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THE EFFECT OF REINFORCEMENT MAGNITUDE UPON RESPONDING UNDER FIXED-RATIO SCHEDULES[1]

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Responding under fixed-ratio schedules was studied as a function of two durations of food presentation. Latency of the first response after food presentation (post-reinforcement pause) was consistently shorter when food was presented for the longer duration. Only one of the four pigeons studied showed a consistently higher response rate, exclusive of post-reinforcement pause, as a function of the longer access to food. When ratio size was reduced, pause durations decreased, and the differences related to the two durations of food presentations became progressively smaller.

It has been demonstrated consistently that the latency of the first response after reinforcement (post-reinforcement pause) increases as the size of the fixed-ratio schedule of reinforcement (FR) is increased (Kaplan, 1956; Ferster and Skinner, 1957; Premack, Schaeffer, and Hundt, 1964; Thompson, 1964; Winograd, 1965; Felton and Lyon, 1966; Mintz, Mourer, and Weinberg, 1966; Mintz, Mourer, and Gofseyeff, 1967; Powell, 1968). The mean response rate, exclusive of the post-reinforcement pause, does not show a consistent relationship to the FR response requirement (Felton and Lyon, 1966; Powell, 1968).

The relationship between reinforcement magnitude and responding under FR schedules has been studied by varying the ratio requirement while the duration of each food presentation remained constant. The relationship could be elaborated further by varying duration of food presentation while the FR requirement remained constant. While it has been found in several experiments that response rates were relatively insensitive to changes in reinforcement magnitude (Keesey and Kling, 1961; Catania, 1963; Neuringer, 1967), one study (Powell, 1968) suggests that the post-reinforcement pause may be more sensitive to these changes.

The present experiment compared the effects of different reinforcement magnitudes upon FR responding by varying duration of food presentation. Pause duration and response rate were analyzed separately.

METHOD

Subjects

Four White Carneaux pigeons were maintained within 10 g of 75% of their free-feeding body weights; three (26, 29, 50) were experimentally naive and the fourth (42) had previous training under fixed-ratio and variable-ratio schedules.

Apparatus

A Lehigh Valley pigeon test chamber, model 1519C, was employed. Fixed ratios were scheduled by a Grason-Stadler ratio counter. The elapsed time from the end of the reinforcement period to the first response in the ratio run, *i.e.*, the post-reinforcement pause, was measured. Pause durations were recorded individually as well as over each daily session. Digital counters, a Grason-Stadler print-out counter, and a Gerbrands cumulative recorder were used to record data.

Procedure

The independent variable was the duration of reinforcement, *i.e.*, the time that the pigeon was permitted access to a grain mixture of 60% kafir, 30% vetch, and 10% hemp.

The three naive pigeons were initially trained to key peck in the presence of a white

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key light. When the response was established, ratio size was gradually increased over sessions. Training of the fourth pigeon (P42) was initiated with a ratio requirement of 50. During training, red and white key lights were present during alternate sessions. Responding in the presence of the white key light produced 2.5-sec access to food, and responding in the presence of the red key light produced 4.0-sec access to food throughout the experiment. All sessions were terminated with the first response after the following number of reinforcements had been produced: 21 (P26), 15 (P29), 25 (P42), 21 (P50).

Training was continued and the response requirement was increased until each pigeon showed consistent differences in pause duration under the two durations of food presentation. These differences were observed under FR 70 (P26), FR 40 (P29), FR 60 (P42), and FR 50 (P50). Then, during 20 consecutive daily sessions, the key lights and respective food durations were alternated on successive days. The next 20 sessions were divided into groups of four sessions with each group consisting of the following sessions: (1) one session with 2.5-sec food presentation, (2) one with 4.0-sec food presentation, (3) one with 2.5-sec food presentation for the first half of the ratios and 4.0-sec food presentation for the second half, and (4) the opposite of (3). Intrasession changes were made during the median food presentation of the session. The pause following this reinforcement was excluded from the data.

The next procedure was a gradual reduction in the response requirement to FR 10 or until the differences in pause durations disappeared. Finally, for two of the birds (29, 42) the ratios were increased to the original experimental requirement. All birds were studied for 12 sessions at each of the FR requirements as ratio size was varied. The two reinforcement durations of 2.5 and 4.0 sec and the respective key lights were alternated on successive days.

