OPERANT CONTROL OF PREENING IN PIGEONS

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Preening in four pigeons was observed and recorded during operant level determinations, continuous and variable interval reinforcement, and extinction. The rate at which preening responses occur seems to be controlled by reinforcement in the same way as other operant behavior. Preening during VI reinforcement and extinction appeared to be similar to preening in many natural situations. With respect to the part of the body preened, considerable stereotypy of responding was shown by all birds, particularly during VI training; there was, however, a conspicuous absence of consistency in the development of stereotypy both within and between individual birds, perhaps due to the nature of the response.

Preening of birds is usually analyzed in terms of specific stimuli such as skin irritations and wet feathers which elicit preening responses. Further, a number of ethologists have shown that in certain conflict situations, preening responses may be facilitated (Andrew, 1956; van Iersel and Bol, 1958; Rowell, 1961). The purpose of this paper is to explore a third source of control of preening responses: the effect of operant reinforcement.

METHOD

The experimental apparatus was a cubic cage, 75 cm on a side, with one solid wall in which was located a standard pigeon food magazine. The cage was in a darkened room; the experimenter sat near one side of the cage in full view of S.

Preening was defined as the beak of the bird touching any feather; a second response was scored if the beak was visibly raised out of the feathers and then returned. The experimenter closed a hand switch as soon as S touched its feathers; the pulse thus generated operated the automatic programming and recording equipment. In addition, during the pauses between responses, the experimenter recorded the location of the responses on a separate bank of counters. Responses were recorded into seven categories: breast, back, tail, left wing underside, left wing top, right wing

underside, and right wing top. White pigeons with colored wings were used to facilitate these discriminations. The more extensive classification of preening responses into 14 areas used by van Iersel and Bol (1958) was not used because of technical difficulties.

Subjects

Four pigeons were maintained at approximately 85% of normal body weight. They had previously been reinforced for key pecking in a discrimination-generalization problem.

Procedure

All Ss were given extensive magazine training over a period of several weeks until they showed a prompt response to the magazine stimuli and no longer showed signs of fear in the experimental situation. On the last two days of magazine training, 60 reinforcements were delivered during a 20-min session, and the operant level of preening responses was recorded. Each S was then given 10 daily sessions (CRF, sessions 1-10) in which each preening movement was followed by the opportunity to eat from the food magazine for 3 sec. Each session lasted 20 min or until S had received 60 reinforcements. The next part of the experiment consisted of 12 daily 20-min sessions (VI 2 min, sessions 1-12) and a final 1-hr session (VI 2 min, sessions 13-15) of VI reinforcement. The 1-hr session was included to see whether high rates of responding would continue for longer than 20 min; data were recorded after each 20-min interval. The

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average interval between reinforcements was about 2 min. During VI training it was observed that Ss tended to stand farther from the food magazine than during CRF; in order to make the amount of food eaten per reinforcement approximately the same in both parts of the experiment, the food magazine was presented for 5 sec during VI training. This was followed by six further daily 60-reinforcement sessions of CRF (sessions 11-16), with a 3-sec magazine presentation. Finally, each S had 1 hr of extinction.

RESULTS AND DISCUSSION

Rate of responding. From an operant level of about 0.2 responses per min, the rate of responding during CRF rose to a stable level of 5 to 8 resp per min (eating time included). This rise in rate occurred gradually during the first few sessions; the final level was reached by all Ss by the fifth session. These data demonstrate that operant reinforcement results in a substantial increase in the frequency of responding of preening responses.

Cumulative records of the first three VI sessions are shown in Fig. 1a. It can be seen that a rather constant rate of responding of about 10 to 15 resp per min was achieved immediately in all Ss (they had been reinforced for key pecking on this same schedule in a previous experiment). By the fifth hour of responding (Fig. 1b) the rate had not changed appreciably, although most of the local fluctuations have almost disappeared. The absolute rate of responding is somewhat lower than for key pecking on the same schedule (Ferster and Skinner, 1957).

Fig. 1. Cumulative records of preening responses for four pigeons; a.) first three sessions of VI 2 min (part of the second session for pigeon D is missing because of equipment failure); b.) fifth hour of responding on VI 2 min for pigeon D; c.) extinction.

During the second set of CRF sessions, the rate returned to about the same level as before.

Extinction sessions are shown in Fig. 1c. The rate during the first 20 min of extinction was as high as, or higher than, the highest rate during VI training in all Ss. Two Ss showed a very substantial decrease in response rate by the final 20 min of extinction, although one showed almost no decrease.

