Reversal and nonreversal learning in the goldfish[1]

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Goldfish were trained in series of 40-trial or 60-trial red-green discrimination problems, in half of which the rewarded color was the same as that of the immediately preceding problem, while in the rest the rewarded color was the unrewarded color of the preceding problem. Reversal was more difficult than nonreversal, and there was no change in the difficulty of either class of problem as training continued. The results are considered in terms of an interference interpretation of progressive improvement in habit reversal.

The control group of a recent experiment on reversal learning in the pigeon was trained in a series of 40-trial red-green discriminations, with red positive for half the problems and green positive for the remaining problems, in Gellermann orders (Gonzalez & Bitterman, 1968). Since half the problems were reversals and half were nonreversals, it was possible to study changes in the difficulty of both kinds of problem with continued training. The results showed a progressive improvement in reversal performance and a corresponding deterioration of nonreversal performance, suggesting that the improvement in reversal could be explained in terms of proactive interference; forgetting the preference developed in one problem should improve performance in the next problem if it is a reversal or impair performance in the next problem if it is a nonreversal. We present here some comparable data for the goldfish, which does not show progressive improvement in habit reversal (Behrend, Domesick, & Bitterman, 1965).

METHOD

The Ss were 17 experimentally naive 3-4 in. goldfish, housed individually in 2-gal tanks, with water filtered, aerated, and regulated as to temperature. The fully automated training apparatus, the same as that used in previous experiments, is described in detail elsewhere (Bitterman, 1966). Each trial began (after a 6-sec intertrial interval in darkness) with the illumination of a pair of Plexiglas targets with red and green lights, the position of the two colors varying from trial to trial in Gellermann orders. Correct choice was followed by reinforcement (target lights off, feeder light on, and a single *Tubifex* worm discharged into the water from a worm feeder), and then by an intertrial interval. Incorrect choice was followed by a 6-sec timeout in darkness, after which the correct target alone was illuminated and the animal reinforced for response to it (guidance).

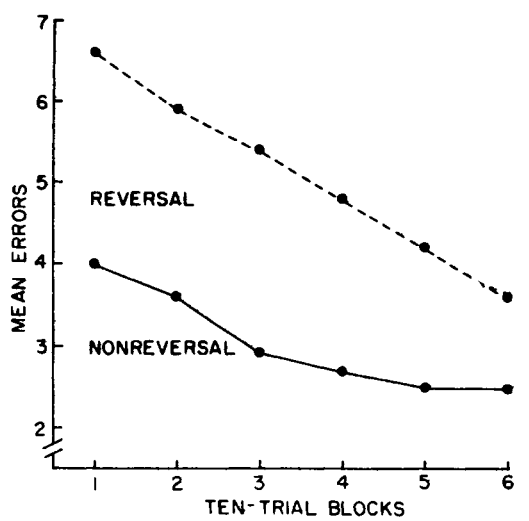

Fig. 1. Within-sessions learning curves for the 60-trial goldfish on reversal and nonreversal days.

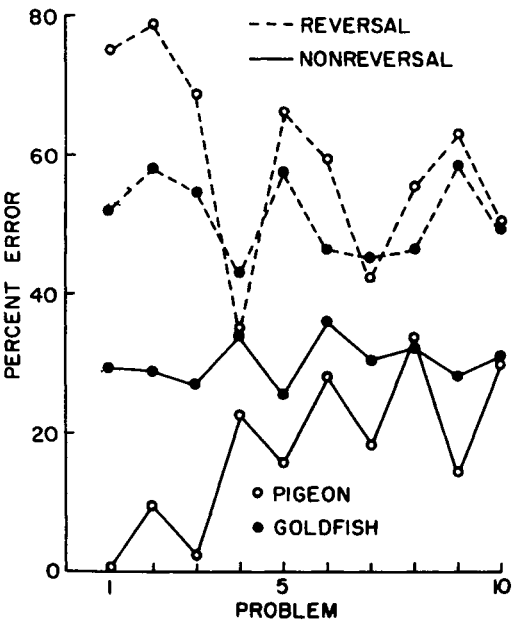

Fig. 2. Performance on reversal and nonreversal days of the 60-trial goldfish and of the pigeons of a previous experiment.

As in the pigeon experiment after which the present one was patterned, the goldfish were trained only on alternate days, although they were maintained on a 24-h feeding schedule. After feeder training and target training, there was a preliminary session with red positive. Then the animals were trained in 20 additional sessions, 10 with red positive and 10 with green positive (beginning with red positive) in Gellermann orders. Of these 20 problems, 10 were nonreversals and 10 were reversals (beginning with a nonreversal). For the first six Ss, there were 40 trials per session, as in the pigeon experiment. Then 11 Ss were trained with 60 trials per session. The increase in number of trials per session was intended to increase the amount of learning within sessions, and thus to increase the initial difference between reversal and nonreversal performance, on the assumption that the greater the initial difference, the easier it should be to detect any tendency toward convergence.

RESULTS

The difference between reversal and nonreversal performance was highly significant in both groups ($p < .01$), and somewhat larger, as expected, with 60 trials per session than with 40. Within-sessions learning curves of the 60-trial animals, based on pooled data for the 10 reversals and pooled data for the 10 nonreversals, are plotted in Fig. 1. The curves show substantial improvement within sessions and a large consequent difference between reversal and nonreversal performance. Pooling the data over sessions was justified by the fact that there was no change in the difficulty either of reversal or of nonreversal as training continued. In Fig. 2, the performance of the 60-trial animals is plotted in terms of errors per session, along with comparable data from the earlier pigeon experiment. The curves for the goldfish give no hint of the convergence ($F < 1$) which is so evident in the curves for the pigeon.

DISCUSSION

If the convergence of the reversal and nonreversal curves for the pigeon can be accounted for in terms of proactive interference, the lack of convergence in the curves for the goldfish points to the absence of proactive interference in the goldfish, an interpretation which was suggested also by the results of another recent experiment of somewhat different design (Gonzalez, Behrend, & Bitterman, 1967; Bitterman, 1968). The interpretation implies a rather basic difference in the learning of the two animals. It is possible, for example, that when a goldfish is trained with red positive after training with green positive, the red preference simply gives way to a green preference, with no residual of the training to red remaining to interfere with the retention of the new preference for green. It should be noted, however, that a more conventional experiment on retention in the pigeon has failed to give evidence of proactive interference (Kehoe, 1963). Further experiments of the same kind are required with both animals.

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NOTE

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