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SPONTANEOUS AND DEFERRED IMITATION IN THE PIGEON

ROBERT EPSTEIN

Foundation for Research on the Nervous System, 36 The Fenway, Boston, MA 02215, U.S.A.

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ABSTRACT

Experimentally-naive pigeons were placed on one side of a clear partition. A pigeon on the other side received food for pecking a ping-pong ball, pulling a rope, or pecking a plastic disk. When given access to a similar object, each naive pigeon pecked or pulled at a low rate for several sessions and two continued to do so for several sessions in the absence of the leader. In a second experiment, the latter effect was demonstrated after a delay of 24 hours, even though the naive pigeons had never had access to the object in the presence of the model. A third experiment demonstrated that the effect on the follower was not due merely to the presence of or activity of another pigeon and was at least somewhat specific to the behavior of the model.

Key words: imitation; observational learning; pigeon; social facilitation.

Occasionally organisms mimic the behavior of conspecifics; the phenomenon, which is usually labeled "imitation" or "observational learning," is an important source of adaptive behavior in humans and other animals (Davis, 1973; Hutchinson, 1981; Miller and Dollard, 1941; Porter, 1910; Rosenthal and Zimmerman, 1978; Thorpe, 1963). It may encompass only a few instinctive behaviors or the full range of behaviors which members of a species can exhibit during their lifetimes. It may occur spontaneously or because of a history of conditioning. It may occur only in the presence of a model or it may be "deferred" — that is, the imitative behavior may appear for the first time long after the model has been removed. There are many

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reports of imitation in animals in general and birds in particular (e.g., Alcock, 1969; Cronhelm, 1970; Klopfer, 1961; Mundinger, 1970; Porter, 1910; Skinner, 1962; Thorpe, 1963). Despite one attempt (Zentall and Hogan, 1976)[1], however, there seem to be no clear demonstrations of either spontaneous or deferred imitation in what is perhaps the second most widely used laboratory animal — the common pigeon (*Columba livia*). In spite of a long-standing suggestion that such imitation does not occur (Skinner, 1953), laboratory lore suggests that it does, and since a variety of research is conducted under conditions under which imitation could conceivably occur (e.g., Boakes and Gaertner, 1977; Epstein, Lanza and Skinner, 1980; Millard, 1979), investigation seems warranted. Three experiments are reported which show what might reasonably be called both spontaneous and deferred imitation of relatively arbitrary responses by laboratory pigeons.

Twelve Racing Homers and two White Carneaux pigeons (276WP and 409WP) served as subjects. All were maintained at about 80 percent of the weights they would normally achieve given free access to food. All were male adults between 1 and 3 years old; they were obtained from breeding farms when they were between 6 and 12 months old. Subjects 337WP, 413WP, 409WP, 421WP, 4Y, 5Y, 18Y, 19Y, 22Y, and 27Y served served as "followers." None of these had ever served in laboratory experiments, and none, before or during the experiment, ever ate from a laboratory feeder[2]. In Experiment 1, the naive birds were paired with four birds of like breed who served as models; in Experiments 2 and 3, to eliminate possible variance due to different models, a single bird was used as the model for all of the followers.

All sessions were conducted in a double chamber, 30 cm high, 31 cm deep, and 55 cm wide (Fig. 1). The birds could see each other through a clear partition in the center of the chamber. Models were always placed in the left half of the chamber and followers in the right. The halves were approximate mirror images of each other: Feeders were attached to the left- and right-hand walls; the right-hand feeder, however, was not wired and had never contained any food. Its food bin was sealed when it came from the manufacturer, and no food was ever placed in it over the course of these experiments. During various conditions, ping-pong balls, plastic loops ("ropes"), or standard response keys (plastic disks, recessed 0.6 cm into the panel) were placed on the front panel at corresponding positions 24 cm from the floor and 3 cm from the partition. Pecking or pushing a ball, pecking a key, or pulling a rope was automatically recorded by electromechanical equipment or a microcomputer. The

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[1]Zentall and Hogan (1976), using a group design and a discrete-trial procedure, claimed to demonstrate imitation of key pecking; however, their feeder contained food, their observers were technically not "naive," since they had been trained to eat from the feeders, and in all but one of the conditions of their experiment, key pecks by the observer operated its feeder. They report an extremely small effect for those observers whose pecks did not produce food (a median of 1 response per session for two of the three birds).

