Proceedings of the Iowa Academy of Science

Volume 65 | Annual Issue Article 58

1958

Three Attempts to Determine the Effects of an Appetitive Secondary Reinforcer on the Extinction of an Avoidance Response

Harold Babb
Coe College

Coral A. Fitterman
Coe College

James H. Paulson
Coe College

Three Attempts to Determine the Effects of an Appetitive Secondary Reinforcer on the Extinction of an Avoidance Response

By HAROLD BABB, CORAL A. FITTERMAN and JAMES H. PAULSON

A study by Pavlov (5, p. 30) indicated that normally painful stimuli applied while hungry dogs were feeding produced less overall avoidance behavior than at times when they were not feeding. In a still earlier study, Jones (3) reported that extinction of avoidance to a feared stimulus was hastened by gradually introducing the stimulus while the child subject was eating. More recently, Farber (1) has presented evidence that feeding in the presence of anxiety-producing cues hastened later extinction to those cues as compared to control animals which did not receive the feeding experience. In Miller's words (4): "Eating and the emotional responses that accompany it are apparently incompatible with fear, and the attaching of these responses to the stimuli that arouse the fear suppresses it."

If reduction of hunger stimulation in the presence of avoidance cues is effective in hastening the extinction of avoidance responses to those cues, then an appetitive secondary reinforcer, if presented contiguously with avoidance cues, might also serve to hasten extinction of avoidance responses to those cues. In other words, since appetitive secondary reinforcers have occurred contiguously with eating responses, it seems reasonable to assume that such cues might become CS's for eating-related responses and might also have a potentiality for inhibiting avoidance behavior if presented with the avoidance cues. The three studies which are described in the present report attempt to test this prediction. In addition, one of the studies includes an attempt to determine the consequences of a secondary reinforcing cue occurring after the avoidance response rather than simultaneously with the avoidance cues.

GENERAL PROCEDURES

The subjects in all three studies were hooded rats from the colony maintained by the Department of Psychology of Coe College. Throughout each experiment they were kept on a 22 hour food deprivation schedule and given 2 hours free feeding on Purina Laboratory Chow in their home cages after the daily experimental session. Water was always available in the home cage.

Avoidance training and extinction procedures were carried out in a sound-proofed room which was lighted only by a dim illumination from the apparatus and a small shielded red light which was used to illuminate the record sheets and a clock. The latter materials, red light, and silent timers and switches were visually shielded from the training compartments.

The avoidance apparatus was modified from a Garrison Company avoidance conditioning cabinet. The interior of the cabinet was separated into two compartments by a sheet of aluminum which contained an opening 4″ wide by 4″ high. The two compartments thus formed were 12″ long by 6″ wide by 8″ high. The front consisted of a removable glass panel. The ceiling was of white plexiglass through which a very dim shaded light filtered to the two compartments. The floor of the apparatus was a grid which could be separately innervated for the two compartments. In the first study, the light stimulus was produced by a small 2 candlepower bulb situated at the ceiling above the door area in each compartment. In the second and third studies, the stimulus light filtered through the white plexiglass ceiling from a 75 watt bulb placed above the ceiling and over the approximate center of each compartment. The sound stimulus was produced by a No. 15 Lungen Buzzer situated 3′ below and 4′ in front of the avoidance apparatus. The shock stimulus was a 1.2 ma. current produced by a Model 228 Stimulator made by C. J. Applegate and Co. Two Model 111 C Hunter Silent Interval Timers were used to control the CS and UCS presentations.

In each study, the basic design of the experimental procedures involved a phase of avoidance training, then secondary reinforcement training, and finally extinction of the avoidance response. Throughout, with the exception of the second phase of studies 2 and 3, the intertrial interval was 50, 60, or 70 seconds. The particular sequence of intervals was determined with the aid of a table of random numbers.

EXPERIMENT I

Subjects and Apparatus

The subjects were 40 male rats between 120 and 140 days of age at the beginning of pretraining.