In general, it can be seen that with respect to rate of responding, preening is controlled by operant reinforcement in the same way as other operant behavior.

Form of the preening response. Preening that occurred during CRF was very dissimilar to normal preening behavior at rest. Very brief or incomplete preening movements were common, and all four Ss showed much excited movement or "dancing" which frequently included behavior similar to the "cat chasing its tail." This strange behavior continued through all of the first 10 CRF sessions in three of the Ss; only one settled down to a routine of preening and eating with very little other movement. During the second set of CRF sessions, this strange behavior was also shown by all four Ss, though less strongly. It seems likely that many of the brief or incomplete movements were due to the fact that reinforcement did not always occur at precisely the same part of a preening movement on subsequent occasions due to the nature of the procedure and the complexity of the response. Much of the dancing is probably "superstitious" behavior (Skinner, 1948): because of the high frequency of reinforcement during CRF, locomotion away from and toward the food magazine between preening movements is also strengthened. It is significant in this respect that the S that did not "dance" preened without any locomotory activity between reinforcements.

During VI and extinction sessions, the preening responses became much more normal in appearance. Although these preening movements were frequently more intense and of shorter duration than the preening shown at rest, the behavior did not differ in any obvious way from preening that occurs in many social situations in pigeons (e.g., during courtship).

Location of responding. The distribution of responses during certain sessions is shown

for each *S* in Fig. 2. A random distribution of preening responses among categories would show about 14% of the responses in each category. It can be seen that there is some non-randomness or stereotypy throughout most of the experimental period.

It is difficult to generalize about the distributions of responses during operant level sessions because they are based on so few responses; if the operant level distribution for bird C is accepted as typical, however, it can be seen that all *Ss* showed greater stereotypy during continuous reinforcement sessions. An inspection of the response distributions session by session revealed that the development of stereotypy during CRF was very erratic, with some *Ss* showing increases and others no change or decreases in level. The switch to VI reinforcement caused an abrupt widening of response distribution as compared with CRF session 10; but by the end of the fifth hour of responding on VI, all *Ss* showed a greater stereotypy than at any time during original CRF training. The return to CRF produced mixed results, while during extinction all *Ss* showed a wider and/or more equal distribution of responses.

During the course of the experiment, the category with the most responses—the modal category—for a given *S* sometimes changed. This can be seen in the distributions for birds B, C, and D in Fig. 2. When the distributions

are compared session by session, it is found that all *Ss* showed at least one change of modal category; and further, there were in total 10 changes of modal category between two CRF sessions, but only one change between two VI sessions. Considering each conditioning session for all *Ss*, breast was the modal category 53% of the time, right or left wing top 37%, and back 10%. The three remaining categories were never modal categories.

In general, these results tend to confirm the findings of Herrnstein (1961) that stereotypy of responding in a spatial situation is greater during VI reinforcement than during CRF. In contrast to his finding that the increase of stereotypy is apparent during the first 15 min of VI training, however, the increase in stereotypy of preening responses did not appear in most *Ss* until the fourth or fifth hour of responding on this schedule. These results also differ from the findings of Antonitis (1951) in that variability of the location of responding does not decrease consistently as a function of the number of reinforcements delivered during CRF.

It is possible to explain these differences by assuming that a certain proportion of the preening responses observed during this experiment were elicited by specific stimuli, and that when such responses occurred and were reinforced, they tended to occur again as operant responses. Since these elicited responses had only one chance in seven of being in the modal category, their occurrence could explain why the development of stereotypy during continuous reinforcement was so erratic. This assumption could also explain why the modal category of response changed so frequently. Further, since the absolute amount of elicited preening should be relatively constant on the average, the proportion of elicited preening during VI training would be less than during CRF because the rate is higher. This would explain why the modal category changed only once during VI training, and why it was possible for greater stereotypy to develop. Moreover, one would expect stereotypy to develop more slowly here than in a class of responses where elicited members are absent. In any case, it seems clear that the development of behavioral stereotypy depends strongly on the class of responses being studied.

Fig. 2. Distributions of location of preening responses for four pigeons. The number in the upper right hand corner of each block is the total number of responses upon which the distribution for that block is based. Category numbers represent: 1. Left wing under; 2. Left wing top; 3. Breast; 4. Back; 5. Right wing top; 6. Right wing under; 7. Tail.

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