A peak shift resulting from a chained reinforcement schedule

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Ten pigeons were given VI 2-min single-stimulus training and then were switched to a chain VI 1-min VI 1-min schedule. For half of the Ss, the original training stimulus became the stimulus closest to primary reinforcement (S_1) and a new stimulus became the stimulus farthest from primary reinforcement (S_2). For the other Ss, the training stimulus became S_2 and the new stimulus became S_1 . After 5½ h of training on the chained schedule, a generalization test in extinction revealed peak shifts away from S_2 beyond S_1 in both groups.

In operant successive discrimination training, Ss are taught that responses in the presence of one stimulus (the positive) are rewarded either with greater frequency (Guttman, 1959; Hanson, 1959) or with a greater magnitude (Mariner & Thomas, 1969) than are responses in the presence of another stimulus (the negative), or that responding must be maintained at a lower rate in the presence of the negative

stimulus in order for reinforcement to occur (Terrace, 1966). When the two stimuli are closely spaced on the same physical dimension and the response rate in the presence of the negative stimulus is reduced relative to the response rate in the presence of the positive stimulus, the peak of the postdiscrimination generalization gradient is displaced from the positive stimulus so as to be farther removed from the negative. Terrace (1966) has suggested that, under these conditions, the negative stimulus is aversive relative to the positive stimulus, and that the "peak shift" in the postdiscrimination gradient is an indication of the aversiveness of the negative stimulus.

A standard procedure for identifying an aversive stimulus is to train a response that will lead to avoidance or escape from that stimulus. J. R. Thomas (1966) found that pigeons will learn a new response (pecking a second key) to avoid return to the component farthest from primary reinforcement in a chained schedule of reinforcement. Unfortunately, it is not possible to determine in Thomas's experiment whether the S is avoiding the component farthest from primary reinforcement or is simply prolonging the duration of the component nearest primary reinforcement. If Terrace's suggestion that

a stimulus associated with a reduced rate of responding is aversive is correct, and Thomas's Ss were indeed avoiding the component farthest from food, then one would also expect that a peak shift would occur in a chained schedule away from the stimulus associated with the component farthest from food. This hypothesis was tested in the present experiment.

SUBJECTS

The Ss were 10 experimentally naive homing pigeons, maintained at approximately 70% of their free-feeding weights.

APPARATUS

All training and testing took place in a Skinner-type automatic key-pecking apparatus described by Thomas & Lopez (1962). The key was illuminated by a Bausch and Lomb monochromator, Model 33-86-02, equipped with a tungsten light source. There was no houselight.

PROCEDURE

On Day 1, all Ss were magazine trained, key-peck trained, and given 50 continuous reinforcements of 4-sec access to the grain hopper. Thirty more continuous reinforcements were given on Day 2, and on Day 3 Ss were given 30 more reinforcements on an FR-5 schedule. This was done to facilitate the subsequent transition to a VI 2-min schedule. For the next 10 days, all Ss were placed on a VI 2-min schedule for 1 h each day. For half the Ss, all training to this point was with a 550-nm light on the key, and for the other half, the key was illuminated by a 570-nm light.

After completion of VI training, each of these groups was placed on a chain VI 1-min VI 1-min schedule with 550 nm associated with the component nearest the primary reinforcement (S_1) and 570 nm associated with the component farthest from primary reinforcement (S_2). Between components of the chain, there was a 4-sec blackout during which the stimulus on the key was changed. To describe the procedure more explicitly, S_2 came on and remained on for a variable period of time averaging 1 min. At the end of this interval, the first peck terminated S_2 and initiated a 4-sec blackout, at the end of which S_1 appeared and remained on for a variable period of time, again averaging 1 min. The first peck at the end of this interval terminated S_1 and produced a 4-sec access to the food hopper, during which another blackout occurred, and then the cycle was repeated.

Fig. 1. Generalization gradients for Ss trained on 570 nm, which was subsequently made S_2 .

Fig. 2. Generalization gradients for Ss trained on 550 nm, which was subsequently made S₁.

enhanced responding to longer wavelengths. Thus, it may be concluded that in the present study both an "area shift" and a "peak shift" away from the 570-nm S₂ took place.

The finding of a shift in the gradients in the direction opposite S₂ in both training conditions in this experiment relates J. R. Thomas's (1966) finding that pigeons will learn a new response to avoid return to the initial component of a chained schedule to Terrace's (1966) contention that the stimulus associated with a reduced rate of responding is aversive. Taken together, these two experiments suggest that Thomas's Ss were indeed avoiding the initial component of the chain and that the stimulus associated with that component is aversive relative to a stimulus closer to primary reward.

All Ss were given 5 1-h daily sessions on the chained schedule. On the sixth day of chained performance, Ss were given a ½-h (reinforced) warm-up with the chain and then a generalization test in extinction with seven monochromatic stimuli (530, 540, 545, 550, 555, 560, and 570 nm) presented in each of six random series. Each stimulus was presented for 60 sec, with a 4-sec blackout between presentations, during which responses were recorded and the test stimuli changed.

RESULTS AND DISCUSSION

All Ss exhibited high response rates in both components of the chain at the beginning of chain training; however, by the end of the third day of training on the chain, all Ss responded at a very low rate in the presence of S₂, while continuing to respond at a high rate to S₁. Over the course of the 6 days of training on the chain, the rate of responding in the presence of S₂ tended to stabilize, and this maintenance of responding in the presence of S₂ indicates that the training schedule was functionally a chain, despite the interpolation of the 4-sec blackout between the presentation of the two monochromatic stimuli. In other

experiments involving the same two training stimuli (cf., e.g., Hanson, 1959) and a multiple (VI-extinction) schedule, responding to the extinguished stimulus falls to zero with less training than was used here.

Figures 1 and 2 present the individual gradients for each S in Groups 1 and 2, respectively. In Group 1, for which the training stimulus was made S₂, all five birds showed peak shifts. In Group 2, for which the training stimulus was made S₁, three peak shifts were obtained.

As Terrace (1966) has pointed out, the peak shift is not as sensitive a measure of the effects of discrimination training as is the degree of asymmetry in the postdiscrimination generalization gradient. Therefore, an asymmetry score was obtained for each S by computing the percentage of responding to stimuli other than S₁, which occurred to stimuli on the side of S₁ opposite S₂. These scores, also presented in the figures, are above 50% for each S in the experiment. The bulk of the literature in which single-stimulus training has been given with the 550-nm stimulus (starting with Guttman & Kalish, 1956) shows gradients that peak at the CS value and are asymmetrical in the direction of

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NOTE

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