Postreinforcement delay training effect on runway speed patterning

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Two groups of eight rats each were trained in a straight-alley runway for 100 acquisition trials and 40 extinction trials. Group SAPR-D was trained on a single-alternation partial-reinforcement schedule with a 15-sec postreward delay period following the rewarded trials. Group SAPR-ND received no delay period on rewarded trials. While Group SAPR-ND showed a reliable patterning effect, no patterning was observed in Ss in Group SAPR-D. During extinction the Ss in Group SAPR-D were less resistant to extinction in the goal segment of the runway. The findings were seen as in general agreement with Capaldi's (1966) sequential aftereffects hypothesis.

Contrary to the finding of Fehrer (1956), Cogan (1966) reported decreased resistance to extinction in Ss trained in a runway with a postreward confinement in the goalbox. Recent investigations (Bowen, 1966; McCain & Bowen, 1967) have found evidence of increased resistance to extinction for Ss trained with postreward delays. Bowen (1966) suggested that a simple extension of the sequential aftereffects position of Capaldi (1966) could account for these latter findings adequately.

Although the findings with respect to the effect of postreward confinement on extinction are, to some degree, equivocal, the acquisition effects are more regular. Typically, no effect upon acquisition performance is found using the postreward delay procedure. In an unpublished pilot study, however, Cogan¹ found that the addition of a postreward confinement to the rewarded trials of Ss trained on single alternation partial reinforcement (reward on every other trial in a series) tends to eliminate the response speed patterning typically found in acquisition (Tyler, Wortz, & Bitterman, 1953; Bloom & Capaldi, 1961; Capaldi & Stanley, 1963). If the postreward delay in the goalbox does establish the stimulus aftereffects of nonreward, then the sequential aftereffects position (Capaldi, 1966) would predict the reduction of, or perhaps elimination of, response patterning to single alternation of reward. The present study was designed to test this hypothesis.

SUBJECTS

Sixteen naive 90-day-old male albino rats, purchased from the Holtzman Company of Madison, Wisconsin, were randomly divided into two groups: single alternation partial reinforcement with a

postreward delay (SAPR-D) and without a postreward delay (SAPR-ND).

APPARATUS

The straight-alley runway used in this study was 15.2 cm high and 10.2 cm wide, and was divided into a .41-m startbox, a 1.73-m stem, and a .41-m goalbox. It was painted a flat gray throughout and was covered with clear red Plexiglas. A microswitch on the startbox door and three photocells allowed start, run, and goal time to be measured. Reinforcement in the form of 16% sucrose solution was delivered by a remotely operated retractable lick tube in the end wall of the goalbox. A 15.2 x 22.86 cm metal cage served as the intertrial-interval (ITI) box.

Fig. 1. Mean acquisition start time for control and experimental groups on reinforced (R) and nonreinforced (NR) trials.

PROCEDURE

After a week of ad lib feeding, all Ss were placed on 23-h food deprivation, receiving wet mash for 1 h each day at approximately the time of day they were to be run. On Days 8 and 9 each S received reinforcement pretraining under both food and water deprivation by being placed in the goalbox of the runway with the goalbox door closed, with reinforcement available. Each S was confined for 30 sec or until he had licked for a total of 10 sec. On Day 10 each S was allowed 10 min of runway exploration with the lick tube withdrawn. Acquisition began on Day 11 and continued for 10 days with odd-numbered trials reinforced and even-numbered trials nonreinforced. The Ss in Group SAPR-ND remained in the goalbox for 10 sec on all trials. The Ss in Group SAPR-D received a 15-sec postreward delay interval on the reinforced trials, initiated by the withdrawal of the lick tube after a 10-sec reinforcement period and a 25-sec confinement period on nonreward trials. The ITI was held constant for both groups at 20 sec. The groups were run in counterbalanced order. Extinction proceeded for 4 days, exactly as did acquisition, except for the absence of reinforcement. During extinction SAPR-ND Ss were continued at 10 sec of goalbox confinement and SAPR-D Ss at 25 sec of confinement on all trials.

Daily medians were computed for start,

Fig. 2. Mean acquisition run time for control and experimental groups on reinforced (R) and nonreinforced (NR) trials.

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Fig. 3. Mean acquisition goal time for control and experimental groups on reinforced (R) and nonreinforced (NR) trials.

run, and goal times for each S for odd and even trials during acquisition. In extinction medians for blocks of five trials (two per day) were calculated.

RESULTS

Start, run, and goal times for reinforced and nonreinforced trials across daily trial blocks during acquisition were analyzed using repeated-measures analyses of variance. Reliable trial effects were found for all three runway segments, reflecting the reliable decreases in running times for both groups (.001 level for start and goal times and .05 level for run time). In addition, there was a reliable (.05 level)

distinction between groups on start time, with the SAPR-D Ss starting slower, as well as a reliable (.05 level) Groups by Trials interaction.