[2]After subject 337WP was used as a follower, he was trained as a model and paired with subject 421WP in Experiment 1. The other leaders in Experiment 1 were birds 338WP, 329WP, and 276WP. Bird 332WP served as the leader in Experiments 2 and 3.

chamber was completely enclosed during each session, and extraneous sounds were masked with white noise. A video camera with a wide-angle lens was attached to the front of the chamber; all sessions were monitored on television and many sessions were videotaped.

All sessions were one-half hour in length and were, without exception, conducted daily, 24 hrs apart. Before each experiment, the models were trained to respond repeatedly on one of the objects: Pecking and pushing the ball, pulling the rope, or pecking the key was reinforced intermittently with food according to a variable-ratio 20 or slightly richer schedule until roughly 1,000 responses were emitted reliably in each session. A 3-sec operation of the feeder served as the reinforcer; roughly 50 reinforcers were dispensed during each session.

There were five phases in the first experiment. The object (ball, rope, or key) was in position on the left panel during all phases. 1) Adaptation to the Chamber — The naive bird was placed alone in the right-hand side of the chamber for three sessions. No object was present on the right panel. 2) Baseline — The object (corresponding to the one on the left panel) was added to the right panel, and the naive bird was placed alone in the chamber for three sessions. Responding during this period served as the control against which responding would be compared during subsequent tests of imitation. 3) Exposure and Adaptation to the Model — The object was removed from the right panel. The naive bird was exposed for three sessions to the model while the model pecked the ball, pulled the rope, or pecked the key. 4) Test 1 — The

Figure 1. The experimental chamber, shown with all three pairs of objects on the front panel. In the actual experiments, only one pair was employed, placed in the uppermost positions where the ping pong balls are shown. The column of small white lights on the left panel was not used in the present experiments.

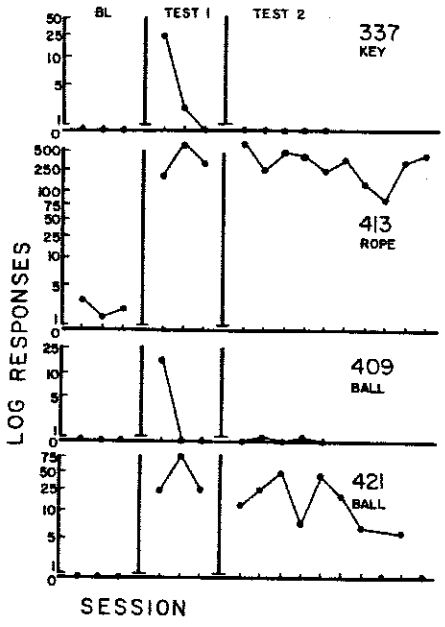

Figure 2. Number of responses by the naive subjects during each half-hour session of Experiment 1, shown for the baseline (BL) condition, a test of imitation in the presence of the model (Test 1), and a test of imitation in the absence of the model (Test 2). All of the subjects pecked or pulled considerably more in the presence of the model than they had before having seen the model, and two of the subjects continued to respond even when the model was no longer present.

corresponding object was added again to the right panel, and the naive bird was exposed again for three sessions to the model while the model pecked or pulled. If the naive bird manipulated the object on its panel more than it had during the baseline period, its behavior could conceivably have been imitative. 5) Test 2 — With the object still on the right panel (and the corresponding object still on the left panel), the naive bird was placed in the chamber for five or ten sessions; the model was absent. If the naive bird continued to manipulate the object on its panel more than it had during the baseline period, we would have some indication of deferred imitation.

Few or no responses occurred during the baseline period (Fig. 2). During the first test, all four naive birds responded at rates considerably higher than the baseline rates. The overall rate of responding for bird 413WP was greater than 16 responses per min in the second session. There was a large deferred effect (Test 2) for subjects 413WP and 421WP.

The second experiment tested for deferred imitation more directly. Only the ball was employed. The experiment was otherwise identical to the first experiment, except

that the fourth phase was omitted. None of the three naive birds pecked the ball during the baseline sessions. All of them did so during all but one of nine test sessions (Fig. 3). The overall rate of responding was greater than 16 responses per min for bird 27Y in the first test session.

