ONE BAR-PRESS PER DAY: ACQUISITION AND EXTINCTION

M. RAY DENNY

MICHIGAN STATE UNIVERSITY

Ordinarily, when a learned response is no longer followed by reward, the probability of the occurrence of this response is diminished and ultimately the response is extinguished. The present study explores the possibility of preventing the extinction of a bar-pressing response under one-trial-a-day acquisition and one-trial-a-day extinction when the bar is always removed immediately after it has been pressed.

EXPERIMENT I

Subjects

The Ss were 16 naive female hooded rats, 80–90 days old at the beginning of the experiment, from the colony of the Psychology Department of Michigan State University. The animals served as Ss for extended periods, in one case as long as 6 months.

Apparatus

A very simple bar-pressing apparatus was used. The box was a plywood 10-inch cube with a 5-by-7-inch glass window on the side opposite the bar. The top was covered with hardware cloth through which the rat was observed. The cylindrically shaped bar was 6 millimeters in diameter, located midway in one wall 2 inches above the floor. The bar extended 2 1/2 inches into the box and a 10-gram pressure was required to depress it. A metal food tray was located on the floor 1 inch to the right of the bar. Following an excursion of 1/4 inch or more of the bar, as determined by the release of a pendulum on the outside of the box, a pellet of food (approximately 0.05 gram) was dropped manually through a short metal tube into the food tray. The bar could be immediately retracted by a simple manual movement.

Preliminary training

Five days of handling and being on a reduced diet were followed by six days of preliminary training. Once a day during this period each S was placed, two at a time, in a box with the bar removed. The food tray contained 20 pellets and each pair of rats remained in the box until all the pellets were consumed. The pairings differed randomly from day to day. Throughout this period and the remainder of the experiment the Ss were fed 9 grams of food 5–10 minutes after being removed from the box. A variety of experimentation in our laboratory indicates that this interval is sufficiently long to prevent incidental reinforcement of a prior response.

Training

There were two main groups of subjects, the control ($N = 6$) and the experimental ($N = 10$). Two additional animals were discarded, one from each main group, because they failed to press the bar within 5 minutes on five successive days. The experimental Ss were divided into two sub-groups, E – 10 ($N = 5$) and

E - 50 ($N = 5$). E - 10 made one reinforced bar-press per day for 10 days and was then immediately shifted to the extinction schedule. E - 50 made one reinforced bar-press per day for 50 days and then was placed on the extinction schedule.¹

The control group ($N = 6$) received no reinforced bar-pressing trials. Immediately following preliminary training they were given one extinction trial per day for 25 days. All control *Ss* were given 25 trials, irrespective of reaching the 5-minute extinction criterion. It was found to be neither necessary nor feasible to give more than 25 such trials. In every other way the control and experimental groups were treated alike.

At the start of each trial (training or extinction) *S* was introduced to the box through the top and placed directly in the middle of the floor at a right angle to the bar. The bar was always in the box prior to introducing the *S*. It was thus possible to measure the latency of each bar-pressing response by means of a stop watch, without introducing an opportunity for *S* to make *alternative responses* in the box *before* presenting the bar. As soon as *S* pressed the bar, the bar was withdrawn. On training trials each experimental *S* received a pellet of food immediately after pressing the bar. Following the withdrawal of the bar, *S* remained in the box anywhere from 75-150 seconds before being placed in an individual cage. If *S* failed to press the bar within 5 minutes, the bar was withdrawn and *S* removed as above.

Extinction

The extinction trials were in every respect like the training trials except that no food pellet ever followed bar-pressing. All animals of the experimental group were given one non-rewarded trial per day for 75 days or until the extinction criterion of no bar-pressing response within 5 minutes was attained. (All *Ss*, but *one* in the E - 10 group, received the 75 trials.) At the end of this period the nine remaining *Ss* were given a set of massed extinction trials, that is, both the *S* and the bar remained in the box until the 5-minute extinction criterion was attained. The *S* could press the bar *ad libitum*, as in the customary bar-pressing procedure; and the number of responses to extinction was recorded. The day following the massed extinction session each *S* was given a single extinction trial to test for spontaneous recovery from the massed regimen. One *S* from E - 10 was also given 50 additional extinction trials, one per day, followed by another set of massed extinction trials and another test for spontaneous recovery.

