3,9]. Accordingly, special attention was given in the following study to the effects of sweetening water or ethanol solution on the consumption of both fluids. Also, because of evidence that the schedule-induction procedure may lose its control over ethanol consumption during extended exposure, even though consumption remains elevated [5], the present experiment included probe sessions and alternation between massed and spaced feeding, both of which enabled assessment of the effect of the schedule-induction procedure on fluid intake.

METHOD

Animals

Twelve male, Long-Evans derived, hooded rats were aged approximately 100 days at the beginning of the experiment when they were sorted arbitrarily into three, 4-animal groups having similar mean body weights. Individual rats

[1] A preliminary report of these findings was presented at the 1976 meeting of the Eastern Psychological Association. The assistance of Marilyn Schwieder and Evalyn Wollis is gratefully acknowledged.

were maintained at close to their respective 100-day weights throughout the study by controlled feeding of Teklad 4% chow after experimentation and at similar times on nonexperimental days.

Procedure

Alcohol and water consumption were recorded during 144–172 daily, 50-min sessions, conducted 4 or 5 days per week. Sessions were conducted in three similar experimental chambers were equipped with a 45-mg pellet dispenser and two calibrated drinking tubes located asymmetrically with respect to the dispenser outlet, as described earlier [3]. One tube always contained 5% (w/v) ethanol, the other tap water, with daily reversals of their respective positions. Water was available in home cages.

Sodium saccharin (0.2%) was added to ethanol solution or water for some experimental sessions. Noyes 45-mg food pellets, 50 per session, were available either altogether in the dispenser outlet at the beginning of the session or singly throughout the session at 1-min intervals. Each group experienced a different sequence of manipulation of these variables, as indicated in Fig. 1. Procedures were changed for a group only at the end of a block of four sessions and then only when each day's mean consumption by that group of each fluid was within 10% of the mean for the block for that fluid, and there were no evident trends. In addition, in order to assess further the contribution of the spaced feeding procedure to consumption of the fluids, rats in Group II were given occasional probes consisting of isolated sessions when food pellets were massed, during blocks of sessions when pellets were being presented intermittently.

RESULTS

Ethanol vs. Water Consumption

With one exception, more ethanol solution than water was drunk when both fluids were unsweetened, whether food presentation was massed or intermittent. The exception, Phase 7 for Group III (III.7), is inexplicable. It followed a phase when water was sweetened and much preferred (III.6), but a similar transition (II.5 to II.6) did not provide anomalous data. Subsequently, in Phase III.8, ethanol was again preferred. The general preference for unsweetened ethanol over unsweetened water when food was massed is evident in data from Phases I.1, I.7, II.1, II.8, and III.8; and, when food was intermittent, in data from Phases I.8, II.2, II.4, II.6, III.3, and III.5.

Although ethanol was preferred to water when both were unsweetened, adding saccharin to water produced a greater increase in consumption than adding saccharin to ethanol solution. This is evident in the case of massed feeding from comparisons of Phases I.2 and I.6 with Phase I.5, and Phase III.9 with Phase III.1; and, in the case of intermittent feeding, from comparisons of Phase I.3 with Phase I.4, Phase II.5 with Phase II.3, and Phase III.6 with Phases III.2 and III.4. (In no phase were both solutions sweetened; thus the preference for sweetened water over sweetened ethanol solution cannot be assessed.)

Intermittent vs. Massed Feeding

Other things being equal, intermittent feeding produced greater consumption of ethanol solution than massed feeding, with one exception. The effect of intermittent

