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Punishment and resistance to extinction using a within-subjects design

ROGER L. MELLGREN, NABIL F. HADDAD, and R. K. CONKRIGHT
University of Oklahoma, Norman, Oklahoma 73069

Subjects were given intermittent punishment (IP) in one alley and continuous food reinforcement (CRF) in a discriminately different alley using a within-subject design such that punished-to-reinforced trial transitions occurred to the IP alley (Group^{P}-P) or to the CRF alley (Group S^{P}-C). Group S^{P}-1 was given IP in both alleys, but punished-to-reinforced trials occurred in only one of the alleys. All three groups showed increased resistance to extinction relative to a CRF control group (i.e., an intermittent punishment effect). However, the absence of any within-subject differences in resistance to extinction failed to support the hypothesis that phenomena produced by partial reinforcement are also produced by the IP procedure. The applicability of partial reinforcement theories to intermittent punishment and the boundary conditions of these theories was considered.

Punishment on some trials during 100% food-reinforced trials has been shown to increase resistance to extinction of the response relative to an unpunished control condition (e.g., Brown & Wagner, 1964). The effect of intermittent punishment (IP) has been interpreted in a manner which parallels explanations of partial reinforcement effects (e.g., Amsel, 1972; Capaldi & Levy, 1972; D'Amato, 1969; Dyck, Mellgren, & Nation, 1974). Although the specific mechanisms differ greatly among different theorists, each assumes that there is generalization between the effects of a punished trial and a nonreinforced trial.

Assuming that there is a degree of generalization between punished and nonreinforced trials, it follows that phenomena established using a partial reinforcement schedule should be replicated using an analogous partial punishment schedule. The purpose of the present experiment was to evaluate whether within-subject partial reinforcement effects (Dyck, Mellgren, & Seybert, 1973; Mellgren & Dyck, 1972) would occur using the IP procedure. The general procedure involves giving continuous reinforcement in one alley and partial reinforcement in the other. If the sequence of nonreinforced and reinforced events is controlled such that nonreinforced trials are always followed by reinforced trials in only one of the alleys, then resistance to extinction is increased in that alley. In the present study, punishment was administered in the IP alley and followed by a reinforced (unpunished) trial in either the same (IP) alley or the continuously reinforced (CRF) alley for a second group. Under the assumption that analogous extinction effects will occur in partial reinforcement and IP situations, it was expected that resistance to extinction would be increased in the reinforced alley that followed punishment (P-R alley). Thus the first group would be more resistant in the IP alley than the CRF alley, and the second group would be more resistant in the CRF alley than in the IP alley. Another group was given IP in both alleys, but reinforced trials following punishment occurred in only one of the alleys (see Dyck et al., 1973), leading to the prediction that resistance to extinction would be greater in that alley.

Requests for reprints should be sent to Roger L. Mellgren, Department of Psychology, 455 West Lindsey, University of Oklahoma, Norman, Oklahoma 73069.

METHOD

Subjects

The subjects were 40 naive male albino rats, 60 days old, purchased from the Holtzman Company, Madison, Wisconsin. They were randomly assigned to one of four groups, but deaths reduced the group sizes to ns of 7, 9, 10, and 10.

Apparatus

Two commercially manufactured Plexiglas straight-alley runways (Hunter) with grid floors were used. They were identical except that one had gray cardboard inserts , and the other had black and white striped cardboard inserts on all sides and ends. The runways measured 150 x 15 x 9 cm and were divided into start, run, and goal sections by guillotine doors. A Grayson-Stadler shock scrambler (Model 700) provided .6 mA of shock for .5 sec in the goalboxes of the runways. A teaspoon was mounted in the middle of the far end of each goalbox and served as a foodcup. Times were measured by 3 .01-sec Standard Electric timers and a series of photoelectric cells yielding start, run, and goal times. Fractionated and total times were converted to reciprocals for analysis. Further details of the apparatus may be found in Dyck et al. (1974).

Procedure

After 8 days of free access to food and water, the subjects were placed on a 12-g-daily food-deprivation schedule. Seven days after the start of the deprivation schedule, all subjects received two reinforced pretraining trials per day for 2 days. On reinforced (R) trials, the foodcup was baited with two pellets (1 cm long) of Purina Hog Starter (approximately 200 mg). On punished (p) trials, the animal received .6 mA of shock for .5 sec immediately after entry into the goalbox. Six trials were given on each of the 14 acquisition days with an ITI of 15 sec. Two groups received 50% IP in one alley and 100% reinforcement in the other (Groups S^p-P and S^p-C), and one group received 25% IP in both alleys (Group S^p-1). The fourth group received 100% reinforcement in both alleys (Group CRF). Group S^p-P had all P trials followed by R trials in the IP alley. Group S^p-C had all P trials followed by R trials in the CRF alley. Group S^p-1 received 25% IP training in both alleys, and all P-R transitions occurred to one alley only. This was accomplished by using sequences of gray (G) and striped (S) alleys with punishment (p) superimposed in the following manner: G_pG_pGSSS, $SGGS_pGS$, S_pS_pGGSG, $SGSSG_pG$, and so on. The use of gray and striped alleys was counterbalanced for all groups.

