The effects of response prevention via operandum removal in the S— of a tonal discrimination*

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Pigeons were trained with or without responses permitted in the S— of an intradimensional tonal frequency discrimination. Subsequent generalization tests yielded steep gradients only for those Ss that responded during S—. Area shift also occurred for these Ss.

Jenkins & Harrison (1960) reported flat gradients of tonal generalization for Ss receiving single stimulus training and steep gradients for Ss receiving interdimensional (tone/no tone) discrimination training. Lyons (1969) demonstrated that Ss which responded during the nonreinforced stimulus of an interdimensional discrimination yielded steeper wavelength generalization gradients than Ss that received "errorless" discrimination training. Terrace (1964) has reported similar results following intradimensional discrimination training along the wavelength continuum.

The preceding results suggest that nonreinforced responding during interdimensional or intradimensional discrimination training serves to sharpen dimensional control (cf. Hearst, Besley, & Farthing, 1970). However, it should be noted that the gradients of Terrace (1964) and Lyons (1969) were along a continuum (wavelength) which typically results in steep gradients following single stimulus training (cf. Riley, 1968). The question remains, therefore, as to the role of nonreinforced responding in the development of reliable dimensional control by a dimension that yields a flat gradient following single stimulus training, e.g., tonal frequency in the Jenkins & Harrison (1960) experiment.

It was the purpose of the following experiment to investigate gradients of generalization along the tonal frequency continuum subsequent to intradimensional discrimination training in which responding in the presence of S— was prevented. While response prevention during S— was effected by a blackout procedure and a fading procedure in the Lyons (1969) and Terrace (1964)

experiments, respectively, operandum removal was utilized in the following experiment.

SUBJECTS AND APPARATUS

The Ss were four naive male Silver King pigeons maintained at approximately 80% of their free-feeding weights.

A standard operant-conditioning chamber with interior dimensions of 30 x 30 x 38 cm was used. A 4 x 4 cm aperture centered 20 cm above the floor and 6 cm from the right edge of the response panel provided an opening for a retractable response key. The key was a 3 x 2 cm milked Plexiglas rectangle mounted on a retractable platform. In the "in" position, the rectangle projected 1 cm into the chamber and formed a 30-deg angle with the response panel. A 15-V ac 15-W clear keylight was mounted behind the panel, 2 cm below the response aperture. Response feedback (operation of a 28-V dc relay) was provided only for responses during the S+ component. A 115-V ac 15-W clear houselight was located 3 cm from the left edge of the response panel and 3 cm above the floor of the chamber. Reinforcement consisted of 4.0 sec access to mixed grain via a solenoid-operated magazine through a 6 x 5 cm aperture centered 15 cm above the floor and 10 cm from the left edge of the chamber. During reinforcement, the keylight and houselight were extinguished. A fan mounted on top of the chamber provided ventilation and masking of extraneous noise. The experimental conditions were governed by appropriate relay circuitry in a separate room.

Tones were provided by a Beltone audiometer connected to a 4-in. speaker mounted behind the response panel and centered 30 cm above the floor and 8 cm from the left edge of the panel. All tones were delivered at maximum, and presumably equal, loudness, as specified by Beltone. Throughout the experiment, the tones were interrupted every 2.0 sec for 0.5 sec. A tone was never present

during reinforcement or time-out (TO).

PROCEDURE Training

All Ss were trained to peck the transilluminated key in the presence of a 1.5-kHz tone by successive approximations to a discrete keypeck. Following the establishment of a discrete response, Ss received three daily sessions of continuous reinforcement (CRF) training. The Ss then received variable-interval (VI) 0.25-min training for the next five sessions. Variable-interval 0.6-min training began on the sixth session, during which a 10-sec TO was introduced every 30 sec. During TO, the tone, keylight, and houselight were inoperative and keypecks had no scheduled consequences. These conditions remained in effect for 20 daily sessions. All sessions terminated after 50 reinforcements had been collected.

During the next session, Ss began training with a two-component multiple schedule. The 1.5-kHz tone (S+) remained correlated with the VI component, while a 0.5-kHz tone (S—) was correlated with periods in which no reinforcement was available. Each daily session consisted of 15 2-min presentations of each component according to a predetermined quasirandom sequence. The 10-sec TO was presented every 30 sec irrespective of the component in effect. For two Ss (P3 and P4), the response operandum was present during periods of S+ and S—, while for two other Ss (P1 and P2), it was present only during the S+ component. For P1 and P2, these conditions prevailed for 15 sessions, while for P3 and P4 they were effective until the rate of S— responding was no more than 25% that of S+ responding during a single daily session (cf. Jenkins & Harrison, 1960).

