Priming the pecking response in pigeons[1]

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Grain displayed behind a transparent response key was used as a stimulus to prime the pecking response of pigeons. After different numbers of primed responses reinforced by the delivery of food below the key, responses in extinction were measured in the absence of the priming stimulus. In producing initial responses the priming stimulus was found to be highly effective, and generalization occurred to the key alone. Within the range of 5 to 355 priming trials the maximum effect was obtained with 30 trials.

In operant conditioning experiments with pigeons, the rate of pecking at the response key may be virtually zero before reinforcement. Three methods for hastening the first responses have been described by Ferster & Skinner (1957).[2] One is to "shape" the pecking response by progressively reinforcing nearer and nearer approximations to it. The two other methods involve "priming" the response by displaying food as a target: grain is fastened to the response window with transparent adhesive tape, or, less directly, practice trials are given with a punchboard which has holes containing grain and covered with tissue paper, cut in some cases so that the grain is visible.

Shaping and priming are of practical importance in research on operant behavior. Priming would appear to have the advantages of being quicker, requiring less skill on the part of the E, and being easier to arrange mechanically. It is difficult to assess how frequently priming techniques are used, because experimental reports commonly fail to provide sufficient information about preliminary training. Priming is supposed to work as a training procedure but no investigation of its effectiveness has been reported.

Procedures that are used in studying human learning commonly include priming. For example, in paired-associate learning the responses that S must learn to make to the stimulus terms are first produced by reading, and the training problem is to shift control from one set of stimuli to another. There are many similar situations in which the first responses are produced by a verbal stimulus or a demonstration, rather than by trial-and-error or shaping through differential reinforcement. Thorndike (1913) described "associative shifting," a procedure of using a priming stimulus and removing it by stages so that control is shifted to a new set of stimuli, but it is only with the advent of programmed instruction (Skinner, 1958) that investigations have been conceived in these terms. In basic studies of simple learning in animals, the action of priming stimuli has generally been neglected although the addition of an element of instruction by priming produces a situation in which animal learning is more obviously comparable with human. Notable exceptions are the experiments on dogs by Konorski (1948) in which movements originally produced by aversive stimuli or by mechanical means were reinforced by giving food, and Terrace's (1963) demonstrations of errorless discrimination learning in pigeons obtained by superimposing new stimuli upon priming stimuli established by earlier training.

In the experiment that follows, the aims were both practical and theoretical: to investigate a very simple priming procedure as a technique for preliminary training, and to examine the relationship between the number of priming trials given and the strength of the primed response.

SUBJECTS

Twenty-four adult male pigeons, not previously used in experiments, were maintained at 80% of ad lib weight throughout the experiment.

APPARATUS

A single-key operant conditioning chamber was used. The key was made of a transparent plastic, and close behind it was a slide with two settings, at one of which a maple pea on a white background was displayed, and at the other the white background alone. Overhead lighting provided general illumination for the chamber and the stimulus slide. The key was connected so that a peck would switch the overhead lights off for 10 sec and at the same time deliver one maple pea into an independently-illuminated food dish at floor level below the key. Provision was also made for gradually dimming the overhead lights at the end of a trial if no response should have occurred within 30 sec. A millisecond timer was used to measure the interval between the onset of the light at the beginning of each trial and the occurrence of pecking. All pecks were recorded.

PROCEDURE

Priming trials followed preliminary magazine training. Each trial started with the overhead lights going on and disclosing the priming stimulus, a maple pea on white card, through the response window at pigeon head-height. A peck at the key delivered a maple pea into the food receptacle at floor level and put off the overhead lights, leaving the food illuminated but the rest of the chamber in darkness. When no peck had occurred at the end of 30 sec the overhead lights were gradually dimmed to zero in preparation for the next trial. The intertrial interval was 10 sec. Each bird received 5, 30, 55, 105, 205, or 355 primed trials with reinforcement. When the number of trials exceeded 50, training was spread over a number of days at a rate of 50 per day. In all cases the final five trials of priming were given in the same session as the first extinction trials. The stimulus slide was then changed, removing the maple pea but leaving the background of white card as before, and the reinforcer was switched off. Extinction

