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Reinforcement of responding and not responding: Alternative responses

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After adult humans earned points according to a variable-interval schedule for pressing a key, they could earn points either by pressing or by not pressing that same key for 10 sec. Decrements in response rate depended on the availability of explicit alternative responses. If one or two other keys were available, responding decreased to the target key, even though responses to the other keys had neither a scheduled nor a historical relation to point increments. Thus, the conjoint scheduling of point presentation for responding and not responding attenuated response rate only when explicit other responses were available.

A response can be eliminated if reinforcer presentation depends on the response not occurring (e.g., Topping & Ford, 1974; Uhl, 1973; Zeiler, 1971). Since only response omission produces the reinforcer, consequences for not responding are combined with extinction for response occurrence. A fundamentally different state arises when not responding and responding are both eligible for reinforcement simultaneously. Now the controlling factors would seem to operate in opposing directions, one to maintain the response and the other to eliminate it. Data on this arrangement are restricted to Rachlin and Baum's (1972) finding that the rate of keypecking in pigeons represented a compromise between the two competing factors.

The present study extended previous work with humans (Zeiler, 1970) to the conjoint reinforcement of responding and not responding. Harman (1973) found that the availability of irrelevant explicit alternative responses actually facilitated the loss of the target response by pigeons when the not responding and extinction schedules were combined. The present study explored the role of irrelevant alternatives when the occurrence and nonoccurrence of the target responses were concurrently eligible for reinforcement.

METHOD

Subjects

Four male and four female adults volunteered to participate throughout the entire experiment. None had been involved in other psychological research.

Apparatus

Three telegraph keys protruded from a 32.5 x 58.5 cm rectangular panel. The keys were arrayed along the bottom edge with the middle key in the center of the panel and the others 13 cm to either side. Ten pilot lights separated by 4 cm were 9 cm from the top edge: the five on the left were red, the others were amber. A blue light was mounted 10 cm from each side, 16.5 cm from the top. Two counters were 9.5 cm from each edge, 14.5 cm from the top. Keys were covered by cardboard boxes when access was prevented. Experimental events were controlled and data recorded by electromechanical equipment located in an adjoining visually and acoustically isolated room.

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Procedure

Each subject was seated in front of the response panel. In the first session, only the center key (Key C) was exposed. The subject was told that keypresses would occasionally register points on a counter and that points were worth one cent each, to be redeemed at the end of the experiment. After the subject was told to earn as many points as possible, the experimenter left the room. Illumination of the blue lights indicated that the 15-min session was in effect. There was a maximum of nine sessions per day for each subject.

Three phases involved two conditions each. Presses of Key C always produced increments of the left counter and 1-sec illuminations of the red lights according to a VI 33-sec schedule. In the first condition of Phase 1, only Key C was available, and the VI 33-sec schedule provided all of the points. The second condition differed in that not pressing Key C for 10 sec also produced points ($\overline{R} > 100$-sec schedule, where $\overline{R}$ indicates nonemission of the target response, and the time indicates the period of omission followed by a point increment) that were accumulated on the right counter and were accompanied by 1-sec illumination of the amber lights. Thus, the schedule in Condition 1 was VI 33 sec, and that of Condition 2 was conjoint VI 33 sec $\overline{R} > 10$-sec.

In Phase 2, the center key (Key C) and the left key were both available, but neither responding nor not responding to the left key resulted in points. The schedules correlated with Key C were identical to those of Phase 1, i.e., VI 33 sec in Condition 1 and conjoint VI 33 sec $\overline{R} > 10$ sec in Condition 2. In Phase 3, all three keys were available, but both the left and right keys were correlated with extinction. Once again, the schedule correlated with Key C was VI 33 sec in Condition 1 and conjoint VI 33 sec $\overline{R} > 10$ sec in Condition 2. During Phases 2 and 3, no points could be earned for a Key C press unless at least 3 sec elapsed since the last press of another key (changeover delay of 3 sec; cf. Herrnstein, 1961). In all three phases, Condition 1 lasted for two sessions and Condition 2 lasted for four.

In summary, each phase involved a transition from VI 33 sec to conjoint VI 33 sec $\overline{R} > 10$-sec schedule for Key C responses. The phases differed in whether there were none (Phase 1), one

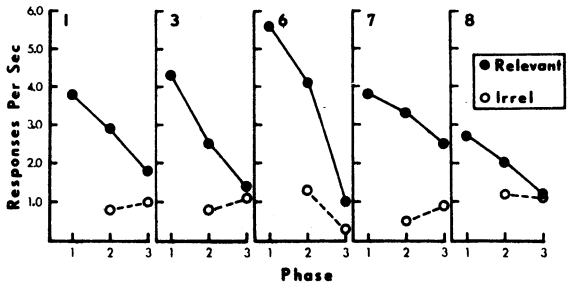

Figure 1. Absolute response rate to the relevant (Key C) and irrelevant keys in the last session of the first condition (only VI 33-sec schedule in effect) of each phase. Each panel is for a different subject.

(Phase 2), or two (Phase 3) irrelevant responses available (relevant only with respect to the changeover delay).

