The effect of S– duration upon generalization along angularity and wavelength dimensions*

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Pigeons were given discrimination training to a white vertical line on a green surround (S+) and a white vertical line on a red surround (S–). The duration of each presentation of the S– was 15, 55, or 165 sec for three separate groups; the duration of each S+ presentation was 55 sec. Following training, a generalization test along either the (relevant) wavelength or the (irrelevant) angularity dimension was given. Wavelength generalization gradients increased in slope with increases in S– duration. Angularity gradient slopes increased only from 15 to 55 sec.

Many studies have been concerned with the effect of discrimination training along one dimension upon the steepness of the generalization gradient along another. One set of findings has shown that such training increases the steepness on a second dimension (Reinhold & Perkins, 1955; Thomas, Freeman, Svinicki, Burr, & Lyons, 1970). At the other extreme, it has been found that such training decreases the gradient slope on a second dimension (e.g., Sutherland, 1964). A comparison of two operant discrimination studies suggested one variable that might influence which effect would be obtained. Newman & Baron (1965) found that training pigeons to discriminate wavelengths did not produce steep gradients on a second (angularity) dimension. By contrast, Thomas et al (1970) similarly trained pigeons to discriminate wavelengths and found that their Ss did yield steep angularity gradients.

While there were a number of procedural differences between these two studies, the one that attracted our interest was the length of the S+ and S– periods during discrimination training: 55 and 15 sec, respectively, for Newman and Baron, and 50 sec for both S+ and S– periods for Thomas et al. We reasoned that since gradient steepness on a second (or irrelevant) dimension had been found (Perkins, Hershberger, & Weyant, 1959) to be greater for a group provided a more difficult discrimination (a condition which would be likely to increase errors), longer S– periods (which would permit a greater number of errors to be made) might produce steeper generalization gradients along a second dimension. The possibility that S– duration might similarly influence generalization slope along the training (or relevant) dimension was suggested by evidence from Terrace (1966) that a peak shift and a steeper gradient was obtained when a discrimination was formed with errors but not without errors.

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METHOD

Subjects

The Ss were 45 experimentally naive homing pigeons maintained at 70%-75% of their free-feeding weights.

Apparatus

The apparatus consisted of two wooden sound-attenuated Skinner boxes with associated automatic programming and recording equipment. Three walls of the experimental chamber were painted flat black. The fourth wall was aluminum and housed a 24-V dc Lehigh Valley food magazine and a translucent pecking key. A 6-V bulb situated behind the panel illuminated the experimental chamber at all times. An Industrial Electronics in-line display cell provided monochromatic lights of 501, 538, 555, 576, and 606 nm and/or five white lines, 7/8 in. high x 1/8 in. wide and oriented 30, 60, 90, 120 and 150 deg in a clockwise direction from horizontal. Masking noise was supplied by a white-noise generator.

Procedure

All birds were trained with the key illuminated by the 90-deg line superimposed on the 555-nm surround. Each S was given magazine and keypeck training on the first day, with 50 (100%) reinforced responses on the next day. On the third day of training, the birds were assigned to one of the three S– duration groups (15 per group) and given 10 days of discrimination training between the 90-deg line on the 555-nm surround (S+) and the 90-deg line on the 606-nm surround (S–). A variable interval 45-sec schedule of reinforcement with a 3-sec feeding cycle was used. The S+ duration was 55 sec for all groups. The S– duration was 15 sec for Group 15, 55 sec for Group 55, and 165 sec for Group 165. Discrimination training sessions lasted 30 min for all groups. For all groups, the S+ and S– were presented in an ABBABAAB order with an unlimited hold and no blackouts.

A warm-up session and generalization test were given on the day following the 10th day of discrimination training. Warm-up consisted of six alternations of S+ and S– for 45 sec each, with two reinforcements provided during each S+ presentation. Ten Ss per group were given a generalization test in extinction to five different angular orientations of the white line presented on the green (555 nm) surround: five Ss per group were tested with the five different wavelengths presented with the white vertical line always present. The order of these stimuli was systematically randomized within a series of five stimuli, with the restriction that the S+ never began a test and that each test stimulus was presented at least one time in each ordinal position of a test series. Twelve different random series were presented to each S. Stimulus presentations were for 45 sec each, with no time-out periods intervening.

