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Resistance to extinction as a function of partial reinforcement and external stimuli: A within-S design*

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Ninety-six male albino rats were conditioned to leverpress for sucrose. The basic design of within-S groups was a 2 by 2 by 2 factorial, incorporating light-ON or light-OFF extinction conditions; CRF(ON)-PR(OFF) or PR(ON)-CRF(OFF) training schedules; and 1,600 or 3,200 total training trials. In addition, there was a 100% reinforcement condition constituting a 2 by 2 factorial of between-S groups incorporating light ON or light OFF, and 1,600 or 3,200 total training trials. Results showed that for within-S groups there were no differences in resistance to extinction and that for between-S groups there were no differences in resistance to extinction; however, all Ss which experienced PR training were significantly more resistant to extinction than Ss which experienced CRF training only. Results were discussed in terms of the response specificity of the PRE.

The most critical problem with which a general theory of extinction must deal is how to account for the effect of intermittent reinforcement (PR) on resistance to extinction. It is well established that resistance to extinction is significantly increased following PR training as compared to training under conditions of continuous reinforcement (CRF), and this phenomenon is commonly termed the partial reinforcement effect (PRE) (Lewis, 1960).

A number of experiments, using a within-S design, have shown that when organisms are intermittently reinforced for making a response under one particular set of external stimulus conditions and continuously reinforced for making the same response under a different set of external stimulus conditions, the organisms are equally resistant to extinction under either set of external stimuli (e.g., Amsel, Rashotte, & MacKinnon, 1966; Brown & Logan, 1965; Rashotte & Amsel, 1968). For example, in an experiment reported by Amsel (1967), rats were run to PR in a black (or white) alley and to CRF in a white (or black) alley. Results showed that S was equally resistant to extinction whether extinction was in both runways or in only one or the other.

These studies show that after training as described above, Ss show what has been called the generalized partial reinforcement effect (GPRE), which is to say that PR training increases resistance to extinction under either set of external stimulus conditions in spite of the fact that one set of stimuli has been associated with PR and the other set has been associated with CRF. Brown and Logan (1965) suggested the terminology, GPRE, and proposed that its magnitude might be a function of the similarity of the stimuli and responses in the PR and CRF training situations.

A similar hypothesis suggests that the PRE is "response specific" (Young, 1969), which is to say that whatever it is that causes the PRE becomes attached in some way (perhaps through classical conditioning) to the proprioceptive stimuli produced by the instrumental response. This hypothesis, as far as it goes, is similar to, if not identical with, that of Mowrer (1960), and would predict that in the experiments cited above, since the same (running) response was made under both sets of external stimulus conditions, and since the PRE was attached to the response-produced stimuli all groups should show the GPRE—the results obtained.

In order for this hypothesis to be tenable, it would be necessary to show that the results obtained in the experiments cited above have some generality and are not restricted to the one type of response (running) in the one type of apparatus (runway). The present study was therefore designed to determine if the same results would be obtained in a different type of apparatus where a different type of response was required.

METHOD

Subjects

The Ss were 96 maive male albino rats, 150-175 g in weight at the start of the experiment.

Apparatus

The apparatus consisted of two identical Scientific Prototype operant chambers, each enclosed in a sound-insulated, ventilated cubicle. Each operant chamber had a grid floor, and fitted on the end wall was a retractable lever and a liquid dipper which dispensed .01 ml of a 40% sucrose solution, used as reinforcement. All E-controlled events were operated by electronic programming equipment.

Procedure

The Ss were randomly selected from the LSU colony and placed in individual cages on ad lib food and water for 4 days, after which Ss were placed on a food-deprivation schedule of 10 g of Purina Chow every 24 h. Water was available in the cages at all times, and Ss were fed approximately 5 min after each experimental session.

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Table 1
Mean Number of Leverpresses in Extinction

	Group	Total Trials 1600	Total Trials 3200
Within-S	PRL-CRD-L	63.7	59.9
	PRL-CRD-D	67.3	69.0
	PRD-CRL-L	66.4	64.2
	PRD-CRL-D	67.6	65.7
Between-S	CRF-D	43.0	38.0
	CRF-L	47.8	41.7

From the 5th to the 9th day, Ss were handled in pairs for 5 min each day, and on the 10th day began magazine training on a VI 30-sec schedule. Experimental sessions consisted of 20 presentations of the dipper and were continued for 4 days.

On the 14th day, all Ss were conditioned to leverpress and on the following day were allowed to make 100 reinforced responses. On the 16th day, Ss began acquisition, which consisted of 100 leverpresses daily. At the beginning of acquisition, Ss were randomly assigned to training conditions which consisted of four within-S groups (N = 16) and four between-S groups (N = 8). Of the four within-S groups, Group 1 received 1,600 total training trials, half of which were under CRF conditions with the houselight in the operant chamber ON, and the other half under PR conditions with the operant chamber dark (houselight OFF). Group 2 received 1,600 total training trials, half of which were under CRF conditions with the houselight OFF, and other half of which were under PR conditions with the houselight ON. Group 3 was identical to Group 1, and Group 4 was identical to Group 2, except that groups 3 and 4 each received 3,200 total training trials. For these within-S groups, houselighting, with its associated reinforcement schedule, was varied across experimental sessions randomly with the restriction that no more than 3 consecutive days were under identical training conditions. For the PR component of the schedule, a different sequence of a VR 2 schedule was used daily.

All between-S groups experienced only light ON or OFF throughout the experiment, and all acquisition trials were under CRF conditions. Group 1 received 1,600 training trials with the light ON, and Group 2 received 1,600 training trials with the light OFF. Group 3 was identical to Group 1, and Group 4 was identical to Group 2, except that Groups 3 and 4 each received 3,200 total training trials.

A discrete trial procedure was used, and the lever, which required 4 sec to retract and extend fully, was inoperative during retraction.

On the day following completion of acquisition, extinction began. Each within-S group was randomly divided, with half the Ss in each group extinguished with the houselight ON, and the other half extinguished with the light OFF. The group which received PR training in the dark (PRD) and CRF training in the light (CRL) and extinguished in the dark (D) is identified as the PRD-CRL-D group. The other groups are similarly identified. Extinction sessions were 15 min in length and continued for 3 days; and during extinction the dipper was inoperative.

RESULTS AND DISCUSSION

The total number of responses made by each S in extinction was recorded, and the data for within-S groups were subjected to an analysis of variance. The results showed no significant main effects and no significant interaction ($p > .05$).

The data for between-S groups were likewise subjected to an analysis of variance, and this analysis also showed no significant main effects and no significant interaction ($p > .05$).

A priori comparisons showed that Ss which experienced PR training made significantly more responses in extinction than did Ss which experienced only CRF training conditions ($p < .05$).

The mean number of leverpresses for all groups is shown in Table 1.

The important finding in this experiment is that even with an extended training period, the PRE did not become differentially associated with, or attached to, external stimuli. This finding is in agreement with the previously cited findings, and adds support to the hypothesis that the PRE is response-specific—which is to say that the PRE becomes attached to the response-produced stimuli.

Thus, the PRE will generalize from one situation to another only when the same response is required in the two situations.

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