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SCHEDULE-INDUCED AGGRESSION AS A FUNCTION OF FIXED-RATIO VALUE[1]

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Pigeons responding for food on fixed-ratio reinforcement schedules attacked live target birds when the ratio value was increased, but not when the value was decreased. The frequency of attacks peaked several days after ratio value change, and then gradually decreased to an original level.

Several reinforcement schedules have been found to elicit aggression in a variety of species. Azrin, Hutchinson, and Hake (1966) and Thompson and Bloom (1966) reported that transitions from reinforcement to extinction produced attacks in pigeons and rats. Aggression also has occurred with maintained reinforcement. During exposure to fixed-ratio schedules, which provided food for every nth response, Hutchinson, Azrin, and Hunt (1968) found that squirrel monkeys attacked an inanimate object (bit a rubber tube), and Gentry (1968) found that one pigeon attacked another.

This experiment further investigated attack when a response was maintained under a fixed-ratio schedule. Following shifts from one ratio to another of a higher value, Hutchinson *et al.* (1968) reported increased aggression with squirrel monkeys, whereas Gentry and Schaeffer (1969) did not obtain an increase in aggression with rats. There are no comparable data obtained with other species. The present experiment investigated aggression in pigeons following both increases and decreases in ratio value.

METHOD

The general method for producing and recording aggression in pigeons was the same as that originally described by Azrin *et al.* (1966).

Subjects

Four experimentally-naive male Nun pigeons, approximately 2 yr old, served, two as experimental subjects and two as targets. Experimental birds were maintained at 80% free-feeding weight, while targets were given free access to food. All pigeons were housed in individual cages, with water and grit continuously available.

Apparatus

The apparatus was a Lehigh Valley Electronics Model 1578B Pigeon Test Chamber containing one response key and a food delivery mechanism. A 5 by 4 by 9 in. (12.7 by 10.2 by 22.8 cm) restraining box containing the target bird was attached to an opening in the wall of the test chamber. A force of at least 75 g (0.74N) against the front of the restraining box by the experimental animal during attack of the target bird produced switch closure, which was recorded as an attack response.

The entire apparatus was located within a sound-shielding, ventilated enclosure. All scheduling and recording were performed by electromechanical equipment located in an adjacent room.

Procedure

The experimental and target pigeons were randomly paired, and the experimental subjects hand-shaped to key peck for food on a continuous reinforcement schedule. Reinforcement consisted of a 4-sec access to grain, with each daily session ending after 35 reinforcements. The response requirement was then gradually increased to FR 60 for Pigeon P7, and FR 50 for Pigeon P8. After five days of responding at these values, the target birds were introduced, and the pairs run for an additional nine days before ratio manipulations were begun. Ratio values were first increased

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and then decreased for both birds. The sequences of ratio manipulations was 60, 80, 100, 120, 100, and 80 for Pigeon P7, and 50, 60, 80, 100, 80, and 60 for Pigeon P8. The subjects were maintained at a given ratio until a criterion of three successive sessions with 10 or fewer aggressive responses in each was achieved.

RESULTS

After fixed-ratio responding had stabilized, the introduction of the target birds resulted in aggressive attacks by the experimental subjects. The frequency of these attacks gradually decreased over subsequent sessions, and was occurring at below criterion level in both subjects for three days before the ratio manipulations were begun.

Throughout the sessions, aggressive attacks occurred predominately during the post-reinforcement pause, but also occasionally during early parts of the ratio run. There was no noticeable change in the distribution of aggressive responses within the ratio segment following ratio increases.

The effects of ratio increases and decreases on aggression (attacks/min) are shown in Fig. 1. Increases in ratio were always followed by increases in aggressive responding, followed by a return to baseline levels. This effect was seen with both subjects, although they differed somewhat in relative amounts of aggression shown. For both subjects, peak attack increases never occurred on the first day of the schedule value change, but occurred instead on Days 5 and 6 for Pigeon P7 and Days 2 and 3 for Pigeon P8.