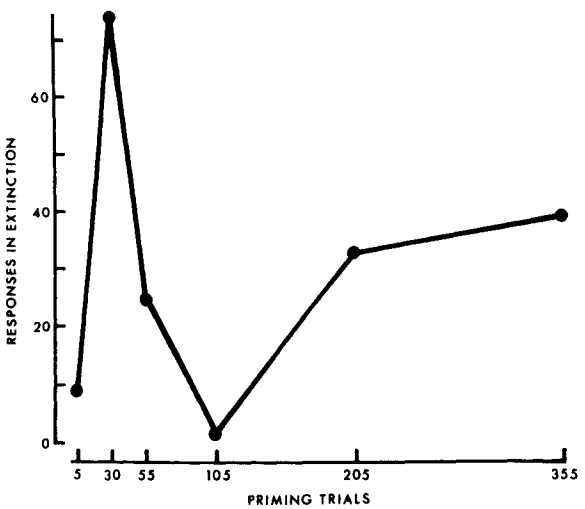

Fig. 1. Mean responses in "extinction" as a function of number of priming trials.

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could be easily assessed by factorially varying reward magnitude in both the acquisition and reinstatement phases.

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NOTE

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Table 1
Responses in Extinction after Different Numbers of Priming Trials

Number of Priming Trials	Numbers of responses in extinction Replication 1	2	3	4
5	34	0	1	1
30	68	9	165	54
55	24	21	39	14
105	6	0	0	0
205	0	46	17	68
305	12	45	65	34

trials ended after a minimum of 20 or after six consecutive failures to respond.

A subexperiment with six birds, one allocated to each number of priming trials was carried out first, then replicated, and replicated again with apparatus that differed in detail, within the specification given above. In a final replication, birds were given extra magazine training in inverse proportion to the number of priming trials to be given, so that all of them had eaten the same amount of food in the experimental chamber before extinction started.

RESULTS

All birds responded to the priming stimulus, 23 starting on the first exposure and one on the second exposure. Responding continued up to the limit of 355 trials of priming with some decrease in latency.

The four separate sets of birds all produced comparable numbers of responses in extinction showing the same pattern of distribution according to numbers of priming trials, i.e., an early peak, a trough, and a rise with increasing exposure to the priming procedure. This is the pattern displayed in Fig. 1 in which each data point gives the averaged performance of four birds, one from each set. Of the 24 birds that were tested, 5 gave no responses in extinction.

DISCUSSION

For practical guidance in the use of priming as a training technique, the results do not indicate that any advantage is gained by giving more than 30 primed and reinforced trials. Observations of behavior suggested that the sudden removal of the priming stimulus disturbed some of the birds in this experiment. An improved technique, which could be fully automated, would be to use projected transparencies of food and to fade out the priming stimulus over a number of trials.

The relationship between trials and extinction scores appears to be irregular, but the shape of the curve presented in Fig. 1 corresponds with the summary given by Razran (1949) of the results of experiments on stimulus generalization in Pavlov's laboratory, i.e., "CR generalization increases in the very initial stages of training the CR, but upon further training begins to decrease slowly, while after a large number of reinforcements it may increase again." In the case of the present experiment there is a complicating factor which may have served to exaggerate the effect. The pecking response changes during priming trials. At first it is always directed at the food and later it may drift to a focus at the edge of the key, or become variable over its surface. The opening of the beak tends also to be reduced, suggesting that the inaccessible food is first responded to as food, but later loses this special characteristic and functions as an ordinary discriminative stimulus. It may be that the "food" peck is more resistant to extinction and this factor contributes to the peak performance obtained after 30 priming trials. Further investigations are in progress.

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NOTE

1. This research was supported in part by the Medical Research Council of Great Britain.

2. "Prompting" and "priming" are distinguished by Skinner (1968). In "prompting," a supplementary stimulus is used "to encourage a prompt appearance of behavior which already exists in some strength," whereas in "priming" the stimulus is fully adequate to evoke the behavior for the first time.