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Punishment and resistance to extinction

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Forty-eight naive male albino rats were trained to leverpress for sucrose on a continuous reinforcement schedule. Experimental groups received different intensities of footshock on a VR-2 schedule during acquisition. Extinction results suggested that the function relating intermittent punishment during acquisition to resistance to extinction may be quadratic.

A number of experiments have reported that intermittent punishment of an instrumental response during acquisition produces increased resistance to extinction (Brown & Wagner, 1964; Linden, 1974; Linden & Hallgren, 1973). This effect has usually been interpreted in terms of conditioned frustration theory (Amsel, 1958, 1962) by assuming that pain, produced by punishment, becomes anticipatory in the same way that frustration, produced by nonreinforcement, becomes anticipatory. More recently, however, Haddad and Mellgren (1976) found that various shock intensities had no systematic effect on resistance to extinction. Linden (1974) has suggested that response-contingent punishment must have a suppressive effect in order to produce increased resistance to extinction, but must be sufficiently moderate that recovery from the suppression occurs during acquisition. The idea is, then, that punishment severe enough to prevent recovery will not increase resistance to extinction and may, in fact, decrease resistance to extinction.

Experiments in this area have typically trained rats to run a straight runway and have used shock as the punishing stimulus. Uhl (1967) trained rats to leverpress in an operant chamber with increasing intensity of shock as the punishing stimulus. His results showed increased resistance to extinction as a function of punishment. However, the experimental procedure was actually a fixed-ratio analogue of the straight runway; in addition, extinction responding resulted in the offset of stimuli associated with punishment, making the interpretation of the results difficult.

This experiment was thus designed to assess the effect of different intensities of intermittent punishment during acquisition on resistance to extinction using an operant chamber.

METHOD

Subjects

The subjects were 48 naive male albino rats, 175-200 g in weight at the start of the experiment.

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Apparatus

The apparatus consisted of two identical Lehigh Valley operant chambers, each enclosed in a Lehigh Valley cubicle. Each operant chamber had a grid floor; fitted on the end wall was a single retractable lever and a liquid dipper that dispensed .01 ml of a 40% sucrose solution, used as reinforcement. All experimenter-controlled events were operated by Lehigh Valley electronic programming devices.

Procedure

The subjects were randomly selected from the LSU colony, placed in individual cages, and kept on an ad-lib food and water schedule for 4 days, after which subjects were placed on a food-deprivation schedule of 12 g of Purina Chow every 24 h. Water was available in the cages at all times, and subjects were fed approximately 10 min after each experimental session.

From Day 5-9 subjects were handled in pairs for 5 min daily; on Day 10, subjects began magazine training on a variable-interval (VI) 30-sec schedule. Experimental periods consisted of 20 presentations of the dipper and were continued for 4 days. On Day 14, all subjects were conditioned to leverpress, and on the folloiwng day they were allowed to make 50 reinforced responses. On Day 16 subjects were divided randomly into six groups. Group CR was on continuous reinforcement throughout acquisition and Group PR was on a VR-2 reinforcement schedule throughout acquisition. The other four groups were on continuous reinforcement throughout acquisition but also received footshock through the grid floor on a VR-2 schedule, with Groups CS2, CS3, CS4, and CS5 receiving a shock of .2, .3, .4, and .5 mA, respectively. On punished trials shock duration was 500 msec. All subjects were given 50 leverpresses daily for 10 days. A discrete trial procedure was used and the lever, which required 5 sec to retract and extend fully, was inoperative during retraction.

Extinction started on the day following completion of acquisition. Extinction sessions were 10 min in length and continued for 3 days.

RESULTS AND DISCUSSION

The total number of responses in extinction were recorded, and results showed that more responses were made by Group PR, followed in order by Groups CS3, CS2, CS4, CS5, and CR. These data were subjected to an analysis of variance which showed an F significant beyond the .01 level. Individual tests showed that Group PR made significantly more responses in extinction than did all other groups and that Groups CS2 and CS3, which did not differ from each other, made significantly more responses than all other groups, excepting Group PR. All significant differences were beyond

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Table 1
Mean Number of Leverpresses in Extinction

Group	Responses	Group	Responses
PR	166.0	CS3	105.6
CR	79.2	CS4	85.9
CS2	99.9	CS5	83.4

the .05 level. These data are presented in Table 1.

An analysis of the response latencies on the last 2 days of acquisition showed that Groups CS3, CS4, and CS5, although not significantly different from each other, were significantly slower than all other groups (Mann-Whitney U, $p < .05$).

The fact that Group PR made significantly more responses than Group CR was expected and is the usual partial-reinforcement effect. However, since Group VR was significantly different from all punished groups, and since punishment produced no increase in resistance to extinction in Groups CS4 and CS5, the notion that there is a common dimension underlying frustrative nonreinforcement and punishment (Linden, 1974; Wagner, 1969) would seem to be suspect. It has been suggested (Linden, 1974) that, in order for punishment to produce increased resistance to extinction, the punishment must be severe enough to produce suppression of responding but not so severe that recovery from this suppression fails to occur. In the present study, however, punishment produced response suppression with no recovery in Groups CS3, CS4, and CS5, and produced no suppression in Group CS2; yet only Groups CS2 and CS3 showed increased resistance to extinction.

Although it is tempting to fit any increased resistance to extinction produced by punishment within the framework of conditioned frustration theory, the present results suggest that it would be inappropriate to do so. Discounting Group VR, the other group means suggest that the function relating intermittent punishment during acquisition to resistance to extinction may be quadratic; however, this is not predicted by current theory, and the reasons for such results are unclear.

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