Transfer of discriminated taste aversion to a leverpressing task*

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Rats were trained to avoid consuming saccharin (but not anise) by following saccharin consumption with apomorphine injections. The Ss later showed lower rates of leverpressing for saccharin than for anise or water. The results indicate that the saccharin taste had acquired generalized motivational properties.

Rats will learn to avoid consuming distinctly flavored foods or liquids when ingestion is followed by gastrointestinal distress or malaise (Garcia & Koelling, 1967). The long time delay possible between the CS and UCS in the taste aversion paradigm has created a great deal of interest in the phenomenon and has caused some concern over whether or not this type of learning follows traditional theories of learning (Rozin, 1969). Typically, the aversion seen following the pairing of a distinct taste with malaise has been ascribed to the acquired motivational properties of the taste stimuli. However, conditioned taste aversions have been limited to situations demanding only consummatory responses, and the generalization of taste aversions from one situation to another has never been tested. Glickman & Schiff (1967) have differentiated between learning as the refinement of basic motor consummatory patterns and learning as the development of an extensive chain of operant behaviors. The latter is more easily obtained in intact mammalian organisms, while the former can be easily demonstrated in more primitive organisms or in mammals with extensive brain lesions. Seligman has argued that the ease of modifying consummatory behavior in the taste-aversion paradigm is due to the fact that rats are evolutionarily prepared to associate tastes with malaise (Seligman, 1970). It might, therefore, be possible that this form of conditioning is limited to the guidance of consummatory acts. However, it does not seem appropriate to consider a cue to have acquired motivational properties unless that stimulus can redirect operant as well as consummatory behavior in a variety of

situations. The present study was performed to determine if a taste, made aversive in a consummatory situation, will acquire motivational properties sufficient to modify operant behavior in another situation.

METHOD

Eight Sprague-Dawley-derived rats of 300-400 g were housed individually in 24 x 17 x 17 cm wire mesh cages with continuous access to Purina food pellets. All animals were placed on a 24-h water-deprivation schedule at the start of the experiment. The only fluids available to the animals during the course of the experiment were those given during the test periods each day. The experiment was conducted in three stages. On the first day of Stage I, the animals were trained in a Skinner box to barpress for a water reward on a continuous schedule of reinforcement. Pressing the bar activated a pump which forced a small amount of water into the cup adjacent to the bar. Each lap of fluid then activated a drinkometer. Both barpresses and licks were recorded automatically. On Days 2-7 of Stage I, or until a stable operant rate of responding had been established, the animals were placed in the operant box for 20 min each day and the number of barpresses and licks, as well as the amount of water consumed, were recorded.

Once a stable rate of barpresses and licks had been established, Stage II of the experiment was begun. On the first day of Stage II, the animals were given access to an anise-flavored solution containing .08% anise extract. The solution was presented to each animal individually in separate drinking cages. The drinking cages resembled the home cages, with the exception that a drinking tube could be attached to the center of the drinking cages. In addition, a 3-in.-diam cup containing food pellets was fixed to the center of the floor at the back of each cage. The drinking tubes were calibrated in milliliters and had a capacity of 100 ml. Following the 20-min access to the anise solution on the initial day of Stage II, the animals were removed

from the drinking cages, given control injections of isotonic saline (15 mg/kg, IP) and returned to their home cages. The amount of fluid consumed was then recorded.

On the second day of Stage II, the animals were again placed in the drinking cages for 20 min. Instead of anise, however, they were presented with a .15% saccharin sodium solution. After the 20-min drinking period, they were again removed, given injections of apomorphine (15 mg/kg, IP), and returned to their home cages where they were observed to become sick within several minutes of the injections. The amount of saccharin ingested by each animal was then recorded. This pattern of daily alternating presentations of the anise and saccharin solutions, coupled with the pairing of apomorphine with the saccharin solution, was continued until an obvious aversion to saccharin had developed. When the amount of saccharin consumed was approximately one-third of the previous day's anise intake, a strong aversion was considered to have developed.

Once the animals had developed aversions to the specified solution, Stage III was undertaken. On the initial day of this stage, the animals were again placed in the Skinner box and reinforced with water for barpressing, as had previously been done during the training period—Stage I. This was done merely to reestablish the baseline response rate. On the following day, half the rats received the saccharin solution as a reward and half received the anise solution. The animals were given 20 min in the operant situation, replaced in their home cages, and the number of barpresses and licks and milliliters consumed were recorded. On the third day of Stage III, the animals who had barpressed for anise the previous day received saccharin as reinforcement, and vice versa. Barpresses, licks, and milliliters consumed were again recorded. On the final day of the experiment, all animals were placed in the operant situation and given water contingent on barpressing. The same measures were again recorded.

RESULTS AND DISCUSSION

The median and range of milliliters consumed and, where appropriate, number of licks and barpresses for key days are shown in Fig. 1. Median duration of Stage I was 9 days (range, 8-13 days) and for Stage II was 7 days (range, 6-9 days). All statistics below were accomplished using the Wilcoxon matched-pairs signed-ranks test, two-tailed. The data for Stage II show that the Ss initially had a slight but insignificant preference for saccharin

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Fig. 1. Median and range of amount of fluid consumed, leverpresses, and licks for H₂O, saccharin, and anise, where appropriate, during last day of Stage I leverpress training, on first and last day of Stage II taste aversion training, and during Stage III leverpress transfer test.

but that conditioning resulted in a significant preference for anise ($T = 0$, $p < .01$). Comparisons of all response measures on the last day of Stage I and

Days 1 and 4 of Stage III indicate that conditioning the saccharin aversion and testing it in the operant situation had no effect on consummatory or

operant behavior for water reinforcement.

To test the generalization of the Stage II conditioned saccharin aversion, the three response measures for saccharin and for anise in Stage III were compared with the appropriate response measures for the first water day of Stage III. All anise measures are slightly but not significantly higher than the water measures, and all saccharin measures are significantly below the water measures (all $T_s = 0$, $p < .01$).

Although Stage II saccharin aversion training significantly affected behavior in the operant situation, the data in Fig. 1 indicate that transfer was not perfect. The median ratio of saccharin to anise consumed on the last days of Stage II training was .309. The median ratio of saccharin to anise responding on the Stage III test was .324 for licks, .416 for milliliters consumed, and .501 for leverpresses. A statistical comparison of these ratios between Stage III and Stage II revealed that the generalization decrement was not significant for licks ($T = 10$, $p > .05$), was not significant for milliliters consumed ($T = 5$, $p > .05$), and was significant ($T = 1$, $p < .02$) for leverpresses.

The data indicate that conditioned taste aversions establish motivational properties in taste stimuli sufficient to modify both consummatory and operant behavior in another situation. Its generalized effect upon an already established operant, however, is less than its influence upon consummatory behavior.

REFERENCES

- GARCIA, J., & KOELLING, R. A. A comparison of aversions induced by X-rays, toxins, and drugs in the rat. *Radiation Research Supplement*, 1967, 7, 439-450.
- GLICKMAN, S. E., & SCHIFF, B. B. A biological theory of reinforcement. *Psychological Review*, 1967, 74, 81-109.
- ROZIN, P. Central or peripheral mediation of learning with long CS-UCS interval. *Journal of Comparative & Physiological Psychology*, 1969, 67, 421-429.
- SELIGMAN, M. E. P. On the generality of the laws of learning. *Psychological Review*, 1970, 77, 406-418.