The mere presence of or activity of a conspecific can increase activity level, a phenomenon called "social facilitation" (Zajonc, 1965). In Experiments 1 and 2 the possibility remained that we had observed mere social facilitation and, it seems, deferred social facilitation; the observers' behavior may not have been specific to the behavior of the model and hence not imitative. Experiment 3 controlled for this possibility. Three naive pigeons pecked the ball little or not at all when exposed to a model who turned in circles; when later exposed to the same model while the model pecked a ball, they pecked at rates typical of the rates reported in the two experiments reported above (Fig. 4). Thus the mere presence of or activity of the model was probably responsible for at most a small portion of the effects observed in these experiments. What appears to be the imitative behavior of the followers seems at least somewhat specific to the activity of the model.

In each of the experiments, each follower motioned toward the model repeatedly and often pecked the restraining partition in its direction, especially toward the model's head while it pecked or pulled the object. More significantly, all of the

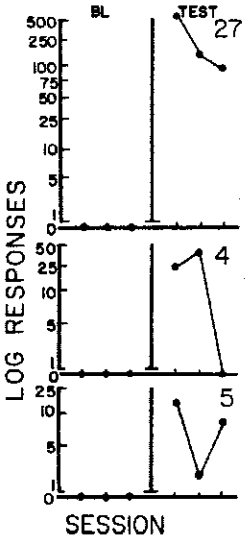

Figure 3. Number of pecks at the ball by the naive subjects during each half-hour session of Experiment 2, shown for the baseline (BL) condition and the following test of deferred imitation. The naive subjects pecked the ball repeatedly during the test even though (a) the model was absent, (b) 24 hrs had elapsed since they had seen the model peck a ball, and (c) they had never had access to a ball in the model's presence.

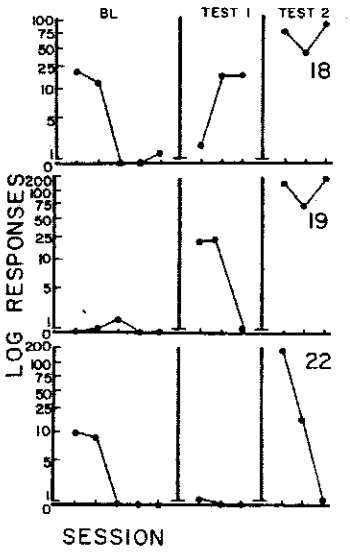

Figure 4. Number of pecks at the ball by the naive subjects during each half-hour session of Experiment 3, shown for the baseline (BL) condition, a test of social facilitation when the model was turning in circles (Test 1), and a test of imitation when the model was pecking the ball (Test 2). All of the birds pecked the ball considerably more when the model pecked the ball than when the model turned in circles. Thus the apparent imitative behavior of the naive birds was at least somewhat specific to the behavior of the model.

followers — even the two (337WP and 409WP) that did not show a deferred effect — motioned and pecked in this way during the tests of deferred imitation.

I recorded on videotape episodes in which followers thrust their heads into their feeder openings and made movements characteristic of feeding for several seconds, either while the model was eating or soon thereafter. It is not surprising that there were few such episodes given that (a) the leaders typically emitted more than 1000 responses to the ball, rope, or key during each half-hour session but ate fewer than 100 times, (b) making feeding movements in a wall opening is presumably an extremely unlikely behavior, and (c) such behavior would require the follower to turn away from (and hence lose sight of) the model.

Though I have called the responses of pecking the ball, pulling the rope, and pecking the key "relatively arbitrary," the response topographies are common in pigeons. Less common responses, such as treadle-pressing — or, as I have noted above, inserting the head into an opening in a wall — are undoubtedly less affected by the behavior of a model. Preliminary work I have conducted on this issue (with C. Grossbard) suggests, however, that if an uncommon response is made common through reinforcement and then later extinguished, the response may reappear in the presense of a pigeon that is engaging in that behavior.

Other research is also suggested. The effect would probably be smaller with pigeons that were isolated from birth (cf. May and Dorr, 1968). The specificity of the effect could be further tested to allow a more precise characterization of the type of imitation we observed (cf. Davis, 1973; Porter, 1910; Thorpe, 1963): If both model and observer had access to all three of the objects and the model were trained to respond on one of them, would the observer respond on the appropriate object? If the model shifted from one to another, would the observer follow? The role of the food is also unclear. Would the effect occur if the observer could not see the model eat or if the observer were not deprived of food? Even without answers to these questions, the current findings have practical significance, since pigeons both in and out of the laboratory are often deprived of food and are seldom, if ever, isolated from birth.

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