Research Report

CAN IMITATION IN PIGEONS BE EXPLAINED BY LOCAL ENHANCEMENT TOGETHER WITH TRIAL-AND-ERROR LEARNING?

Daren H. Kaiser,[1] Thomas R. Zentall,[1] and Bennett G. Galef, Jr.[2]

[1]*University of Kentucky and* [2]*McMaster University*

Abstract—*Zentall, Sutton, and Sherburne (1996) reported that pigeons observing a conspecific demonstrator either step on or peck at a treadle to obtain food subsequently showed a significant tendency to manipulate the treadle as had their demonstrator. Zentall et al. suggested this finding showed observer pigeons had learned by imitation to peck at or step on the treadle. However, the same result might have been obtained if pigeons had learned to step on the treadle by trial and error, and pigeons exposed to a treadle-pecking demonstrator had come to peck at the treadle as a result of nonimitative social-learning processes such as local enhancement or contagion. Here, we report the results for two control groups, showing that pigeons do not learn to step on or peck at a treadle for food reward unless they observe a relevant demonstrator. These results considerably strengthen the original conclusion. Future research using the two-action method to demonstrate imitative learning should include similar controls.*

In an article recently published in this journal, Zentall, Sutton, and Sherburne (1996) interpreted the results of an experiment they conducted as providing "clear evidence of imitative learning in pigeons" (p. 345). Zentall et al. allowed each of 24 magazine-trained pigeons to watch for 15 min while a demonstrator pigeon either stepped on or pecked at a treadle 50 times and received a food reward each time that it did so. In subsequent 30-min tests, 9 of the 12 pigeons that observed a demonstrator step on the treadle also stepped on the treadle, and none of these pigeons pecked at it. Of the 12 pigeons that watched a demonstrator peck at the treadle, 5 pecked at the treadle and 5 stepped on it. Appropriate statistical analysis showed that the correlation between the motor patterns demonstrators and subjects used to depress the treadle was not likely to be due to chance alone.

As Zentall et al. suggested, the *two-action* procedure they used has the potential to provide unequivocal evidence of imitative learning in animals (Galef, 1988; Heyes & Dawson, 1990; Whiten & Ham, 1992). However, there is a general problem associated with using a simple correlation between the behavior of subjects and that of their respective demonstrators as evidence of imitative learning in a two-action procedure.

For the sake of argument, assume that a naive pigeon released into the apparatus Zentall et al. used would wander about until it chanced to step on the treadle and thereby gain access to food. Such a subject would be likely to learn by trial and error that stepping on the treadle would be rewarded. Assume also, as has been reported many times in the literature (e.g., Tolman & Wilson, 1965; Turner, 1964), that (a) birds exhibit a marked increase in their probability of pecking at any object they have seen other birds peck at and (b) such social effects on frequency and orientation of pecking can persist for many hours after a subject has seen a conspecific peck at a target (Bartashunas & Suboski, 1984; McQuoid & Galef, 1992). Such contagious pecking, or local or stimulus enhancement of pecking (Spence, 1937; Thorpe, 1963), is not in itself indicative of learning by imitation.

Consequently, the correlation between behavior of demonstrators and subjects found by Zentall et al. might be explained in terms of individual learning together with some nonimitative form of social learning, the type of explanation that Zentall et al. had hoped to exclude by use of a two-action procedure. In general, unless both groups of subjects exposed to demonstrators in a two-action procedure increase their frequency of engaging in whichever action their respective demonstrators exhibit, the two-action method does not provide compelling evidence of imitative learning.

Here, we present data from control conditions needed to reject the hypothesis that the significant correlation between the behavior of demonstrators and subjects reported by Zentall et al. (1996) was the result of nonimitative learning processes.

METHOD

Subjects

Twenty-four 5- to 8-year-old White Carneaux pigeons obtained from the Palmetto Pigeon Plant (Sumter, South Carolina) served as subjects. The pigeons were individually caged and were maintained at 80% to 85% of their free-feeding body weights with free access to water and grit. The colony room was maintained under a 12-hr/12-hr light/dark cycle.

Apparatus

The apparatus, consisting of two Large Modular Test Chambers (Colbourne Instruments, Allentown, Pennsylvania) placed side by side, was the one used by Zentall et al. (1996). A treadle was mounted in one chamber near the Plexiglas wall separating the two chambers. A grain feeder was mounted in the center of the wall near the treadle (see Zentall et al., 1996, for details).

Procedure

We treated members of the two control groups, each consisting of 12 pigeons, exactly as Zentall et al. (1996) had treated observer pigeons in their experiment, with three exceptions: First, we exposed observer pigeons in one of the control groups to an experimentally

Address correspondence to Bennett G. Galef, Jr., Department of Psychology, McMaster University, Hamilton, Ontario L8S 4K1, Canada; e-mail: galef@mcmaster.ca.

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naive demonstrator rather than to a demonstrator that we had trained to step on or peck at the treadle. Second, we exposed observer pigeons in the other control group to an experimentally naive demonstrator that we had trained to eat from the feeder and that we fed, at variable intervals, 60 times during the 15-min observation period (trained demonstrators in the study by Zentall et al., 1996, received approximately 60 rewards during each 15-min observation period). Third, any responses of a demonstrator to the treadle during the observation period had no programmed consequences.

Immediately following each observer pigeon's 15 min of observation of its demonstrator, we replaced the demonstrator with the observer. During the next 30 min, any responses made to the treadle by the observer were reinforced (see Zentall et al., 1996, for details).