In this study, the apparatus used for the secondary reinforcement training consisted mainly of 5 modified Wahmann LC-175/A cages. The cages were 7″ wide by 9½″ long by 7½″ high and were covered with removable ½″ mesh hardware cloth. The hardware cloth end of each cage was covered from within by an aluminum-colored piece of plywood which extended from the bottom to 4½″ above the top of each cage. On the plywood, centered 1½″ from the

floor, a small aluminum cup was attached and 1″ above it was a ½″ hole through which 45 mg. pellets of food, obtained from the P. J. Noyes Company, could be dropped into the cups. Each cage was 1′ distant from the next and all were attached firmly to an aluminum-colored plywood base. The pellet-delivery mechanism was so arranged that a pellet could be delivered to all 5 cages simultaneously. The sound stimulus used was produced by the same buzzer as in avoidance training. It was placed 3′ below and 4′ in front of the center cage. Secondary reinforcement training was conducted in a separate soundproof room from that used in avoidance training. The lighting of the cages was indirect and approximately as dim as the between-trials lighting of the avoidance apparatus.

Procedure

The animals were put on a 22 hour food deprivation schedule and handled for a few seconds each day for 35 days prior to the beginning of the first experimental trials. In avoidance training the light stimulus came on and five seconds later was followed by shock. Both shock and light were manually terminated by the experimenter immediately after the animal had passed through the door area into the next compartment. The animals were given 10 trials a day for 20 days.

One animal died during training and 13 were dropped from further training for failing to meet a criterion of 6 conditioned responses on the last day of avoidance training. This left 26 animals who were ranked for total number of conditioned responses. Each successive four animals were randomly distributed, individually, to one or the other of two groups, each two animals comprising a level for later analysis. The last grouping contained 6 animals and consequently the last level of each group consisted of 3 animals.

On the day following avoidance training no trials were given since the animals had been regrouped and food deprivation schedules had been disrupted. On the second day, each animal was put in the secondary reinforcement apparatus for 10 minutes with neither food nor buzzer. Trials in the apparatus were begun the next following day. Five animals were run at a time, 10 trials a day for 15 days. For the experimental groups, on each trial a food pellet dropped into the food cup in each cage approximately one-half second after the beginning of the sound of the buzzer. The buzzer continued for five seconds and was terminated automatically. The control group was treated identically except that no food pellet accompanied the buzzer. After the last day of secondary reinforcement training one day of reconditioning was given with procedures identical to original conditioning. On the next following day the extinction procedure was begun.

Both groups were treated identically in extinction. The buzzer was activated simultaneously with the onset of the stimulus light and both were cut off manually when the subject moved into the next compartment. If the subject had not responded by the end of 5 seconds the stimuli were terminated automatically, no shock occurred, and the trial was recorded as an error. Ten extinction trials a day were given for 14 days.

Results

The number of errors in reconditioning and extinction were analyzed by a treatment by levels analysis of variance. The differences were small and insignificant in both instances. In extinction, the mean and standard deviation for the group which had received buzzer and food originally was 42 and 35.05 respectively. For the group which had received buzzer alone the M was 39.4 and the S.D. was 22.7.

EXPERIMENT II

Subjects and Apparatus

The subjects were 36 female rats between 245 and 270 days of age at the beginning of pretraining.

It was felt that the disparity in overall stimulus conditions between the secondary reinforcement training situation and the avoidance learning situation may have been a factor in the failure of the secondary reinforcement cue to affect extinction in the first study. Consequently, the secondary reinforcement training in the second experiment was done in the avoidance learning apparatus. A small aluminum cup was attached to the side opposite the doorway in each compartment and an aluminum plate was fitted over the doorway during secondary reinforcement training to insure that the animal could not pass from one compartment to the next. In addition, the stimulus light source was changed from the 2 candlepower bulb to a 75 watt bulb in the expectation of facilitating the avoidance training.

Procedure

The animals were put on a 22 hour food deprivation schedule and individually handled for approximately a minute each day for seven days prior to the beginning of the experimental procedure. The first stage of the experiment consisted of 16 days of avoidance training, 8 trials a day. The procedure for this training was identical to that of the first experiment.

