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Another look at "superstitions" in pigeons

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Pigeons were exposed to fixed-time schedules of food delivery. The "superstitious" behaviors observed were stable within subjects but differed markedly across subjects. These results are consistent with Skinner's (1948) study but not with the data reported by Staddon and Simmelhag (1971) or Timberlake and Lucas (1985). However, our study was not an adequate test of Skinner's hypothesis concerning the development of the various behaviors observed. Tests of his view are proposed.

The study of "superstitious" behavior in the pigeon began with B. F. Skinner's classic 1948 study. Skinner exposed 8 pigeons to a fixed-time (FT) 15-sec noncontingent schedule of food. He reported that 6 of the birds developed reliable "superstitious" behaviors, including circling, head swinging, and pecking.

These behaviors, according to Skinner, were operantly conditioned. He proposed that this operant conditioning occurred when the bird was engaged in a behavior that preceded food delivery. The food increased the probability of the behavior's recurring and being accidentally reinforced again. Each reinforcement following the behavior increased the probability of the behavior's recurrence.

Skinner's explanation of "superstitious" behavior dominated operant theory for over two decades. He speculated on the relationship between contiguity and contingency and their role in conditioning. Skinner proposed that a contingent situation may mean only that reinforcement follows the behavior (i.e., contiguity is the important factor in conditioning). He believed that when reinforcement is delivered, conditioning occurs, even when, as in the case of a noncontingent schedule, the behavior has not caused the reinforcement. The organism behaves as if there is a causal relationship when reinforcement closely follows a response.

Skinner's conclusions have been challenged by Staddon and Simmelhag (1971) and Timberlake and Lucas (1985). Staddon and Simmelhag exposed birds to both variable-time (VT) and FT schedules. Food was presented every 12 sec with the FT schedule and, on average, every 8 sec with the VT schedule. With both schedules, the delivery of the food was independent of the subjects' behavior.

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Staddon and Simmelhag (1971) observed a high level of pecking in all of their subjects. They argued that pecking was selected, from all possible responses, because of the reinforcer. The selection of pecking in response to food was believed to be biologically determined. Pecking naturally accompanies food; therefore, when food is anticipated, pecking occurs. The occurrence of pecking is readily explained by the classic stimulus-substitution hypothesis (Pavlov, 1927).

Timberlake and Lucas (1985) exposed pigeons to an FT 15-sec schedule of food. They found that their subjects developed a pattern of activity directed at the hopper wall. However, virtually *no* pecking was observed. They argued that the observed behavior represented species-typical patterns of appetitive behavior related to feeding.

The purpose of the present study was to investigate the discrepancies in the results reported by Skinner (1948), Staddon and Simmelhag (1971), and Timberlake and Lucas (1985).

EXPERIMENT 1

Method

Subjects. Seven 5-year-old male White King pigeons from Palmetto Pigeon Plant (Sumpter, SC) were maintained at approximately 75% of their free-feeding body weights. They were housed in individual home cages under a 16:8 h light:dark cycle. Water and health grit were continuously available. Prior to Experiment 1, the birds had served as subjects in a study conducted as part of an undergraduate course in animal learning and behavior. In that study, the birds were trained to eat from the food hopper and were then exposed to 25 sessions in which 5-sec food deliveries were presented on an FT 20-sec schedule. Food delivery was noncontingent on behavior.

Apparatus. Two 34.9 × 34.3 × 33.4 cm operant pigeon chambers with flat black interiors were located in separate rooms. The response keys were covered with black tape. The food was delivered through a 5.1 × 5.7 cm opening, the lower edge of which was 9.5 cm from the floor. Chamber illumination was provided by a 7-W shielded light centered on the intelligence panel, 2.9 cm from the ceiling. A wide-angle peephole was mounted on the chamber door, and a blower provided ventilation and masking noise. Standard electromechanical control and recording devices were located in an adjacent room.

