Extinction of the consummatory response to a saccharin solution

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An attempt was made to replicate Sheffield & Roby's (1950) findings that saccharin consumption did not extinguish when the saccharin was presented in the absence of a primary reinforcer. The present study reduced the number of prior eating experiences by the Ss to 1/8 and increased the amount of extinction time to 17 times that of Sheffield and Roby's Ss. Safeguards were also taken to insure that there was no food present in the S's stomach in order to meet a criticism leveled at Sheffield and Roby's study by Smith & Capretta (1956). Despite the two modifications to Sheffield and Roby's design, the present study replicated Sheffield and Roby's findings. Saccharin consumption did not extinguish during 4,380 h of extinction time. This suggests that Sheffield and Roby's findings are still perhaps the best single argument against the "secondary reinforcement" explanation of saccharin consumption.

Sheffield & Roby (1950) presented data concerning extinction of consummatory responses to a saccharin solution. They contend that saccharin is not reinforcing only because of "acquired reward value," as proposed by Hull (1943). If saccharin were only a secondary reinforcer, it should lose its reinforcing properties as it is presented in the absence of the primary reinforcer (nutritional properties of food). Sheffield and Roby found no such extinction. On the basis of these results, they concluded that saccharin is not just a secondary reinforcer.

Smith & Capretta (1956) criticized Sheffield and Roby's findings on the grounds that saccharin consumption and the digestive processes may have occurred together during some of the experimental trials. That is, food may have still been in the Ss' stomachs at the time of saccharin ingestion.

Sheffield and Roby could, perhaps, be criticized on another basis as well. The second objection questions the adequacy with which Sheffield and Roby tested for extinction.

Their extinction trials covered a period of only 53 days, during which time, the Ss made "no doubt millions of instrumental tongue movements." The Ss were about six months old at the beginning of the study. If consummatory behavior is to be considered a number of instrumental responses, and if "millions" of such nonreinforced responses occur in 53 days, it is difficult to visualize the number of reinforced instrumental eating responses during the six months prior to the test. If the number of test periods (146) is compared with the number of prior eating cycles (2,190, if it is assumed that the Ss ate about every 2 h as reported by Powelson, 1925, and Richter, 1927), there is still an inadequate ratio of reinforced-to-extinction trials.

The present study was designed to correct these two possible shortcomings of Sheffield and Roby's study.

Subjects

Thirty-eight¹ laboratory rats of mixed phenotype were separated into three groups. One group was used as a control group for the other two. It consisted of 14 males. One experimental group consisted of 11 males and the other was made up of 13 females. All Ss came from four litters. The Ss were 21 days old at the beginning of the experiment and were weaned on the first day of the experiment.

Apparatus

The Ss were tested in their home cage. Water bottles were the only apparatus used. A saccharin solution of 1.3 g/liter was used. This is the same concentration used by Sheffield and Roby and was found to be most preferred by rats (Beebe-Center & Waddell, 1948).

Procedure

The two experimental groups were placed on 22 h food deprivation. They were allowed to eat from 10 AM until 12 noon. During the nontest phase, which lasted from 8 AM to 8 PM, a 16 oz water bottle filled with tap water was available at the side of the cage. This bottle was removed during the test period (8 PM to 8 AM) at which time two 16 oz bottles were available at the front of the cage. One bottle contained 450 cc of tap water, the other contained 450 cc of saccharin solution. The bottles were always placed in the same position. Testing was continued daily for one year. Data were grouped into one week intervals.

The control group was allowed to feed ad lib until the 20th week. During the 20th week their treatment was identical to the treatment of the experimental groups. The control group was also tested during the 51st and 52nd weeks. During all other weeks, the control group was allowed to feed ad lib and never came into contact with saccharin solution.

Results

The consumption of saccharin solution was compared with the consumption of water for each group. The data are expressed in terms of per cent of the total fluid intake that was from the saccharin bottle (i.e., 90% saccharin means 90% of the total fluid consumed was saccharin and the other 10% was water). The preference did not decrease as a function of trials. That is, extinction did not take place. The males consumed 98.13% saccharin during the first week. The preference increased to 98.77% during the 52nd week. The females consumed 98.84% saccharin during the first week and dropped to 98.10% during the 52nd week. A Z test for the difference between two propor-

tions indicated that both differences were nonsignificant (Senders, 1958).

An analysis of the data for control and experimental groups for the 52nd week also shows no significant difference. That is, the control group, with only three weeks' exposure to saccharin, did not differ significantly from the experimental group, which had 52 weeks' exposure. The control group consumed 99.11% saccharin during the 52nd week as compared to 98.77% for the experimental males.

Conclusions

Sheffield & Roby (1950) seem to be justified in their conclusion that saccharin preference does not extinguish in the absence of the "primary reinforcer" (the nutritional properties of food). The present study modified Sheffield and Roby's experimental design in order to meet Smith and Capretta's contention that the "resistance to extinction" may be due to the presence of food in the digestive system at the time of saccharin ingestion. In the present study, the Ss had no food available for 8 h prior to the presentation of saccharin. The food should have been in the stomach for about 2 h after feeding, and then the stomach should have been empty for about 6 h prior to the presentation of the saccharin (Powelson, 1925; and Richter, 1927).

In the present study the ratio of previously rein-

forced trials to extinction trials was modified in order to test extinction more adequately. The number of prior reinforcements was reduced by using Ss that were 21 days old at the beginning of the study rather than using six month old Ss. Extinction trials lasted 12 h a day for one year (4,380 h) rather than 258 h of data as reported by Sheffield and Roby. The present study reduced the number of prior reinforcements to about 1/8 the number of the previous study, while providing about 17 times as much extinction test time.

References

- BEEBE-CENTER, J. G., & WADDELL, D. A general psychological scale of taste. *J. Psychol.*, 1948, 26, 517.
HULL, C. L. *Principles of Behavior*. New York: Appleton-Century, 1943.
POWELSON, M. H. Gastric transplantation. *Science*, 1925, 62, 247.
RICHTER, C. P. Animal behavior and internal drives. *Quart. Rev. Biol.*, 1927, 2, 307.
SENDERS, V. *Measurement and Statistics*. New York: Oxford University Press, 1958, 398.
SHEFFIELD, F. D., & ROBY, T. B. Reward value of a non-nutritive sweet taste. *J. comp. physiol. Psychol.*, 1956, 49, 553.
SMITH, M. P., & CAPRETTA, P. J. Effects of drive level and experience of the reward value of saccharin solutions. *J. comp. physiol. Psychol.*, 1956, 49, 553.

Note

1. The experiment started with 38 Ss, but one S died from each group (♂ 11th week; ♀ 36th week; Control 46th week). So that at the end of the experiment there were 35 Ss.