Testing

During each test session, all Ss were given eight 30-sec presentations of each of the following tones: .125, .25, .5, .75, 1.0, 1.5, 2.0, and 3.0 kHz. A 10-sec TO followed each presentation and allowed for stimulus changes. The order of tonal presentations was randomized in eight blocks, each of which contained one presentation of each tone.

All Ss received four such tests, each separated by one session of retraining under the conditions immediately preceding testing. No reinforcement was administered during any test session.

Subsequently, P1 and P2 were given training in which the key was present during S+ and S—. Following this training, P2 received four generalization tests identical to previous tests.¹

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Fig. 1. (a) Percentage of total responses to each test stimulus following response prevention in the S- component. (b) Percentage of total responses to each test stimulus following discrimination training. For both figures, numbers in parentheses represent total number of responses for the four tests for each S.

RESULTS AND DISCUSSION

The percentage of total responses made to each test stimulus for P1 and P2 is shown in Fig. 1a. It is apparent that both Ss demonstrated very little differential responding during tests. These flat gradients, then, indicate an absence of reliable control by the tonal dimension following response prevention in the S- component.

The gradients for P3 and P4 are presented in Fig. 1b. Also shown is the gradient for P2 after subsequent training. These steeply sloped gradients are indicative of reliable dimensional control. It should be noted that the greatest area of each curve lies under values which are in a direction opposite that of S-. Such an "area shift" has been reported along visual dimensions, e.g., Hanson (1959) using wavelength and Bloomfield (1967) with line tilt. However, it has only recently been reported following an auditory discrimination (Gerry, 1971). While these investigators also reported a change in response mode, i.e., peak shift, such a result was observed only for P2 in the present case.

The gradients presented in Fig. 1 are averages of four tests. With the exception of somewhat more variability during the first tests for P1 and P2, the average gradients are representative of the four individual gradients for all Ss. It is also noteworthy that even though P1 and P2 were not matched with P3 and P4 in terms of the number of S+-S- sessions, the differences proved to be slight. That is, P1 and P2 each received 15 such sessions, while P3 required 18 and P4 only 10 sessions to reach the discrimination criterion. S P2 required 9 sessions to reach the criterion during subsequent training.

Behavioral contrast effects often observed in studies of this nature (i.e., involving a reinforced and a nonreinforced component) were evident prior to the first generalization tests for all Ss but P2. An increased rate was observed for these Ss by the fourth S+-S- session. The average deviation of S+ rate from the mean rate of the six sessions preceding S+-S- training for all S+-S- sessions was +26.0% for P1, 0.0% for P2, +40.0% for P3, and +11.5% for P4. During subsequent training of P2, an average increase in S+ rate of 18.9% was observed. While it could be argued that the response rate facilitation during S+ for P1 is indicative of dimensional control, whether dimensional control is a necessary concomitant of such rate changes is questionable (Scull, Davies, & Amsel, 1970). However, if these rate changes are assumed to imply dimensional control, in the present case the tonal dimension is not necessarily implicated (see below).

Congruent with Terrace (1964), gradient slope was greater if responding in the presence of S- occurred. Since flat gradients were obtained in the absence of such responding, the present results suggest nonreinforced responding to be a necessary condition for dimensional control. However, an alternative interpretation exists. If key presence was the dominant cue for P1 and P2 during training, variation in tonal frequency would be expected to effect little change in responding if the dominant cue (the key) was present. Since the key was present during generalization testing, the results are open to the preceding "cue utilization" interpretation (cf. Honig, 1969).

Grossen, Kostansek, & Bolles (1969) reported that the introduction of a previously established appetitive

S+ suppressed avoidance responding (Group S+ I). It may be possible then to index dimensional control by such a transsituational approach (see also Desiderato, 1969, 1970). Applied to the present case, if an avoidance baseline was maintained on alternate days with the no-key procedure, subsequent generalization testing could involve presentation of the various tonal stimuli during avoidance. It appears that such a procedure would eliminate the interpretive difficulties regarding cue utilization.

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NOTE

1. SP1 died after 17 sessions of subsequent training.