Figures 1, 2, and 3 show that the SAPR-ND Ss developed patterning in all three runway segments, beginning on Day 6 for start and goal time and on Day 8 for run time. Combining the medians for the last 3 days revealed reliably slower speeds on nonreward trials than on reward trials for Group SAPR-ND (.003 level for start time and .001 level for run time and goal time, with one-tailed sign tests). Although no appropriate patterning was observed in the SAPR-D Ss on any of the three measures, it was observed that there was a tendency toward reverse patterning in Group SAPR-D on the last few days of acquisition. That is, these Ss tended to run slower on the rewarded trials, as shown in Figs. 1, 2, and 3. Sign tests revealed this tendency to be reliable (.035 level) for run and goal times for the last day, with seven out of eight experimental Ss running slower on the reinforced trials. Although a similar trend was found for start times (see Fig. 1), the difference was not reliable.

The extinction data were also analyzed with repeated-measures analyses of variance for start, run, and goal times over trial blocks. Reliable trials effects were found for all three measures, reflecting extinction of the running response (.05 level for start and .01 level for run and goal times). In addition, Group SAPR-D was reliably (.05 level) less resistant to extinction for the goal measure (see Fig. 4). This same tendency, although not reliable, can be seen for start and run times in Fig. 4.

Fig. 4. Mean extinction, start, run, and goal times for control and experimental groups.

DISCUSSION

The results clearly show that Group SAPR-D, which received postreward delay training, did not learn to pattern after 100 acquisition trials, while the controls began to pattern by the end of 60 trials. Although the confinement times of the two groups differed, Capaldi (1967) has pointed out that longer goalbox confinement times lead to better patterning. Since the SAPR-D Ss, with this advantage, did not pattern, it would seem that the detention of rats in a nonrewarded goalbox for 15 sec following reinforcement does negate the patterning behavior associated with the single-alternation schedule. This finding can be seen as in general agreement with the position stated by Capaldi, Veatch, & Stefaniak (1966), that patterning behavior is controlled by the stimulus consequences of reward and nonreward. According to this position and to the more general theory stated by Capaldi (1966), the results of the present study could be accounted for by the fact that the addition of a postreward delay period to the rewarded trials set up a situation in which the immediate stimulus aftereffects on both rewarded and nonrewarded trials are those of nonreward. Therefore, since the aftereffects of all trials are similar, there is inadequate discriminability between rewarded and nonrewarded trials and patterning fails to develop. This is in basic agreement with the findings of Capaldi & Spivey (1963), that the magnitude of the partial reinforcement effect in extinction decreases when Ss are fed after nonrewarded acquisition trials in an intertrial feeding box similar to the goalbox.

Although other positions have been advanced in regard to the patterning phenomenon, notably the frustration hypothesis of Amiel (1958) and the temporal discrimination position discussed by Wall & Goodrich (1964), these positions do not offer as sufficient a theoretical explanatory system for these results as does the sequential aftereffects hypothesis. Indeed, it would seem that the temporal discrimination hypothesis (Wall & Goodrich, 1964), which suggests that Ss on single-alternation schedules learn to pattern essentially by learning a fixed-interval response schedule, would have to predict patterning in both groups. If, as some evidence indicates (Cogan, 1966), the postreward confinement period is not frustrating, as Amiel (1958) defines the term, then the frustration hypothesis would also predict patterning in both groups.

The observation that at the end of 100 trials of acquisition there appeared to be some reverse patterning in Group SAPR-D

leads to the speculation that patterning might have developed in SAPR-D Ss if more acquisition trials had been run, since faster running on nonrewarded trials in the single-alternation paradigm is usually observed prior to the development of patterning appropriate to the reward contingency. This suggests that the postdelay interval might not completely mask the reinforcement aftereffects.

The fact that Group SAPR-D showed a tendency to be less resistant to extinction than the controls is somewhat confusing, since both the sequential aftereffects hypothesis and the majority of the postreward delay studies would suggest that these animals should be more resistant to extinction. Perhaps extinction behavior is affected more by the longer overall nonrewarded goalbox confinement time of the Ss during extinction than by the postreward delay per se.