RESULTS AND DISCUSSION

The performance measure was a latency score based on the median latency for each *S* for each block of five trials. The mean of this median latency for each group of *Ss* constituted the latency score as plotted in Fig. 1. A median was employed because of the several 5-minute scores in the control group; the mean and median were in close correspondence in the experimental group.

¹Ordinarily, each *S* was run every day of the week at about the same time of day. However, during the extinction series there was a period of 20 days for six *Ss* of the experimental group during which time *E* was hospitalized. During this period, all *Ss* were fed, watered, and cared for but not run in the apparatus. In every case, however, the latency on the first day after this 20-day intermission was the same as or slightly less than the latency of the day prior to the intermission. In no way was the intermission detectable in the performance of the *Ss*.

Figure 1. The first and last blocks of five acquisition trials of the E groups and the extinction curves for all groups.

Five of the six control *Ss* reached the extinction criterion on at least one trial by the 25th day. The other *S* showed no improvement in mean latency from the first block of five trials to the last block of five trials. The data for the control group as a whole are plotted in Fig. 1.

The data for the first block of five acquisition trials and the last block of five acquisition trials for the two experimental groups are plotted in the far-left portion of Fig. 1. The remainder of Fig. 1 presents the course of performance for E - 10 and E - 50 during the so-called extinction trials. E - 50 appears to have reached an asymptotic level of performance by the beginning of the extinction period and continued to perform at this level throughout the extinction trials. The curve for E - 10 is based on the data for four *Ss* rather than five because one animal extinguished on the 13th extinction day. In no other experimental animal was any tendency to extinction ever noted. At the end of acquisition the strength of the bar-pressing response in this anomalous animal, as measured by latency, was very weak. The median latency for the first and second block of five acquisition trials was in both cases 1 minute, which is considerably out of line with the latency of the four other *Ss* of E - 10 on the second block of acquisition trials as can be seen in Fig. 1.²

It is apparent in Fig. 1 that E - 10 had progressively decreasing latencies until it met the level of the E - 50 group. The control group, on the other hand, had very

²In this connection it is relevant to point out that two animals in a preliminary study which were given only 5 reinforcements performed erratically with high latencies and met the extinction criterion.

high and increasing latencies. Thus, it does *not* seem reasonable to assert that the bar-pressing response in the experimental groups failed to extinguish because a rat in the restricted area of the box would depress the lever anyway, or that bar-pressing was reinforced by removal and placement in a familiar cage.

The behavior of each *S* of the E group was remarkably similar and there was little day-to-day variation in the E - 50 group, as was also true of the E - 10 group after approaching asymptotic performance. The one *S* of the E - 10 group which was given 50 more extinction trials showed no tendency to extinguish during this period, having a mean latency of 4.3 seconds on trials 121-125 as compared with a mean of 2.3 seconds on trials 71-75. The slight increase in latency, in view of the general behavior of the animal, might very possibly be attributed to an increase in age.

An analysis of the massed extinction trials shows that the E - 10 group gave a mean of 46 responses to extinction and E - 50 a mean of 77 responses to extinction. If anything, more responses to extinction were obtained here than in a conventional bar-pressing experiment employing a large number of continuous reinforcements. On the day following the massed extinction trials there was complete spontaneous recovery. The mean latency on this day was 0.4 second less than on the 75th day. Complete spontaneous recovery was also present on the second test for the E - 10 subject given 50 additional extinction trials.

Although the present results demonstrate a failure of extinction, they would probably be more meaningful if it were known whether the one-trial-a-day schedule was essential. Perhaps the immediate removal of the bar alone is crucial. To this end Experiment II was performed, using a spaced five-trial-a-day schedule.

