

# Acquisition and retention of two operant responses in redwinged blackbirds

DENNIS BUCHHOLZ  
*Grinnell College, Grinnell, Iowa 50112*

and

DAVID HOTHERSALL  
*Ohio State University, Columbus, Ohio 43212*

In redwinged blackbirds, perch-hopping and keypecking are two responses which differ greatly in their relation to the birds' natural behavior, in their topographies, and in their operant levels. Using a series of ratio schedules, we trained two redwings first to keypeck for food and then to perch-hop. Two other birds were trained first to perch-hop and then to keypeck. Extinction and CRF reacquisition tests followed a 36-day interim rest period. Perch-hopping had a much higher operant level and was easier to shape as an operant response than keypecking, but both responses were acquired as operants and came under the control of the ratio schedules. In the extinction test all the birds made more perch-hops than keypecks; during reacquisition three birds preferred to perch-hop. In a second experiment we changed the interim housing conditions to prevent any possible reinforcement of the association between either keypecking or perch-hopping and food, and thus to eliminate one possible explanation of the results of Experiment I. The results were similar to those of the first experiment.

In instrumental conditioning experiments, the effects of reinforcement may depend upon the behaviors selected as instrumental responses. Thorndike (1898) conditioned hungry cats to escape from puzzle boxes to obtain food. While his procedures and results are well known, it is less widely recognized that Thorndike used at least eight different puzzle boxes in his experiments. His descriptions of them (Thorndike, 1911, pp. 31-34), together with photographs of the actual boxes he used (Burnham, 1972), show that they required such different responses as biting or pulling a wire loop, clawing a button, pulling a string, a combination of these responses, or licking and scratching. Thorndike found that the cats quickly learned to escape from boxes which required simple, definite responses (Thorndike, 1911, p. 46), but others were learned much more slowly. The cats had particular difficulty in the situation which required that they lick or scratch their own bodies to escape. While every cat eventually learned to make these responses, they were acquired with great difficulty and soon degenerated into vestiges of the original actions. Clearly, the nature of the instrumental response was an important determinant of the course of conditioning.

In the two experiments reported in this paper, we compared acquisition and retention of two topographically different responses, perch-hopping and keypecking, in feral, redwinged blackbirds. We had previously been successful in conditioning perch-hopping as an

operant response and had related our success to the roosting and perching which is characteristic of redwings in their natural environments (Bastian & Hothersall, 1970). Two different and conflicting predictions could be made with respect to keypecking as an operant response in redwings. Since keypecking has a very low operant level in these birds—redwings in laboratory cages will frequently perch-hop, but will seldom, if ever, keypeck—it might be predicted that keypecking would only be conditioned with some difficulty, and certainly much more slowly than perch-hopping. On the other hand, observations of the behavior of redwings in their natural environments show that in searching for food they continually peck at ears of corn, leaves, insects, etc. (Giltz & Stockdale, 1960). Consequently, the prediction in this case would be that keypecking would be easily conditioned and readily retained as an operant response in redwings. The two experiments reported in this paper were conducted to assess the validity of these two predictions.

## EXPERIMENT I

### Method

**Subjects.** Four feral, male redwinged blackbirds (*Agelaius phoeniceus*) served as subjects in this experiment. The birds were trapped in Columbus, Ohio and were estimated to be at least 1 year old at the time of capture.

Throughout the experiment, the birds were housed in a large sound-shielded room. They were maintained on a mixture of Purina pigeon chow and wild birdseed. Water was available at all times.

**Apparatus.** The operant conditioning chambers were similar to those described in detail by Bastian and Hothersall (1970).

Reprints may be obtained from David Hothersall, Laboratory of Comparative and Physiological Psychology, The Ohio State University Research Center, 1314 Kinnear Road, Columbus, Ohio 43212.