Procedure. Three pigeons (A-1, A-2, A-3) were assigned to Chamber A, with the remaining pigeons (B-1, B-2, B-3, B-4) assigned to Chamber B. These assignments were the same as in the preceding study. The pigeons were exposed to 30 sessions in which 5-sec food deliveries were presented on an FT 20-sec noncontingent schedule. The sessions terminated immediately after the 30th food delivery. The pigeons

were observed during Sessions 2, 3, 9, 10, 16, 17, 29, and 30. One observer (T.C.J.) viewed the pigeons in Chamber A during Sessions 3, 9, 17, and 30 and the pigeons in Chamber B during Sessions 2, 10, 16, and 29. The sequence was reversed for the second observer (T.A.L.).

After Sessions 2 and 3, the two observers discussed the subjects' responses without reference to specific birds. It was agreed that for subsequent sessions, records of behavior would center on any pecking responses (e.g., the number of intervals with one or more pecks, the direction of the peck, etc.), and that other responses such as wing flaps, turning circles, pacing, and so forth, would also be recorded. These responses were noted during each session, and a summary was prepared; the summary was subsequently not seen by either observer until the study was completed. After the study was terminated, the summaries were shown to a student (S.E.C.) who was unfamiliar with it. The summaries from Session 9 were presented in a column. The summaries for Session 10 were presented in a random order next to the Session 9 summaries. The student was told that each column contained a summary of the behavior of each of 7 pigeons. She was asked to match the summaries, thereby creating seven pairs. She was told that if there was not a clear match, she should pair the summaries that appeared to be most similar. The same procedure was then conducted with the summaries from Sessions 16 and 17, and, finally, from Sessions 29 and 30. After all the summaries had been matched, the number of correct matches was determined by looking at codes that had been placed on the backs of the summary sheets. These codes were not visible while the summaries were matched.

Results and Discussion

The behavior patterns were distinctive enough for the summaries to be matched successfully. In fact, the 21 pairs were all correct matches.

We think that it is important to emphasize two points: First, behavior patterns differed markedly across subjects. Second, as is indicated in Table 1, the majority of the pigeons made virtually no pecks even after exposure to an FT 20-sec schedule for a total of 55 sessions.

The results of Experiment 1 do not support Staddon and Simmelhag's (1971) prediction of pecking by all birds at the end of each interval. Schwartz (1984) has suggested that perhaps Skinner did not report pecking by his pigeons because he disregarded and/or did not focus on pecking. However, in our Experiment 1, the observers focused on pecking, and this response was not seen in most of the birds. Although the pigeons were almost always facing the front wall immediately prior to food delivery, we did not find the consistent wall-directed behavior reported by Timberlake and Lucas (1985).

Table 1
General Descriptions of Observed Activities

Subject	Description
A-1	Flapped wings in almost all intervals. Pecked floor throughout one of 180 intervals. No other pecking was observed.
A-2	Made hundreds of pecks to houselight in each session. Pecked throughout all intervals.
A-3	Turned in a circle in the majority of intervals. No pecking was observed.
B-1	Pecked at or in food hopper throughout all intervals.
B-2	Faced the front wall throughout each session. No pecking was observed.
B-3	Behavior was somewhat erratic. Usually missed at least one food delivery. Pecked at hopper during some intervals.
B-4	Flapped wings in the majority of intervals. Turned in a circle during several intervals. No pecking was observed.

The results are consistent with Skinner's position. However, our Experiment 1 does not represent an adequate test of his operant conditioning theory of "superstitious" behavior, since the pairing of food and responses was neither controlled nor recorded.

EXPERIMENT 2

The purpose of Experiment 2 was to determine whether similar behaviors are seen with FT schedules ranging from 8 to 80 sec.

Method

Subjects. Ten experimentally naive 5-year-old male White King pigeons from Palmetto Pigeon Plant were maintained under the same conditions as were the pigeons in Experiment 1.

Apparatus. The apparatus was the same as that used in Experiment 1.