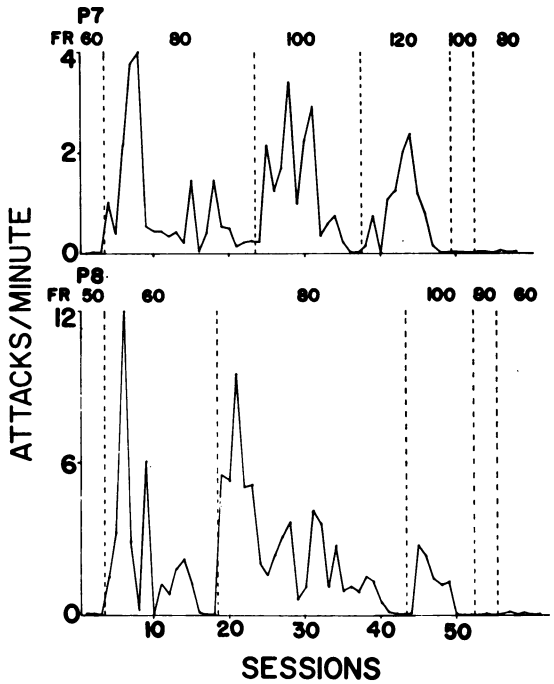

Fig. 1. Effects of fixed-ratio increases and decreases on frequency of attack of target bird. Ratio values are indicated at the top of each graph, with changes occurring at the dashed vertical lines.

Following the initial attack increase at each FR value, attack frequency gradually decreased. Comparison of mean attack rates at each ratio value, however, yielded no consistent trends. Following each increase, aggression returned to criterion level (three sessions of 10 or fewer aggressive responses) in 20, 14, and 12 days for Pigeon P7 at ratios of 80, 100, and 120; and 15, 25, and 9 days for Pigeon P8 at ratios of 60, 80, and 100.

When attack frequency declined after the final ratio value increase, decreases in the ratio produced virtually no change in attack frequency. This was seen for both animals across all decreases in ratio value.

DISCUSSION

In the present study, aggression elicited by fixed-ratio schedules of food reinforcement occurred primarily during the post-reinforcement pause and in early parts of the ratio run. Similar observations have been reported by Gentry (1968) also with pigeons and by Hutchinson *et al.* (1968) with squirrel monkeys. Using rats and water reinforcement, however, Gentry and Schaeffer (1969) found attacks to be equally distributed throughout the interreinforcement interval. The present study also found that successive increases in FR value always elicited aggression; Gentry and Schaeffer did not. These differences in findings may have resulted from differences in types of animals, reinforcers, and procedures used.

Following increases in ratio value, no change was observed in distribution of attack responses during the interreinforcement interval. Hutchinson *et al.* (1968), on the other hand, found increases in ratio to produce shifts in attacks to later in the interreinforcement interval. Since these studies involved different types of animals (pigeons *vs.* squirrel monkeys), aggressive responses (attacking a live target bird *vs.* tube biting), and general

procedures, no reconciliation of their findings can be made. Other findings of the two studies, however, were similar. Both studies found that aggression did not occur immediately after the ratio value increase, but instead occurred several sessions later. Both studies also reported no aggression increase following decreases in ratio value.

In the present study, following each ratio increase, aggression gradually returned to the original low level. Aggression produced by ratio increases thus appears to be a transient effect, unlike aggression elicited by recurring continuous reinforcement-extinction sessions (Azrin *et al.*, 1966).

The fact that increases in response requirement produced increases in frequency of aggressive attack, while decreases did not, and that following a ratio value increase the frequency of attacks gradually decreases to baseline, indicate that fixed-ratio schedule-induced aggression is not due merely to reinforcer presentation and withdrawal (Gentry and Schaeffer, 1969). Instead, the effect appears to result either from a decrease in the rate of reinforcement or an increase in response requirement, and therefore depends on the immediate past history of the organism.

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