They were made of 1.3-cm hardware cloth, overlaid on a .64-cm plywood frame 92 x 64 x 64 cm in size. Each chamber contained a movable response perch 40 cm long, mounted 30 cm above the floor at one end of the chamber. A fixed perch was mounted 5.1 cm above the response perch and at a right angle to it. Two additional fixed perches were placed in the center of the chamber, parallel to the movable response perch and 38 cm above the chamber floor. A food tray was centrally mounted on one of the chamber's side walls. It was fitted with a retractable opaque lid. A small (10.2-cm) movable perch was mounted in front of the food tray, so that the time the bird spent feeding could be recorded.

A standard lever microswitch was mounted on one wall directly above the lid of the food tray. The microswitch lever extended out at an angle over the top of the food tray. Attached to one end of the lever was a piece of plastic, 2.1 x 1.9 x 1.0 cm, which served as the response key. The movable perch and the key, the two operanda, were in the conditioning chamber throughout the experiment.

When not being trained or tested, the birds lived in large, group holding cages made of hardware cloth and containing two fixed perches, a circular food dish, and a large water bottle. The dimensions of the holding cages were the same as those of the conditioning chambers.

**Procedure.** Each bird was placed in a conditioning chamber and allowed 4 days of adaptation with free access to the food in the tray. Training began on the 5th day. Half of the birds were trained to hop on the movable perch to gain access to the food. When the bird hopped on the perch, the food tray lid retracted for 5 sec, and then closed, unless the bird flew down to the perch in front of the food tray. If the bird flew down to the

food tray perch, the lid remained retracted for 5 sec. The remaining birds were trained to keypeck for food. Since the response key was mounted directly over the food tray, the additional contingency used with the perch-hopping birds was not needed.

Both birds quickly learned to perch-hop for food without any shaping of the response. For the birds reinforced for keypecking, it was necessary to give a number of additional adaptation days followed by hand shaping of keypecking using the method of successive approximations. After initial acquisition, both responses were reinforced for 2 days on continuous reinforcement (CRF), followed by 2 days of training on each of the following fixed-ratio requirements: FR2, FR5, FR10, FR20, and FR30. After the last day of ratio training, the contingencies were changed so that the birds previously reinforced for keypecking had to perch-hop, while birds previously reinforced for perch-hopping had to keypeck. The birds required to perch-hop quickly learned to emit this response, while keypecking again required some shaping. Each bird was then given 4 days of CRF and 2 days of training on each of the ratio schedules FR2, FR5, FR10, FR20, and FR30, with the second response being reinforced.

At the end of each day's session, the number of responses on the reinforced operandum, the number of reinforcements, the number of responses on the nonreinforced operandum, and the amount of time spent feeding were all recorded. Daily sessions were 5 h long.

After completing the second series of ratio schedules, the birds were removed from the conditioning chambers and transferred to a large group cage. They were housed there for 36 days before being returned to the conditioning chambers. During the interim period, ad-lib food and water were both available. The transfer back to the conditioning chamber was carried out at the end of the day, and the bird was left in darkness for 19 h before the beginning of the first test session. This procedure minimized emotional disturbance at the beginning of the test session and also insured a high level of motivation.

During the first test session, both responses were nonreinforced, i.e., extinction schedules were in effect for both perch-hopping and keypecking. The latency of the session's first response of each type was recorded, as were the total numbers of perch-hops and keypecks. At the end of this extinction session, the birds were given free access to food for 30 min. On the following 3 test days, we gave preference tests in which both perch-hopping and keypecking were reinforced on CRF and the birds were free to emit both responses.

Following the last of these test sessions, the birds were given a number of days of ad-lib food and water and were then released.

**Results**

Figure 1 shows the results for the two birds trained first to perch-hop for food and then to keypeck; Figure 2 presents the results for the two birds trained first to keypeck for food and then to perch-hop.

