Induced alcohol consumption through positive reinforcement[1]

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Fourteen male, hooded, 90-110 day old rats were conditioned to ingest either a 7% EtOH solution or a Sucaryl solution to gain access to a strong positive incentive environment. The tendency to select the correct solution in preference to water resisted extinction for 42 days of nonreinforcement. The group conditioned to drink EtOH consumed significantly greater quantities of their test solution during extinction than did their Sucaryl counterparts.

The rationale for the present study arose because of the authors' previous observations (Senter, Smith, & Lewin, 1967; Senter & Persensky, 1967) indicating that the coupling of *positive* reinforcement with alcohol ingestion can result in the establishment of relatively persistent drinking behavior. This study was designed to make several reinforcing stimuli available to rats as a consequence of selection and ingestion of an ethanol solution.

Method. The apparatus was two interconnecting plywood boxes. The smaller (10 x 10 x 12 in.) of these was painted flat white and had the lips of two Richter bottles thrust through holes in one side. One of these bottles contained water and the other the test solution, viz, either a 7% (V/V) ethanol solution or a Sucaryl (Abbott) solution (1 tablet per 100 ml water). Adjacent to the start box, but separated from it by a transparent guillotine door, was a larger (10 x 14 x 12 in.) "incentive chamber" which contained stimuli known to have positive incentive value for rats: (1) the walls of the chamber were painted with a variety of complex visual patterns (Dember, Earl, & Paradise, 1957); (2) tunnels, balls, blocks, etc., conducive to satisfaction of the "exploratory drive" (Montgomery, 1954; Montgomery & Segal, 1955); and (3) food, both standard laboratory chow and sunflower seeds.

The Ss were 14 male, hooded rats ranging from 90 to 110 days at the beginning of the experiment divided into experimental (alcohol; N = 8) and control (Sucaryl; N = 6) groups. After two days of allowing 1 h free access to the conditioning apparatus, the animals were placed on a 23 h food deprivation schedule and allowed to enter the incentive chamber where they were permitted to eat or explore for 30 sec. A Richter bottle containing the 7% (V/V) EtOH solution or the Sucaryl solution was available in the start box. This procedure was repeated 10 trials daily for two days.

For the next phase of the experiment, the door to the incentive chamber was opened only after the animal had approached and drunk some of the test solution. As time progressed the animals were required to drink increasing amounts of their test solutions before the connecting door would be opened. When the animals were induced to drink at least 2 ml of test solution per trial, the conditioning period was begun. The Ss were allowed free access to food, water, and their respective test solution in their home cages after each day's running for a period of time such that the 23 h deprivation schedule was maintained.

During the conditioning period the Ss were placed in the start box with water and their respective test solutions. Readings on the bottles were checked at 5 min intervals. Any animal which had drunk 2 ml or more of the test solution after the 5 min was allowed to enter the incentive chamber and remain there for 5 min. This procedure was repeated for 45 min per day for 27 days.

Next Ss were placed in the start box for 15 min with the water and test solution in place, but they were no longer allowed access to the incentive chamber. The 23 h food and liquid deprivation schedule was maintained during this extinction period. The a priori criteria for extinction were (1) complete cessation of drinking in the start box or (2) the occurrence of the choice of a larger volume of water than of the test solution (E/T or S/T < .50).

Results. The index of *relative* alcohol or Sucaryl consumption reported here is in volume (ml) of EtOH or Sucaryl solution consumed divided by the total volume (ml EtOH or Sucaryl plus water) of fluid consumed in the start box for each day; this index is designated as E/T or S/T.

During conditioning both groups increased in the absolute amount of test solution consumed daily while in the start box, but their relative consumption index remained virtually (approximately .95) unchanged except for daily variations. The absolute consumption data collected during conditioning were subjected to a 2 (treatments) by 27 (time in days) analysis of variance. The comparison of treatments failed to produce a significant F ratio. The time comparison resulted in an $F = 6.98$ ($df = 26/312$, $p < .01$) The interaction of Treatments and Time resulted in an $F = 2.08$ ($df = 26/312$, $p < .05$).

During the extinction period both groups maintained a high relative selection for their respective test solution for the entire 42 days with E/T or S/T rarely dropping below .85.

As can be seen from Fig. 2, a difference existed between the absolute consumption rates of the two test solutions during extinction. These data were subjected to a 2 (treatments) by 42 (time in days) analysis of variance. The comparison of treatments resulted in $F = 10.14$ ($df = 1/12$, $p < .01$). The time comparison yielded $F = 3.70$ ($df = 41/492$, $p < .01$). The interaction of Treatments and Time resulted in $F = 4.35$, ($df = 41/492$, $p < .01$).