RESULTS

As can be seen in Figure 1, few observers in either control group stepped on the treadle during testing. Data describing the number of pigeons (out of 12) that watched a demonstrator step on the treadle in the experiment conducted by Zentall et al. (1996) are included for comparison (stepping-demonstrator group). Statistical analysis indicated that the control groups differed significantly from the stepping-demonstrator group in the frequency with which their members stepped on the treadle during testing, $\chi^2(2) = 9.4$, $p < .009$.

None of the observers in either control group pecked at the treadle, whereas Zentall et al. (1996) found that 5 of 12 experimental subjects that had observed a demonstrator peck at the treadle also did so, $\chi^2(2) = 11.6$, $p < .003$.

DISCUSSION

The results of this experiment, in which pigeons in control groups were significantly less likely to either peck at or step on the treadle during testing than were pigeons that had observed a conspecific demonstrator perform one of these acts (Zentall et al., 1996), are consistent with the hypothesis that the pigeons in the study by Zentall et al. (1996) did learn by imitation to peck at and step on a treadle. Similar experiments, using a two-action method with Japanese quail (*Coturnix coturnix japonica*) as subjects (Akins & Zentall, 1996), provide further evidence of imitative learning by birds.

At a more general level, however, whenever the two-action method is used to assess imitative learning and acquisition of either action might be accounted for by trial-and-error learning, local enhancement, or any other nonimitative process, the strength of the argument for imitative learning is significantly diminished. Therefore, in studies of imitative learning using the two-action method, control groups should be included. The members of these control groups should be allowed to acquire the relevant responses for themselves after exposure to whatever motivation-inducing cues are provided to members of imitative-learning groups by the simple presence of a conspecific (Zajonc, 1965). Only when demonstration of both acts increases their respective frequencies above those exhibited by members of the control groups can one be certain that what appears to be imitative learning cannot be accounted for by the action of simpler, nonimitative processes.

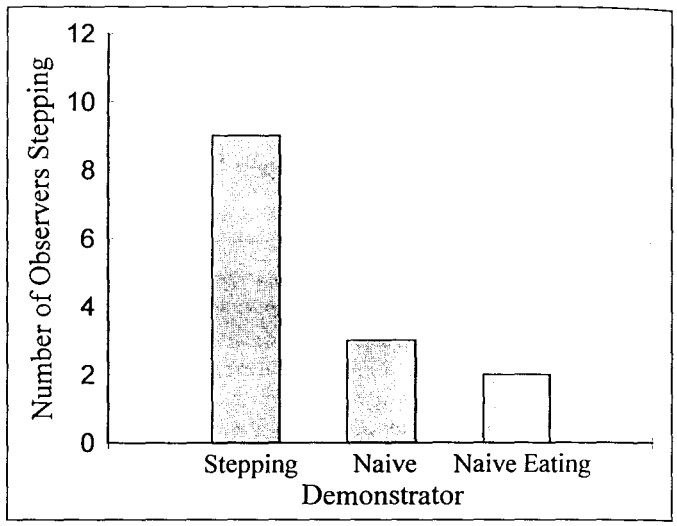

Fig. 1. Number of pigeons stepping on the treadle one or more times during the 30-min test following 15 min of observation of either a demonstrator trained to step on the treadle (stepping demonstrator; from Zentall et al., 1996), an experimentally naive demonstrator (naive demonstrator), or an experimentally naive demonstrator fed on a variable schedule (naive, eating demonstrator).

REFERENCES

Akins, C.K., & Zentall, T.R. (1996). Imitative learning in male Japanese quail (*Coturnix japonica*) involving the two-action method. *Journal of Comparative Psychology, 110,* 316–320.

Bartashunas, C., & Suboski, M.D. (1984). Effect of age of chick on social transmission of pecking preference from hen to chicks. *Developmental Psychobiology, 17,* 117–121.

Galef, B.G., Jr. (1988). Imitation in animals: History, definition and interpretation of data from the psychological laboratory. In T.R. Zentall & B.G. Galef, Jr. (Eds.), *Social learning: Psychological and biological perspectives* (pp. 3–28). Hillsdale, NJ: Erlbaum.

Heyes, C.M., & Dawson, G.R. (1990). A demonstration of observational learning using a bidirectional control. *Quarterly Journal of Experimental Psychology, 42B,* 59–71.

McQuoid, L.M., & Galef, B.G., Jr. (1992). Social influences on feeding site selection by Burmese fowl (*Gallus gallus*). *Journal of Comparative Psychology, 106,* 137–141.

Spence, K.W. (1937). Experimental studies of learning and higher mental processes in infra-human primates. *Psychological Bulletin, 34,* 806–850.

Thorpe, W.H. (1963). *Learning and instinct in animals* (2nd ed.). London: Methuen.

Tolman, C.W., & Wilson, G.F. (1965). Social feeding in domestic chicks. *Animal Behaviour, 13,* 134–142.

Turner, E.R.A. (1964). Social feeding in birds. *Behaviour, 25,* 1–43.

Whiten, A., & Ham, R. (1992). On the nature and evolution of imitation in the animal kingdom: Reappraisal of a century of research. In P.J.B. Slater, J.S. Rosenblatt, C. Beer, & M. Milinski (Eds.), *Advances in the study of behavior* (Vol. 21, pp. 239–283). New York: Academic Press.

Zajonc, R.B. (1965). Social facilitation. *Science, 149,* 269–274.

Zentall, T.R., Sutton, J.E., & Sherburne, L.M. (1996). True imitative learning in pigeons. *Psychological Science, 7,* 343–346.

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