During the last day of adaptation, all four birds made more perch-hops than keypecks. These two responses clearly differ in their operant levels. Perch-hopping was rapidly acquired as an operant response, while keypecking required shaping, both as a first response and also following extensive experience perch-hopping for food. However, the time required to shape keypecking as a second response was much shorter than it had been as a first response. This was probably due to the bird's familiarity with the conditioning situation and particularly with the food delivery mechanism. Despite these differences in adaptation and initial acquisition, both perch-hopping and keypecking were successfully

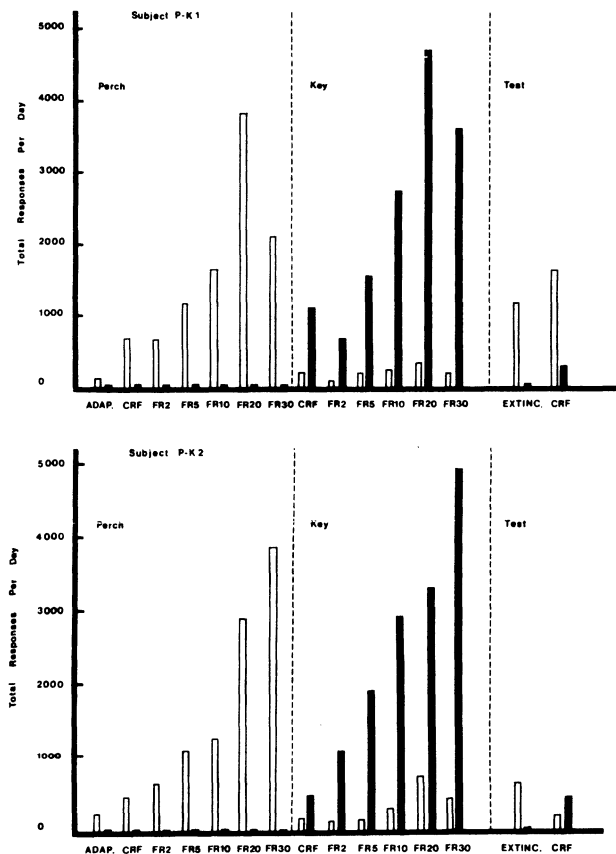


Figure 1. Total numbers of responses per day for two birds trained first to perch-hop (white bars) and then to keypeck (black bars) during the three phases of Experiment I.

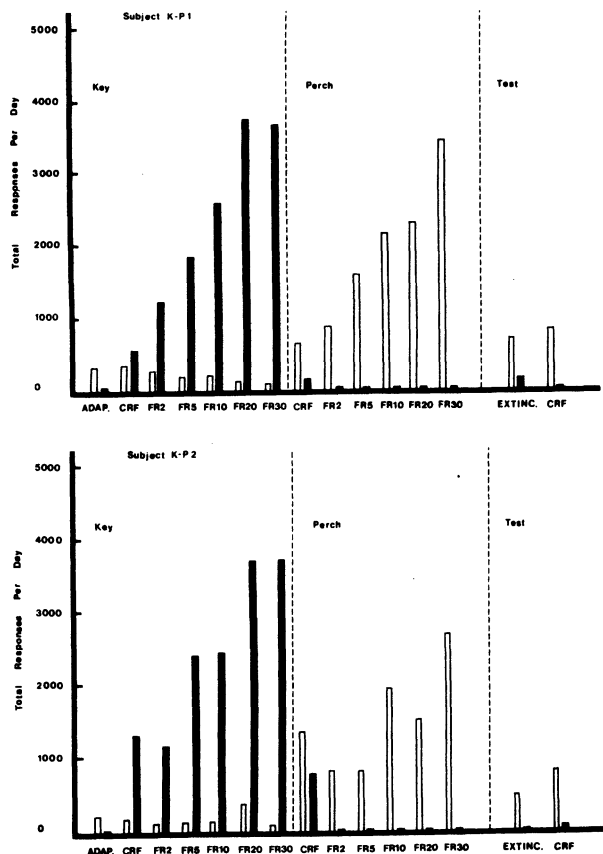


Figure 2. Total numbers of responses per day for two birds trained first to keypeck (black bars) and then to perch-hop (white bars) during the three phases of Experiment I.

conditioned as operant responses. All of the birds adjusted well to the ratio schedules and learned to emit increasing numbers of both responses as the ratio requirements increased. In all cases the number of nonreinforced responses remained at a low level, although the birds reinforced for keypecking tended to make more nonreinforced perch-hops, as compared to the number of nonreinforced keypecks emitted by the birds reinforced for perch-hopping.