After this period, the compartments were separated by an aluminum plate over the doorway and the food cup was attached to the

wall of each compartment. The compartment in which each animal was placed was changed on alternate days. The animals were split into three major groups. For the animals of the first group each trial consisted of being placed in the apparatus with Purina Laboratory Chow in the cup. A buzzer began sounding immediately after the animal was inserted but before the animal began eating the food. At the end of one minute the buzzer stopped and the animal was removed from the apparatus and returned to its individual retaining box outside the experimental soundproof room. Each animal was given 5 such trials each day for 10 days with an intertrial interval of approximately 7 minutes. The second group received food on each trial but no buzzer sounded, while the third group experienced the buzzer on each trial but no food was available. In all other regards, both the second and third groups were treated identically to the first.

After the secondary reinforcement training each of the three major groups were split into two sub-groups for the extinction trials. The first of these sub-groups experienced the sound of the buzzer along with the light avoidance cue. Both came on simultaneously and stayed on until the animal moved to the other compartment or for five seconds if the avoidance response did not occur. The second of the sub-groups experienced the avoidant light cue alone. The light stayed on until the animal responded or until five seconds elapsed if he did not respond. If the animal responded to the avoidant cue the buzzer came on immediately and stayed on for 5 seconds. If he did not respond the buzzer was not heard. All animals received 8 trials a day for 16 days.

Results

An analysis of variance for factorial design revealed an F significant at less than the .05 level for the difference between the two extinction procedures. The difference can be accounted for on a basis of greater stimulus intensity dynamism for the sub-groups receiving the buzzer with the avoidant cue rather than after the avoidant response, though the experiment does not critically test such an hypothesis. Differences between groups as a possible function of secondary reinforcement were again non-significant. The means and standard deviations for extinction are presented in Table 1.

Table 1

Means and Standard Deviations of Correct Responses in Extinction

Second Phase Treatment	Sec. Reinf. Cue with Avoid. Cue		Sec. Reinf. Cue after Avoid Resp.	
	Mean	S.D.	Mean	S.D.
Food	49.17	12.12	42.00	16.44
Food + Buzzer	47.83	10.34	27.17	24.22
Buzzer	46.67	8.62	38.17	12.42

EXPERIMENT III

Subjects and Apparatus

The subjects were 30 female rats 68 to 80 days of age at the start of pretraining. The apparatus was the same as that described for Experiment II.

Procedure

The animals were put on a 22 hour food deprivation schedule 8 days prior to the beginning of the avoidance training and were handled for approximately 1 minute each day.

All animals received avoidance training for 8 days, 8 trials a day. The procedure was identical to that of the two previous experiments with the exception that the avoidance light came on only one-half second before the occurrence of shock. Almost all of the trials, then, were escape trials rather than avoidance trials.

Following the avoidance training, 8 days of secondary reinforcement training were begun. The food cups were attached and the covering for the door area was inserted. The compartment in which the animal was placed was alternated on successive days throughout this phase of training. The animals were separated into three groups of 10 animals each. The first group received food and experienced the buzzer simultaneously, the second group received the food alone, and third group experienced the buzzer but without the presence of food. Separate one minute trials were discontinued in this experiment and all animals received a full 8 minutes of their designated treatment before being released from the compartment. They received only one 8 minute trial a day.

Following the secondary reinforcement training, the food cups and the cover for the door area were removed and extinction trials were begun. The animals received 8 extinction trials per day for a total of 8 days. On the first 2 days, however, extinction was to the light alone. On the following 6 days extinction was to the combination of light plus buzzer.

Results

The present experiment contained more animals per group and increased the relative amount of time devoted to secondary reinforcement training. Still, an analysis of variance indicated our differences were not significant. The means and standard deviations for the two successive procedures are presented in Table 2.