Discussion. The data indicate that allowing Ss to gain access to a chamber containing items of strong positive incentive value can act as a motivator sufficiently strong to induce prolonged selection and consumption of a distinctively flavored solution. The rate of learning of the discrimination and consumption habits is essentially the same whether the solution is 7% ethanol or Sucaryl (vs water). The tendency to discriminate between the test solution and water is very resistant to extinction, for both E/T and S/T remain quite high and show no systematic decline over 42 days with no access to the incentive chamber. The *consumption* habit, however, appears to be more resistant to extinction when the solution previously effective in gaining reinforcement is EtOH. This intergroup difference was not apparent during training (see Fig. 1).

One criticism of the present study could be based on the fact that the high level of EtOH consumption exhibited during the extinction period might have been a simple manifestation of hunger (EtOH provides calories). Two factors lead the writers to discount this possibility. These are: (1) If the differential consumption levels were caused by the availability of calories in EtOH, the difference should have been apparent during conditioning as well as during extinction, and (2) early in the experiment the writers attempted to establish a control group in which animals were placed, hungry and thirsty, in the start box with a ration of EtOH solution equal to that consumed on the same day by a predesignated experimental S pairmate. The plan was to allow the animals to drink a "yoked" amount of EtOH and then to place them in the incentive chamber later in the day for a period of time equal to that spent by each experimental pairmate. When the alcohol consumption was not directly coupled with access to the incentive chamber the animals, even though both hungry and thirsty, were most reluctant to drink their EtOH ration. No animal ever consumed its full ration EtOH even though they were allowed 3 h

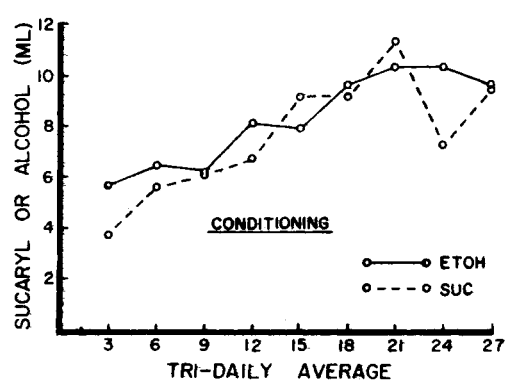

Fig. 1. Mean absolute quantity of alcohol or Sucaryl solution consumed in the start box during conditioning (3 day averages).

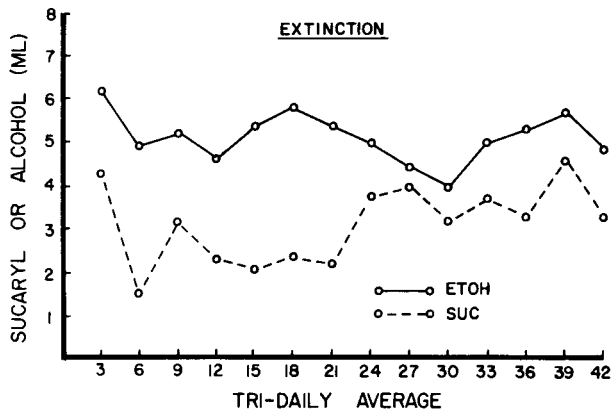

Fig. 2. Mean absolute quantity of alcohol or Sucaryl solution consumed in the start box during extinction (3 day averages).

to do so and some animals were eventually working under as much as 72 h of food and water deprivation. Four of the eight animals designated for this abortive control group died within two weeks and the others showed definite signs of dehydration and starvation. Had the major motive inducing EtOH consumption in the experimental Ss been hunger, it should have been manifested in these control animals for whom there was no conditioning, too.

The results of this experiment generally support the previous findings reported by Senter, Smith, & Lewin (1967) and Senter & Persensky (1967) indicating that making the occurrence of *positive* reinforcement contingent on an alcohol consumption operant can result in a persistent and relatively high level of voluntary EtOH consumption subsequent to the conditioning procedure.

REFERENCES

DEMBER, W. N., EARL, R. W., & PARADISE, N. Response by rats to differential stimulus complexity. *J. comp. physiol. Psychol.*, 1957, 50, 514-518.

MONTGOMERY, K. C. The role of the exploratory drive in learning. *J. comp. physiol. Psychol.*, 1954, 47, 60-64.

MONTGOMERY, K. C., & SEGAL, M. Discrimination learning based on exploratory drive. *J. comp. physiol. Psychol.*, 1955, 4, 25-28.

SENTER, R. J., & PERSENSKY, J. J. Effects of environment on ethanol consumption after conditioning. *Quart. J. Stud. Alc.* in press.

SENTER, R. J., SMITH, F. W., & LEWIN, S. Ethanol ingestion as an operant response. *Psychon. Sci.*, 1967, 8, 291-292.

NOTE

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