The birds all showed a rapid and successful adjustment to the changed reinforcement contingencies during the second phase of the experiment. The numbers of reinforced "second" responses increased systematically, while the number of nonreinforced "first" responses decreased. Similar results were found for both orders of response training. The two birds reinforced for perch-hopping as a "first" response made more perch-hops while being reinforced for keypecking, as compared to the number of keypecks made during the second phase by the birds previously reinforced for emitting that response. The results from the second phase clearly show that the reinforcement contingencies were effective in controlling responding in these birds.

The latencies of the first perch-hop and keypeck at the beginning of the extinction session following the 36-day interim period are shown in Table 1.

Table 1  
Experiment I: Extinction Response Latencies

Subjects	Keypeck (min)	Perch-Hop (min)
K-P-1	59.5	.7
K-P-2	45.8	1.6
P-K-1	23.6	.3
P-K-2	40.7	.7

Note—The number of keypecks is shown in the numerator of each entry and the number of perch-hops in the denominator.

Response latencies of the first extinction perch-hop were clearly much shorter than those of the first extinction keypeck. The total numbers of responses of both types made during the extinction sessions are shown in Figure 1. In extinction all four birds perch-hopped more than they keypecked. This result obtained whether or not perch-hopping was the most recent response they had learned. During the final CRF phase, the two birds first trained to keypeck made many more perch-hops, as did one of the birds (P-K-1) first trained to perch-hop. The response pattern of these three birds during the CRF retest phase was particularly striking: They would hop on the perch, causing the food tray lid to retract, fly down to the food tray, and feed for 5 sec. At the end of the reinforcement period, the bird was directly in front of the key mounted over the food tray lid. Despite their physical proximity to the key and the fact that keypecks were also reinforced on CRF, the birds would usually fly away from the key back up to the perch and would repeat the response chain beginning with a perch-hop. The second bird trained in the perch-key order (P-K-2) emitted more keypecks during the CRF retest phase, thus showing a recency effect.

Discussion

Perch-hopping and keypecking are two responses which differ in their relation to the natural behavior of redwing blackbirds, and in their topographies and operant levels. Keypecking required extensive shaping as an operant response, while perch-hopping did not require any preliminary training. While they differed in their initial availability, both responses were readily conditioned as operants, and they both came under the control of a succession of ratio schedules. The perch-hopping results replicate those of Bastian and Hothersall (1970). In addition, the results of the present experiment show that a second response, keypecking, can be successfully conditioned as an operant in redwinged blackbirds.

Prior to this experiment, two different predictions were made with respect to the rate of acquisition of perch-hopping and keypecking as operant responses. Based upon the differences in operant level of these two responses, it was predicted that perch-hopping, the response with the high operant level, would be acquired quickly as an operant response, while keypecking, the response with the low operant level, would be acquired much more slowly. On the other hand, consideration of the natural behavior of redwing blackbirds led to the prediction that the association between keypecking and food might be more rapidly acquired. The results of this experiment show that both predictions were incorrect, since we did not find any differences in the rate of acquisition of perch-hopping and keypecking as operant responses. All four birds learned to emit increasing numbers of either response. They were also able to learn the responses sequentially, i.e., a bird having previously been reinforced for keypecking was able to learn to perch-hop and vice versa.

However, some evidence for the importance of biological constraints on the performance of redwings was found in the results of the extinction and CRF retest phases, which followed an interim rest period. On an extinction test all the birds made more perch-hops than keypecks, whether or not perch-hopping was the more "recently" reinforced response. During the CRF retest both responses were reinforced. Under these conditions, three of the birds made many more perch-hops than keypecks. The remaining bird made more keypecks. For that subject keypecking was the more recently reinforced response, so it appears that in his case some type of recency effect was operating.