Table 2

Means and Standard Deviations of Correct Responses in Extinction

Second Phase Treatment	Extinction to Light		Extinction to Buzzer and Light	
	Mean	S.D.	Mean	S.D.
Buzzer Alone	8.7	3.8	23.4	8.2
Buzzer + Food	8.2	3.1	24.8	5.8
Food Alone	7.5	2.7	20.6	8.3

DISCUSSION

All three studies fail to support our hypothesis that an appetitive secondary reinforcer would be incompatible with an avoidance response. Nor did the second study provide any evidence that a secondary reinforcer, applied after the avoidance response, might increase the frequency of responding. In the first study, secondary reinforcement training was given in an apparatus considerably different from that in which the animals received their avoidance training. The procedure involved distinctive periodic occurrences of the combination of a sound stimulus and food reinforcement. In the second experiment, the avoidance cue was intensified, apparatus differences in the two training situations were diminished, and the effects of the secondary reinforcement cue applied after the avoidance response was investigated. In the third study there were a larger number of subjects per group, a larger amount of time given to secondary reinforcement training compared to training trials involving shock, a change from avoidance training to escape training and a change from frequent distinctive secondary reinforcement training trials in the direction of fewer but temporally extended trials.

All three studies used training procedures which are consistent with Hull's specifications for producing a secondary reinforcer. Moreover, the first two experiments involved procedures intended to make the secondary reinforcing cue serve as " . . . discriminanda for the reward . . ." (5, p. 181). It is possible, nevertheless, that we were not successful in producing an effective secondary reinforcer in any of the three instances. We made no independent check of the influence of our presumed secondary reinforcer on simple habit acquisition. In fairness, however, it should be pointed out that all studies of the effectiveness of secondary reinforcement are confounded in a similar manner. In such studies the relative success in producing a secondary reinforcer is tested in a later transfer situation. Any estimate of effectiveness in producing a secondary reinforcer is, then, a function of the adequacy of original training procedures and/or also of the 'sensitivity' of the transfer situation to the influence of secondary reinforcement. From this it would seem that the present series of studies have not demonstrated a failure of secondary reinforcement to affect an avoidance response, nor a failure to pro-

duce a secondary reinforcer, as such, but rather a failure to produce either one or the other, or both.

If we consider the secondary reinforcement procedures to have been effective, however, we must conclude that the presence of our secondary reinforcer had no demonstrable effect on the extinction of avoidance responding. With this result, perhaps the reasoning behind our hypothesis should be reinspected. Hull suggested that " . . . a stimulus component which has previously been conditioned to a reaction involving strong autonomic or emotional aspects, e. g., a fear reaction, will presumably acquire in this indirect way a stronger habit loading than would a component not so conditioned." Hull assumed the fear reaction yielded a "powerful stimulus" which combines with the conditioned stimulus in control over the occurrence of the response (2, pp. 208-209). Similarly, if emotional responses accompany eating, as suggested by Miller, they may also provide stimulation which will coordinate with whatever stimulus has been presented directly preceding eating responses. The results of the present experiments, however, lead us to suggest that whatever interoceptive stimulation accompanied eating probably contributed considerably less to the effectiveness of our secondary reinforcer than stimulation from fear reactions contributed to the avoidance cue.

Literature Cited

1. Farber, I. E. Response fixation under anxiety and non-anxiety conditions. *J. exp. Psychol.*, 1948, 38, 111-131.
2. Hull, Clark L. *Principles of Behavior*. New York: D. Appleton-Century Company, 1943.
3. Jones, M. C. The elimination of children's fears. *J. exp. Psychol.*, 1924, 7, 383-390.
4. Miller, N. E. Learnable drives and rewards. In S. S. Stevens (Ed.), *Handbook of Experimental Psychology*. New York: John Wiley and Sons, Inc., 1951, p. 452.
5. Pavlov, I. P. *Conditioned Reflexes*. (Translated by G. V. Anrep.) London: Oxford University Press, 1927.
6. Webb, Wilse B. and Nolan, Carson Y. Cues for discrimination as secondary reinforcing agents: a confirmation. *J. comp physiol. Psychol.*, 1953, 46, 180-181.

DEPARTMENT OF PSYCHOLOGY
COE COLLEGE
CEDAR RAPIDS, IOWA