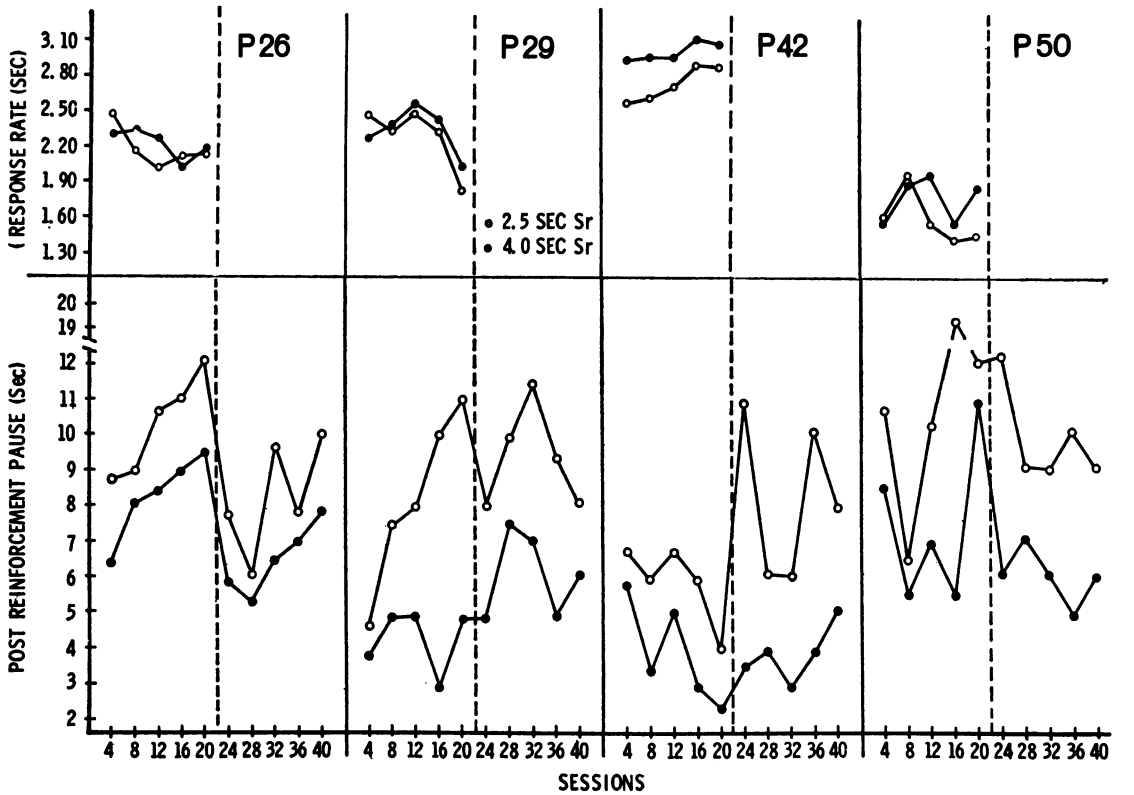

Fig. 1. Mean response rates and duration of post-reinforcement pause under two durations of food presentation. Each point plotted is the mean of four successive sessions. During the first 20 sessions, changes in duration of food presentation were made between sessions. During Sessions 21 to 40, changes were made during individual sessions and between sessions.

RESULTS

The post-reinforcement pause was consistently shorter for all birds when the 4.0-sec reinforcement duration was in effect. The differences in pause duration were approximately the same whether the changes in reinforcement duration were made between sessions or during a session. These data are presented in Fig. 1. Correlated T Tests for each bird showed differences in duration of the post-reinforcement pause as a function of reinforcement duration to be significant beyond the 0.05 level of confidence.

The mean response rates during the first 20 sessions were determined by dividing the total number of responses per session by the total session time less the post-reinforcement pause less the reinforcement time. Of the four pigeons, only P42 consistently had a higher mean response rate under the longer reinforcement duration (Fig. 1). A correlated T Test showed a difference significant beyond the 0.05 level of confidence.

Figure 2 shows the results when FR size was gradually decreased for all animals, and then was returned to its original experimental value for two of the birds (29, 42). As the ratio requirement was reduced, pause durations decreased; and the differences in duration arising from reinforcement duration became progressively smaller. When the FR was increased to the original experimental requirement for Birds 29 and 42, pause durations increased and the differences arising from the two reinforcement durations again appeared.