Procedure. All subjects were trained to eat from the food hopper and then exposed to 30 sessions, in which 5-sec food deliveries were presented on a noncontingent FT schedule. Sessions terminated after the 25th food delivery. Five subjects were assigned to each of the two chambers. The FT schedule was 8 sec for 3 pigeons (A-4, B-5, B-6), 15 sec for 5 pigeons (A-5, A-6, A-7, B-7, B-8), and 80 sec for the remaining 2 pigeons (A-8, B-9). The pigeons were observed during Sessions 6, 7, 13, 14, 21, 22, 27, and 28. The pigeons in Chamber A were observed by T.A.L., while T.C.J. observed the pigeons in Chamber B.

Results and Discussion

The results were similar to those of Experiment 1. Two of the pigeons exposed to the FT 15-sec schedule pecked during the majority of intervals in the last two observed sessions. The other pigeons made very few, if any, pecks after 4 weeks of exposure to the noncontingent schedules. As in Experiment 1, the results failed to support Staddon and Simmelhag (1971) or Timberlake and Lucas (1985). Once again, our data were consistent with, though not an adequate test of, Skinner's position.

GENERAL DISCUSSION

Staddon and Simmelhag's (1971) results are widely cited in journal articles and leading texts on animal learning and behavior (e.g., Domjan & Burkhard, 1986; Schwartz, 1984; Staddon & Ettinger, 1989). The present study seriously calls into question the generality of their data. Similarly, our results differed from the consistent wall-directed behaviors reported by Timberlake and Lucas (1985).

As noted previously, our study is not an adequate test of Skinner's view of operant conditioning. One strategy for studying Skinner's position is suggested by Neuringer's (1970) study. In his experiment, one group of pigeons was reinforced with food the first three times a response key was pecked. Then the birds were placed on a noncontingent VT schedule of reinforcement. The pigeons continued to peck the response key at a substantially higher rate than both an extinction control group that did not receive reinforcement after the initial three food presentations and a response-independent control group, which was not initially reinforced for pecking but was placed directly on a VT schedule of noncontingent food. Neuringer concluded that his experiment supported Skinner's position. While we think that the results of his study are clearly consistent with Skinner's theory, we do not think the study represents a strong test of his view, because Staddon and Simmelhag's (1971) position would predict similar results. However, Neuringer's (1970) strategy can be used with several arbitrarily chosen non-food-related behaviors that differ across subjects. Timberlake and Lucas (1985, Ex-

periment 2) reinforced pigeons for either pecking the magazine wall or turning in a circle. The birds were exposed to an FT 15-sec schedule after receiving training on a response-dependent fixed-interval 15-sec schedule. The investigators found that the trained behavior (pecking or turning) declined rapidly, while wall-directed behavior emerged. Given the conflicting results found by Neuringer (1970), the general strategy employed in these experiments clearly warrants further study (see Eldridge, Pear, Torgrud, & Evers, 1988).

Another strategy would be to expose different groups of subjects to different reinforcers (e.g., electrical stimulation of the brain, onset of a heat lamp in a cold chamber) delivered on noncontingent schedules. Skinner's position suggests that various behavior patterns would develop across subjects, whereas responding should be reinforcer-specific according to Staddon and Simmelhag (1971) and Timberlake and Lucas (1985). We believe that it is important to indicate which behaviors are specific to a given reinforcer *prior* to conducting the study. Timberlake and Lucas (1985) argued that the behavior they observed represented species-typical patterns of appetitive behavior related to feeding. However, they noted that "it is not yet clear how wall-directed behavior fits into the pigeon's natural repertoire of obtaining food" (p. 293).

Of course, the two proposed strategies could be combined (i.e., Neuringer's procedures could be employed with a variety of reinforcers).

Obviously, the processes posited by Skinner, Staddon, and Simmelhag (1971) and Timberlake and Lucas (1985) might all influence responding. Indeed, it is well known that reinforcers have multiple effects. The behaviors observed may be influenced in an important way by the theoretical view held by the observer. As noted by Sagan (1987) and others, "believing is seeing."

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