RESULTS

Three subjects responded at between .01 and .10 responses per second in all conditions. These rates sufficed to acquire most of the points made available, but they were too low to permit observing differences among the various conditions. The other five subjects, however, responded at high rates in the first condition of Phase 1. Figure 1 shows the rates in the last session of the first condition (VI 33 sec correlated with Key C). Since rate to Key C declined as the number of irrelevant keys increased, the baseline for evaluating effects of the conjoint schedule changed progressively. To deal with this shifting baseline, Figure 2 shows rate in the last session of the second condition (conjoint VI 33 sec $\overline{R} > 10$ sec) expressed as the proportion of rate emitted in the first condition of the same phase.

With no irrelevant keys (Phase 1), the addition of the $\overline{R} > 10$ sec schedule did not affect relative response rate. With one alternative, irrelevant key (Phase 2), responding to Key C declined for four of the five subjects. With two irrelevant keys (Phase 3), responding decreased to Key C for all five subjects. There was no consistent difference in the effects of one and two irrelevant keys. Although three subjects revealed a larger decline in the conjoint schedule with one irrelevant key, one subject showed no decrement prior to the introduction of the second irrelevant key.

When the VI 33 sec schedule was the only source of points, each subject responded nearly equally to all available keys when the irrelevant responses occurred less frequently and the rate to Key C increased. This trend was reversed during the conjoint schedule. For four subjects, responding to the irrelevant keys increased by as much as sevenfold between the first and second conditions of Phases 2 and 3. Whereas rate to the irrelevant keys was low when only the VI 33 sec schedule prevailed, it increased markedly under the conjoint schedule. Key C controlled the highest response rate during the VI schedule, but rate was less than half that occurring to the irrelevant keys under the conjoint schedule.

The five subjects earned an average of 25.6 points ($\sigma = 1.9$) in Condition 1 of each phase. With the conjoint schedule, the average points earned from the VI component was 26.4 ($\sigma = 2.1$) in Phase 1, 20.8 ($\sigma = 6.9$) in Phase 2, and 20.4 ($\sigma = 7.2$) in Phase 3. No points were earned via the $\overline{R} > 10$ sec schedule in Phase 1, the average was 55.2 ($\sigma = 23.5$) in Phase 2, and 62.5 ($\sigma = 20.4$) in Phase 3. The number of points earned by not responding tended to increase over sessions, but excessive variability precluded firm conclusions about trends.

DISCUSSION

For subjects that pressed the key at a substantial rate when only the variable-interval schedule was in effect, the introduction of irrelevant response keys reduced responding. The results supported Harman's (1973) observation that a specific alternative response facilitates response elimination. The present data were novel in two respects. First, in the previous studies of irrelevant responses in response elimination, the response only became irrelevant during the response elimination phase. Previously, it has been explicitly reinforced. In the present study, the irrelevant responses never had been deliberately correlated with reinforcement, and, in fact, the changeover delay guaranteed that there never could be a close adventitious correlation. Second, in the earlier studies, only the omission of the target response produced the reinforcing stimulus, but now either the occurrence or the omission of the response had such effects. The facilitating effect on response decrement of explicit alternative responses seems to be independent of whether or not the alternatives were ever reinforced or whether the emission of the target response continues to produce the reinforcing event.

This experiment did not establish the reasons for the increment in the rate of the irrelevant responses during the conjoint schedule. The results fit with data (Harman, 1973; Zeiler, 1970) suggesting that this increase stemmed from adventitious correlations between the emission of an irrelevant response and the occurrence of a point increment via the not-responding component of the conjoint schedule applied to Key C.

The results differed from those of Rachlin and Baum (1972) in failing to show a rate-reducing effect of the conjoint VI $\overline{R} > t$ schedule when there were no explicit alternative responses. The difference probably stemmed from the 10-sec t value parameter

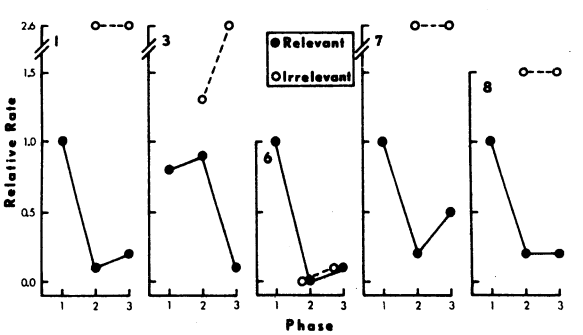

Figure 2. Relative response rate to the relevant and irrelevant keys in the last session of the second condition (conjoint VI 33 sec $\overline{R} > 10$-sec schedule in effect) of each phase. Rates are relative to those shown in Figure 1 for the same phase.

vs. the 2-sec value used by Rachlin and Baum. Given a prevailing high response rate, subjects are more likely to contact the not-responding dependency with smaller t values. With irrelevant responses available, the result was to divert responses away from the target key long enough for subjects to obtain points from the not-responding schedule, and rate then was reduced.

The literature on punishment imposed in the context of ongoing reinforcement (see Azrin & Holz, 1966 for a review) also reveals the critical role of parameter values. If a response continues to be reinforced while it also results in electric shock, ensuing performance stems from the interaction of the schedule of positive reinforcement, the schedule of shock delivery, and the intensity of shock. So, it is not unreasonable to assume that the present data represented the interaction of the specific schedules of reinforcement for response emission and response omission.

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