DISCUSSION

Studies have shown that when magnitude of reinforcement is held constant, the post-reinforcement pause increases as a function of increases in the FR requirement (Felton and Lyon, 1966; Mintz *et al.*, 1967; Powell, 1968). The present experiment showed that duration of the post-reinforcement pause can also be changed as a function of changes in reinforcement magnitude when the FR requirement is held constant. The longer reinforcement time employed here produced consistently shorter pauses in the four animals studied.

The present experiment also showed that the effect of reinforcement magnitude upon post-reinforcement pause duration decreases as the FR requirement decreases. This indi-

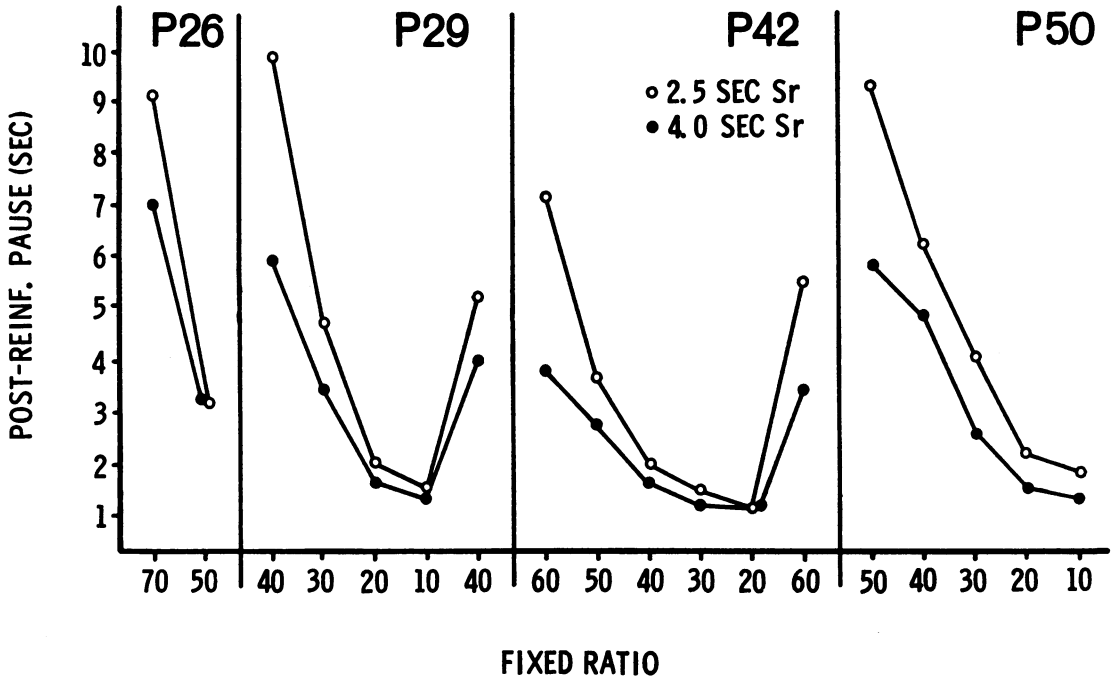

Fig. 2. Mean duration of post-reinforcement pause under two durations of food presentation at various FR response requirements. Changes in procedure followed the order shown from left to right along the abscissa for each subject. Each point plotted is the mean of the final 12 sessions under the respective procedures.

cates that reinforcement magnitude and the FR response requirement interact in their effect upon the post-reinforcement pause. These data suggest that a relatively constant post-reinforcement pause duration might be maintained at various FR requirements if appropriate changes in reinforcement magnitude were made.

Kelleher, Fry, and Cook (1964) employed an adjusting schedule in which the FR response requirement was varied as a function of the length of the post-reinforcement pause. They found that the pause duration could be reliably controlled through this contingency. The present findings suggest that the post-reinforcement pause could be similarly controlled through variations in reinforcement magnitude which were contingent upon pause duration.

Response rate was reliably related to reinforcement magnitude for one of the birds (42), but the other three (26, 29, 50) showed small and inconsistent differences. Both Felton and Lyon (1966) and Powell (1968) reported similar inconsistencies in the relationship between response rate and FR size. The present results provide further evidence of the sensitivity of the post-reinforcement pause to changes in independent variables which have little effect on FR response rate when it is measured independently of the post-reinforcement pause.

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