Extinction consisted of five trials per day for 4 days at a 15-sec ITI. All trials were nonreinforced and unpunished; the subjects were confined in the unbaited goalbox for 30 sec on each trial. The second through the fifth trials of every extinction day were run in a counterbalanced double alternation sequence (e.g., GSSGG).

RESULTS AND DISCUSSION

Since differences in start, run, and goal speeds were reflected in the total speed measure, all results reported here pertain to the total speeds. There were no between-groups terminal acquisition differences ($F = .74$ for groups in a one-way ANOVA on the last acquisition day). Analysis of the last 6 days in acquisition for performance in the two alleys revealed that only Group S^p-C performed differentially. Subjects in this group ran faster in the CRF alley than in the IP alley [$t(9) = 5.17, p < .01$].

As shown in Figure 1, an intermittent punishment effect was observed in extinction with all IP groups showing increased resistance to extinction relative to the CRF group. A 4 (groups) by 2 (alleys) by 4 (days) unequal ns ANOVA revealed the main effect of groups to be highly significant, $F(3,32) = 4.88$, $p < .01$. The interaction of Groups by Days was also significant [$F(9,96) = 3.01$, $p < .01$], indicating that Group CRF extinguished at a faster rate than the other three groups. The groups did not show differential performance to the two alleys (the alley in which P-R transitions occurred vs. the other alley), as shown by the nonsignificant main effect of alleys [$F(1,96) = 2.18$, $p > .10$]. The interaction of Alleys by Groups, however, was significant [$F(3,96) = 6.02$, $p < .01$], indicating the superiority of Group S^p-C in the continuously reinforced alley and the lack of any comparable differences in the other groups. This difference is entirely accounted for by a carry-over difference from the acquisition phase. Thus there is no evidence for differential within-group effects as a function of the sequence of punished and nonpunished trials, although the between-groups differences provide support for increased persistence of responding in extinction due to IP in acquisition.

The failure of the sequence of punished and reinforced trials to determine differential resistance to extinction is somewhat surprising, given previous findings indicating the importance of sequential variables in situations where punishment has been used (e.g.,

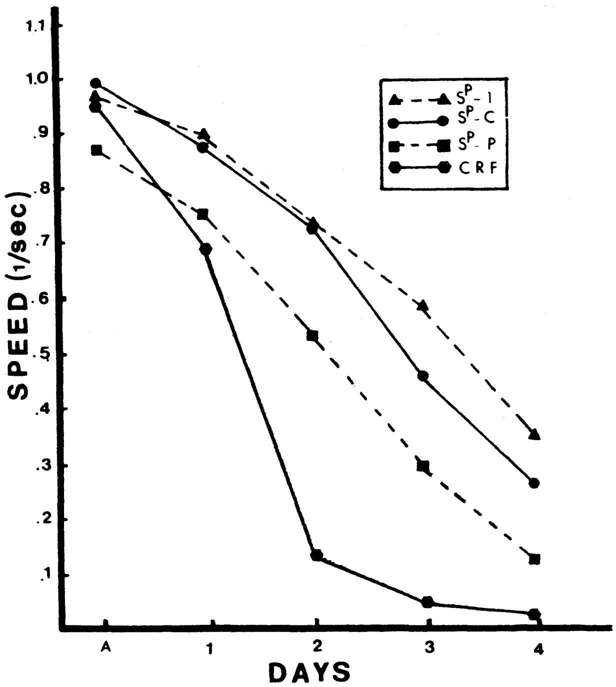

Figure 1. Total speeds for the four groups on the last day of acquisition (A) and the 4 days of extinction.

Capaldi & Levy, 1972; Dyck et al., 1974; Wroten, Campbell, & Cleveland, 1974). A number of reasons exist for the failure of the sequence of trials to determine resistance to extinction, not the least of which is that the within-subject IP procedure involves processes beyond the boundary conditions of the sequential hypothesis. In this regard, it is important to keep in mind that the within-subject effects reported by Mellgren and Dyck, although statistically reliable, are not large in absolute terms. Indeed, Rudy, Homzie, Cox, Graeber, and Carter (1970) have failed to find reliable within-subject differences due to trial sequencing. Similarly, the increased resistance to extinction seen in IP groups relative to a CRF control have not been large (e.g., Brown & Wagner, 1964; Martin & Ross, 1964). Thus, while it is not impossible that reliable within-subjects effects may be obtained by an appropriate manipulation(s) of some variables, the present data suggest that the phenomenon is not a robust one, if it exists at all.

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