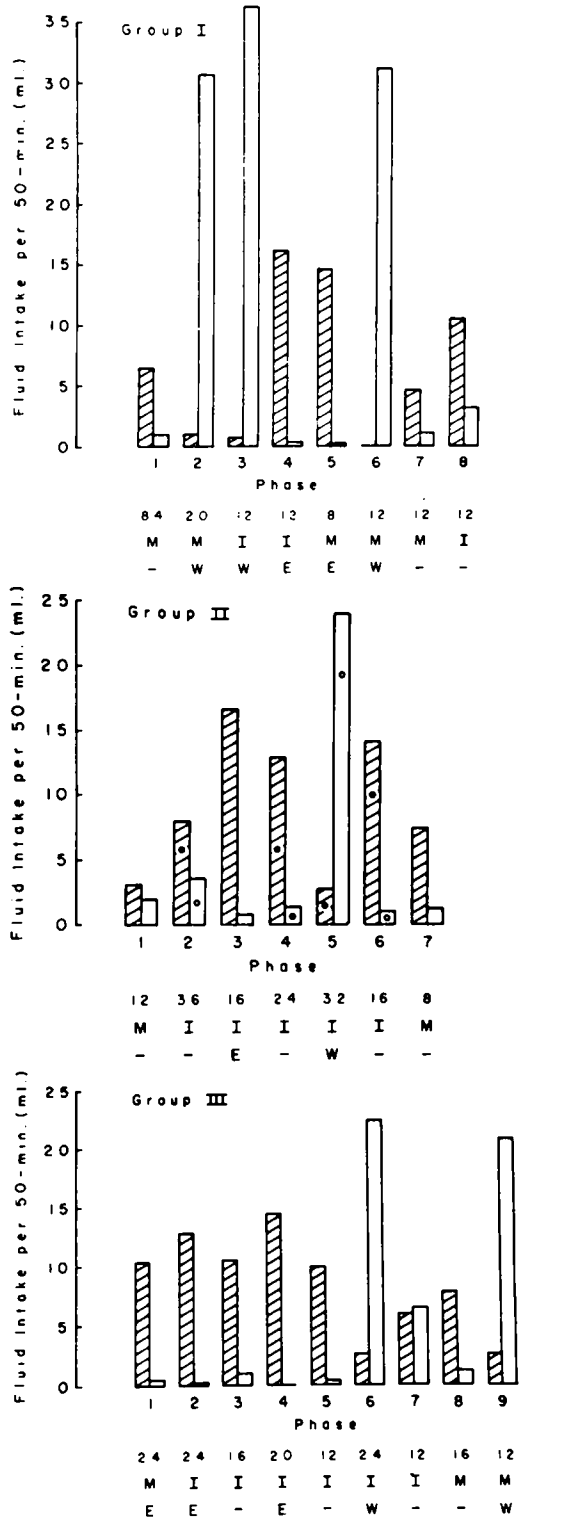

FIG. 1. Consumption of 5% ethanol solution (striped bars) and water (open bars) by the three experimental groups as a function of sweetening and spaced feeding. Each pair of bars represents mean liquid consumption during the final four sessions of the particular procedure described below the bars, where it is indicated whether presentation of each session's 50 food pellets was massed (M) or intermittent (I), whether 0.2% saccharin was added to ethanol (E), water (W) or neither (–), and for how many

FIG. 1. (continued)

sessions each procedure was applied. The filled and open circles within bars in the centre panel show, respectively, mean ethanol and water consumption during two sessions when food presentation was massed: one such probe session was conducted in each of the two blocks of four sessions preceding the block whose data are represented by the bars. The various phases of manipulation of sweetness and food presentation for each group are represented sequentially from left to right in the three panels.

feeding is evident in the case of unsweetened solution from comparisons of Phase I.8 with Phases I.1 and I.7, Phases II.2, II.4, and II.6 with Phases II.1 and II.8, and Phases III.3 and III.5 with Phase III.8; and, in the case of sweetened ethanol solution, from comparisons of Phase I.4 with Phase I.5, and Phases III.2 and III.4 with Phase III.1. The exception again concerns Phase III.7. Ethanol drinking during this phase of intermittent feeding was not greater than during Phase III.8, when feeding was massed. There was more water drinking in Phase III.7 than in Phase III.8. As a consequence, total drinking was greater under the intermittent feeding condition of Phase III.7.

Other things being equal, intermittent feeding also produced greater consumption of sweetened water than massed feeding. This is evident in comparisons of Phase I.3 with Phase I.2, and Phase III.6 with Phase III.9.

Two other kinds of comparison strengthen a conclusion than intermittent feeding produced more drinking than massed feeding. The first is that all possible valid comparisons of total amount of fluid consumed under the two conditions show that more fluid was consumed during intermittent feeding. The second is that all comparisons of drinking during probe massed sessions and neighboring intermittent sessions during Phases II.2, II.4, II.5, and II.6 show that there was more drinking of both ethanol solution and water when feeding was intermittent than when it was massed.

Sweetened vs. Unsweetened Fluids

In every possible valid comparison sweetening a fluid produced greater consumption of that fluid, especially when the fluid was water. The greater consumption of sweetened than unsweetened fluids, when food was massed, is evident from comparisons of Phases I.2, I.5, and I.6 with Phases I.1 and I.7, and Phases III.1 and III.9 with Phase III.8; and, in the case of intermittent feeding, from comparisons of Phases I.3 and I.4 with Phase I.8, Phases II.3 and II.5 with Phases II.2, II.4, and II.6, and Phases III.2, III.4, and III.6 with Phases III.3, III.5, and III.7.

Exceptionally high consumption levels were recorded when food presentation was intermittent and a fluid was sweetened: during such 50-min sessions consumption of sweetened ethanol solution was in excess of 12 ml (Phases I.4, II.3, III.2, and III.4) and provided approximately 3.0 g/kg/hr ethanol; consumption of sweetened water was in excess of 22 ml (Phases I.3, II.5, and III.6).

The comparisons that show enhancement of consumption by sweetening, show also that sweetening one fluid depressed consumption of the other fluid.

DISCUSSION

The results of the study show that sweetening and spaced feeding augmented ethanol consumption in food-restricted rats. Jointly, sweetening and spaced feeding produced a higher sustained rate of oral intake of ethanol than has previously been reported – approximately 3 g/kg/hr. Sweetening an alternative fluid, in this case water, produced marked inhibition of ethanol intake. Accordingly, sweetening, in conjunction with the schedule-induction procedure, can be considered a useful device for the establishment and maintenance of excessive ethanol use in animals. Sweetening alternative fluids can be viewed as an effective means of preventing or inhibiting ethanol intake.

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