EXPERIMENT II

Method

The *Ss*, after discarding nonresponders, consisted of 7 naive hooded female rats approximately 110 days old and 3 male albino rats approximately 200 days old.

The procedure, except as described below, was exactly like the procedure for the E - 10 group in Experiment I. Five trials a day were given both during acquisition and extinction, and at least 5 minutes elapsed between trials. *S* was kept in an individual running cage rather than the home cage between trials. In order to be sure that five trials per day during acquisition were as effective as one trial per day, each *S* was reinforced until the median latency of the last five trials was 9 seconds or less (9 seconds was the mean *Mdn* latency on the last five acquisition trials of the four E - 10 *Ss* which failed to extinguish). The *Ss* received a mean of 13.5 rewarded trials (Range = 11-23) as compared to the 10 trials received by each *S* of E - 10. Extinction began the same day if the acquisition criterion was achieved before five trials were given on any one day. Because of the absence of extinction effects in the four E - 10 *Ss* with which these *Ss* were being compared, the extinction criterion was made somewhat less stringent (3 minutes of no response). A record was kept of each *S*'s behavior during extinction.

Results

The mean *Mdn* latency on the five trials prior to extinction was 7 seconds. It therefore seems reasonable to assume that the response tendency in this group was of the same order as in E - 10 of Experiment I. The extinction results are quite dif-

ferent, however. All 10 *Ss* extinguished. The median number of trials to extinction was 35.5 (Range = 26–59). The two groups began to diverge on the latency measure by the second block of five extinction trials.

DISCUSSION

The results of the two experiments taken together seem to indicate that 1) bar-retraction immediately after discrete bar-pressing does not itself prevent extinction; and 2) one trial a day, or at least highly spaced trials, is essential to the virtual prevention of extinction. Whether bar-retraction would yield different results than other methods or insuring a single response has yet to be determined. The importance of bar-retraction was definitely suggested, however, since *E* observed that approach to the ever present food tray extinguished during the non-rewarded trials even though bar responding did not.

What aspect of the relative massing of trials is important in effecting extinction is also in doubt. One compelling observation by *E* in Experiment II was that on the trial or two just before *S* extinguished, all *Ss* began to make vigorous attempts to escape from the box. An implication here is that frustration effects may accumulate with a 5-minute intertrial interval and become sufficiently strong to instigate competing responses.

Actually, given the conditions of Experiment I, neither the occurrence of learning in *E* – 10 during early extinction trials nor the failure to extinguish is incompatible with theories of Guthrie (1953) or Denny and Adelman (1955).

SUMMARY

In Experiment I two groups of rats, *E* – 10 and *E* – 50, were trained to press a bar one trial a day for 10 and 50 trials, respectively, and were then given 75 extinction trials, one per day. A control group which received no training was given 25 unrewarded trials, one per day. The bar was always removed from the box as soon as *S* had depressed it.

The latency of the bar-pressing response increased markedly for the control animals, but reached a low, stable level in the *E* groups. One *S* in the *E* – 10 group, which was performing with a high latency at the end of training, extinguished. There was no evidence of extinction behavior in the remaining nine *Ss*.

In Experiment II, 10 rats were trained to press a bar five trials a day until each *S*'s performance was at least equal to that of the *E* – 10 group in Experiment I (a mean of 13.5 trials) and were then given extinction trials until a 3-minute no-response criterion was attained. All daily intertrial intervals were at least 5 minutes. All *Ss* extinguished in less than 60 trials under this condition, indicating that something close to one trial a day is crucial in preventing the extinction of a bar-pressing response.

REFERENCES

- Denny, M. R., and Adelman, H. M. Elicitation theory: I. An analysis of two typical learning situations. *Psychol. Rev.*, 1955, **62**, 290–296.
Guthrie, E. R. *Psychology of Learning*. New York: Harper, 1953.

Received April 1, 1959