Although both responses were successfully conditioned as operants, thus showing the power of operant conditioning procedures in modifying the behavior of these birds, the redwings showed a preference for perch-hopping over keypecking during adaptation, extinction, and (with one exception) during the CRF retest phase. One possible explanation of the latter two results relates to the experience of the birds during the interim period. They were housed together in a large holding cage containing food, water, and perches, but no keys. While the fixed perches in this cage were different from the movable ones in the operant conditioning chambers, it is possible that the association between perch-hopping and feeding was reinforced during the interim period, whereas the association between keypecking and feeding was not. So, the extinction and CRF retest results may have been a reflection of the birds' experience during the interim period, rather than due to the characteristics of the two responses. In our second experiment we tested this explanation using training and test procedures identical to those of the first experiment, except that the interim housing conditions were changed to prevent any possibility of adventitious reinforcement of either response.

## EXPERIMENT II

### Method

**Subjects.** Four feral, male redwinged blackbirds were used as subjects. The conditions of capture and maintenance were identical to those of Experiment I.

**Apparatus.** The conditioning chambers used for the first experiment were used in Experiment II.

**Procedure.** The adaptation, conditioning, extinction, and CRF reacquisition procedures were identical to those of the first experiment. Two of the birds were first trained to perch-hop for food and then to keypeck; the other two birds were trained in the reverse order. The one change in procedure related to the housing conditions during the 36-day interim rest period. A large Plexiglas cage containing food, water, but *no* perches was used. The food and water dishes were recessed into the floor.

### Results

The adaptation and initial acquisition results were similar to those of Experiment I. While all four birds made more perch-hops than keypecks in adaptation, both responses were successfully conditioned as operants and came under the control of a succession of ratio schedules. Results for the extinction and CRF retest phases, conducted after the 36-day interim period, are shown in Table 2. The two birds trained first to keypeck for food and then to perch-hop made many more extinction perch-hops than keypecks, and showed a clear preference for perch-hopping throughout the 3 CRF retest days. A similar pattern of results was found in one of the birds trained first to perch-hop for food

**Table 2**  
**Experiment II: Extinction and CRF Reacquisition Response Totals and Latencies**

Sub- jects	Extinction		CRF Reacquisition		
	Responses	Latency (min)	Day 1	Day 2	Day 3
K-P-6	0/414	300/5.4	0/677	0/553	1/403
K-P-7	10/750	254/1.6	35/551	42/321	5/675
P-K-5	1/485	250/2.4	0/1881	0/1555	0/2082
P-K-8	234/286	33/1.4	14/1828	199/1053	260/590

and then to keypeck. The second bird trained in the perch-key order showed a much weaker preference for perch-hopping, thus showing the influence of the bird's more recent experience.

### Discussion

The results of Experiment II were very similar to those of the first experiment. Both perch-hopping and keypecking were successfully conditioned as operant responses. A preference for perch-hopping emerged during the extinction and CRF reacquisition phases which followed the interim 36-day rest period. The results of the second experiment indicate that the preference for perch-hopping found in Experiment I did not depend upon adventitious reinforcement of perch-hopping during the interim period.

## GENERAL DISCUSSION

Both perch-hopping and keypecking can be conditioned as operant responses in redwinged blackbirds and brought under schedule control. Given a choice between perch-hopping or keypecking, with either extinction or CRF schedules in effect for both responses, the birds clearly preferred to perch-hop. Thus, in acquisition contingent food reinforcement appears to have masked any biologically determined tendencies, predispositions, or preferences of the birds. It was only during the later tests that clear differences between the two responses became apparent. These results suggest that "biological constraints" may effect not the initial formation of associations between responses and reinforcement, but rather the behavior of an animal given a choice between previously reinforced responses that differ in their relation to the animal's natural behavior.

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