REFERENCES

- AMSEL, A. The role of frustrative non-reward in noncontinuous reward situations. *Psychological Bulletin*, 1958, 55, 102-119.
- BLOOM, J. M. & CAPALDI, E. J. The behavior of rats in relations to complex patterns of partial reinforcement. *Journal of Comparative & Physiological Psychology*, 1961, 54, 261-265.
- BOWEN, J. Effect of post-reward confinement on choice behavior. *Psychonomic Science*, 1966, 6, 131.
- CAPALDI, E. J. Partial reinforcement: A hypothesis of sequential effects. *Psychological Review*, 1966, 73, 459-477.
- CAPALDI, E. J. A sequential hypothesis of instrumental learning. In K. W. Spence and J. T. Spence (Eds.), *The psychology of learning and motivation*. New York: Academic Press, 1967. Pp. 67-156.
- CAPALDI, E. J., & SPIVEY, J. E. Effect of goalbox similarity on the aftereffect of non-reinforcement and resistance to extinction. *Journal of Experimental Psychology*, 1963, 66, 461-465.
- CAPALDI, E. J., & STANLEY, L. R. Temporal properties of reinforcement aftereffects. *Journal of Experimental Psychology*, 1963, 65, 169-175.
- CAPALDI, E. J., VEATCH, R. L., & STEFANIAK, D. E. Stimulus control of patterning behavior. *Journal of Comparative & Physiological Psychology*, 1966, 61, 161-164.
- COGAN, D. C. Post-reinforcement delay in extinction: A failure to replicate. *Psychonomic Science*, 1966, 6, 343-344.
- FEHRER, E. Effects of reinforcement and of pre- and post-reinforcement delays on learning and extinction. *Journal of Experimental Psychology*, 1956, 52, 167-176.
- MCCAIN, G., & BOWEN, J. Pre- and post-reinforcement delay with a small number of acquisition trials. *Psychonomic Science*, 1967, 7, 121-122.
- TYLER, D. W., WORTZ, E. C., & BITTERMAN, M. E. The effect of random and alternating partial reinforcement on resistance to extinction in the rat. *American Journal of Psychology*, 1953, 66, 57-65.
- WALL, A. M., & GOODRICH, R. P. Differential responding on reinforcement and nonreinforcement trials occurring in fixed repeating patterns. *Psychonomic Science*, 1964, 1, 193-194.
- NOTE
1. D. C. Cogan, Double runway effects of partial reinforcement. Unpublished manuscript, 1964.

Visual factors in observational learning with rats

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Albino rats learned to leverpress for food reinforcement through observation as quickly as hooded rats. Hooded rats, observing a trained rat through a screen, which reduced visibility, learned just as quickly as hooded rats which observed the trained rat through Plexiglas. Leverpressing was more quickly acquired by hooded rats that were shaped than hooded rats learning through observation. The results suggest that the contribution of visual observation to learning in rats is relatively minor and does not involve a high degree of visual acuity.

Several recent experiments have compared observational procedures with shaping as techniques for training rats to leverpress for positive reinforcement (Corson, 1967; Powell, 1968; Powell, Saunders, & Thompson, 1968; Jacoby & Dawson, 1969). The results of these experiments do not agree. Powell (1968) and Powell et al (1969) found shaping to be the most effective training method with albino rats. Corson and Jacoby and Dawson found no difference, or that observation was superior, depending upon the measure of performance evaluated. These experiments employed hooded rats as Ss.

There appear to be several possible explanations for these differences. Jacoby and Dawson suggest that the skill of the person who is shaping the animal can have a significant influence on the rate of acquisition. A second possibility is the existence of differences in vision between rats with nonpigmented eyes (albino rats) and pigmented eyes (hooded rats). Experiments have already shown that hooded rats are superior to albino rats in both visual acuity (Lashley, 1930) and depth perception (Greenhut, 1954; Davidson & Walk, 1969). A third possibility, although it seems unlikely, is that hooded rats acquire a response more

slowly through shaping than do albino rats.

The purpose of the present experiment was threefold: (1) to compare observational learning of a leverpress response in albino rats and hooded rats, (2) to compare observational learning and shaping of this response in hooded rats, and (3) to assess the contribution of vision to observational learning with hooded rats. Jacoby & Dawson (1969) employed techniques designed to optimize the visual process in their experiment. Most of these techniques were incorporated in the present experiment for the same purpose.

METHOD

The Ss were 11 naive albino rats, Sprague-Dawley derived, and 48 naive hooded rats, Long-Evans strain, or Long-Evans derived. All rats were between 120 and 180 days old at the start of the experiment. The animals were food deprived for 23 h prior to each experimental session and then had free access to food for 1 h after the session. Water was available at all times in the home cages.

The test apparatus was a Ralph Gerbrands operant-conditioning chamber with a single lever. All of the modifications employed by Jacoby & Dawson (1969) were incorporated in the present chamber. These included (1) positioning the lever 3 in. directly above the dipper opening, (2) placement of a clear Plexiglas partition at a diagonal (corner to corner) within the chamber, (3) covering of the outside

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