A DEMONSTRATION OF AUTO-SHAPING WITH MONKEYS

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The Brown-Jenkins auto-shaping procedure for pigeons was found applicable to monkeys. Repeated pairings of lighted keys with reinforcement generated key-pressing behavior. The animals rapidly learned a simultaneous light-dark discrimination. The topographies of key-pressing and magazine behavior differed; the food tray was not illuminated.

Brown and Jenkins (1968) described a procedure by means of which pigeons "self-shape" their own key-pecking response. At irregular intervals, a standard pigeon key is lighted for a few seconds; each time the key light is turned off, an illuminated tray filled with grain is made available to the pigeon. Availability of the grain is contingent only on the lighted key; no response to the key is required. Nearly all pigeons exposed to this procedure learned to peck the lighted key. Furthermore, they acquired the key-pecking response rapidly and with remarkably few "errors" (intertrial responses).

Brown and Jenkins performed most of the necessary control experiments, *e.g.*, presenting the key light without grain; presenting the grain just before the key light; presenting the grain with a constant key light; *etc.* None of these control procedures was as successful in generating key-pecking behavior. However, certain problems still remained, and the present investigation sought to clarify them.

First, is the auto-shaping procedure applicable only to pigeons? General applicability would increase the theoretical importance of the procedure and extend its practical utility.

Second, is it necessary to illuminate both the response key and the reinforcement tray? Brown and Jenkins investigated this in two ways. The key was lighted during intertrial

periods and (a) turned off, or (b) changed from white to red, during the few seconds before the lighted (white) food tray was presented. They found that the key peck was less likely to emerge when the dark key was paired with reinforcement than when the white or red key was so paired. However, they did not pair the lighted key with an unlighted food tray.

Third, must the subject's responses to the key and to the reinforcement tray be the same (*e.g.*, pecking, in the pigeon)?

METHOD

Subjects, Apparatus, and Procedure

Four rhesus monkeys were maintained at 80% of their free-feeding weights. Unsuccessful attempts had been made to hand-shape key-pressing in Monkey R19. The other animals were experimentally naive.

On one wall of the experimental chamber were three translucent circular keys, each of which could be illuminated separately (Sidman and Rosenberger, 1967). The keys, each 0.75 in. in diameter, were aligned horizontally, 5 in. apart, and 12.25 in. above the floor. A small unlighted plastic tray, 7.6 in. below the center key, received 1-g banana pellets at appropriate times. The chamber light remained on at all times. Programming and recording were automatic.

The subjects were first trained to pick up food pellets from the tray as soon as they were delivered. The keys were unlighted during magazine training.

The subjects then received two sessions, each consisting of 60 pairings of an 8-sec key light followed immediately, at the offset of the key

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light, by delivery of a food pellet. Only one of the three keys was lighted during each 8-sec trial, but the particular key that was illuminated varied from trial to trial in a mixed sequence. Between trials, all keys were dark. Intertrial intervals varied randomly from 15 to 45 sec, with a mean of 30 sec. (In Monkey R19's first session, the average intertrial interval was 60 sec.) An additional specification was that no trial could begin unless at least 5 sec had elapsed without an intertrial response to any key.

The pellet came automatically at the end of each 8-sec trial. No key press was required. However, if the animal pressed the lighted key during an 8-sec trial, the light went off immediately and a pellet was delivered. If it pressed a dark key during the trial, the light went off but no pellet was delivered.

RESULTS

All monkeys pressed a lighted key within the first 60 trials. In fewer than 120 trials, all reached a learning criterion of nine correct responses in 10 consecutive trials. Figure 1 shows each monkey's acquisition of correct key-pressing behavior.

Fig. 1. Acquisition of key-pressing by four monkeys. Each trial without a correct response moved the line a step horizontally to the right. Each trial on which the animal pressed a lighted key moved the line a step upward. *E* indicates an error during a trial. The inset at the upper right shows hypothetical slopes for a range of percentages of trials on which the animal presses a lighted key.

During the trials, with one of the three keys lighted, the animals' behavior was nearly errorless; they rarely pressed a dark key. As indicated by the arrows in Fig. 1, Monkey R30 pressed a dark key on three trials; Monkeys

R33 and R19 on one trial each; and Monkey R24, never.

The animals did make "errors" by pressing dark keys during the intertrial intervals, when no keys were lighted. Intertrial responses gradually lessened and disappeared. For three of the monkeys, the first key press came during an intertrial period. Two of these three initial responses were on the key that had been lit during the preceding trial.

Considering only the first response during each intertrial period, 59% were on the key that had been lit during the preceding trial. Random intertrial pressing would have yielded 33% of such responses. Considering the first intertrial response after *only* those trials on which the animal failed to press a key, 53% were on the preceding bright key. Thus, even intertrial responses were strongly determined by the key that had just been lighted and paired with reinforcement.

DISCUSSION

The auto-shaping procedure, originally demonstrated by Brown and Jenkins with pigeons, is also applicable to monkeys. Repeated pairings of lighted keys with reinforcement generated key-pressing behavior.

We have not attempted to assess the relevance or even the necessity of any particular aspect of the auto-shaping procedure, relying rather on the Brown and Jenkins studies and on common experience with monkeys in this and similar situations for the assurance that key-pressing would not otherwise have been generated. A primary significance of the present study is to extend to another species of subject the practicality of the auto-shaping procedure.

The emergence of responses to lighted keys does not depend on a consummatory response to a lighted food magazine. In the present experiment, the food tray was not illuminated.

The success of the auto-shaping procedure does not require that the animal's responses to the key be the same as its responses to the reinforcer. Although the monkey used its fingers both to press the key and to pick up the pellet, the topography of these two behaviors is quite different. This is particularly true in comparison with the pigeon, whose pecking response is the same whether to the key or to the grain.

The monkeys rapidly learned a simultaneous light-dark discrimination, but during intertrial periods they pressed dark keys more often than the pigeons in the Brown and Jenkins studies. An unexpected finding was that even intertrial responses were strongly determined by the key that had been bright on the preceding trial.

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