RESULTS AND DISCUSSION

Generalization along the (Irrelevant) Angularity Dimension

The data for the three groups are presented in Fig. 1. It can be seen that, after wavelength discrimination training, the angularity generalization gradient was steepest for Group 55, followed by Groups 165 and 15. A trend analysis was performed on gradient slope

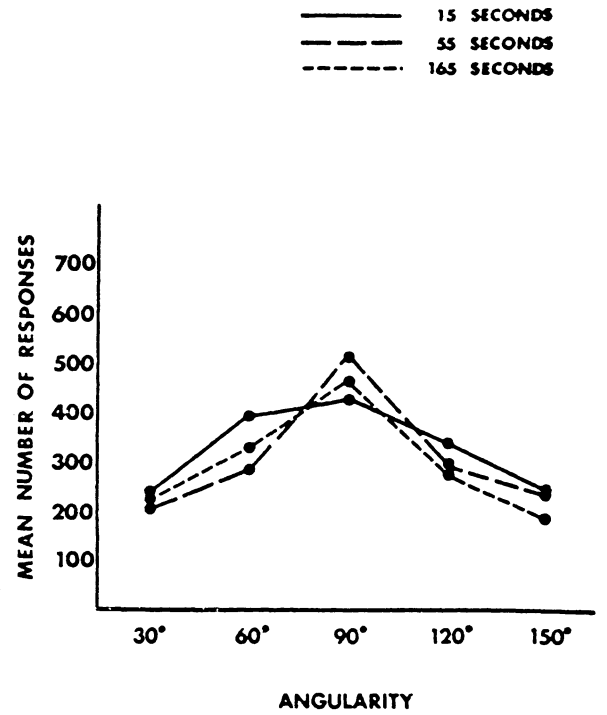

Fig. 1. Generalization gradients along the (irrelevant) angularity dimension.

measures.[1] Analysis of these slope measures showed nonsignificant differences among the groups, $F(2,27) = 1.17$, $p > .05$. However, a test of the difference between the mean slopes for Group 15 (which was similar to Newman and Baron's) and Group 55 (which was similar to Thomas et al's) yielded a $t(18)$ of 2.57, which was significant at the .025 level.

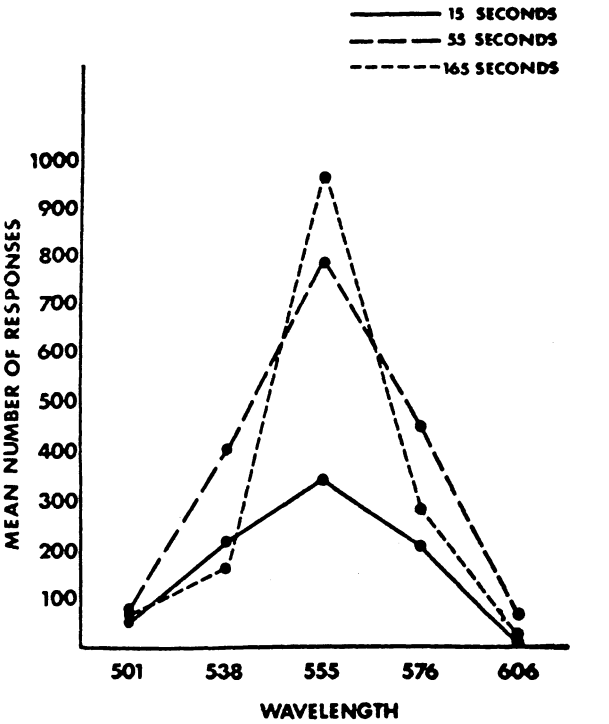

Fig. 2. Generalization gradients along the (relevant) wavelengthth dimension.

Generalization along the (Relevant) Wavelength Dimension

Generalization gradients along the (relevant) wavelength dimension are shown in Fig. 2. It can be seen that the longer the S– duration during wavelength discrimination training, the steeper were the gradients. Since the 606-nm test stimulus constituted the S– during discrimination training, it seemed appropriate to restrict statistical analysis to the left side of the gradients, i.e., to responses made to 501, 538, and 555 nm. A slope measure of these values was obtained for each S, and a trend analysis performed. The three groups differed from one another, $F(1,12) = 8.15$, $p < .001$. It is clear that longer S– durations during wavelength discrimination training produce steeper wavelength gradients.

The present study thus shows that generalization gradient slopes along the relevant and irrelevant dimensions were differentially affected by S– duration. The gradient along the (irrelevant) angularity dimension was steeper for Group 55 than for Group 15, but the gradients for the three groups did not significantly differ in slope. By contrast, it was found that S– duration was linearly related to gradient slope along the relevant dimension

These results would seem to reconcile the differential findings of Newman and Baron and Thomas et al. The exact nature of the effect of S– duration on relevant and irrelevant gradients, however, is not at all clear. Perhaps the degree to which an organism is required to inhibit responding during discrimination learning is an important variable. That is, learning not to respond in a discrimination task may be qualitatively different when different S– durations are employed. These differences may have differential effects on S+ generalization gradients. Such a hypothesis might receive support by relating S– duration to the slope of inhibitory gradients.

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NOTE

1. A unidirectional gradient was first determined for each S, i.e., the number of responses made during the generalization test was shown as a function of the number of steps separating the test stimuli from the training stimulus. Following this, the slope (beta) was determined for the best fitting (least squares) straight line.

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