The effects of extinction and "central tendency" on stimulus generalization in pigeons'

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Abstract

Following VI training to respond to a monochromatic stimulus, pigeons were tested for generalization in extinction with stimuli of shorter wavelength than the CS (uni-directional test) or with both shorter and longer wavelengths (bi-directional test). Regardless of test condition the gradients became reliably steeper during extinction; when gradients were equated for amount of extinction during testing there was no significant difference in steepness attributable to test condition.

Problem

Two very different test procedures have commonly been employed in the study of stimulus generalization. Hiss and Thomas (1963) have labeled these the "comparison" and "non-comparison" procedures. With the non-comparison procedure each S is tested for response strength to only one novel stimulus; thus groups of Ss are required to determine a gradient of generalization. With the comparison procedure each S is tested with a number of different stimulus values, thus making it possible to obtain gradients from individual organisms. The validity of the comparison procedure has been questioned (Grant & Schiller, 1953; Prokasy & Hall, 1963; etc.) on the grounds that the gradient may change in form during the course of testing in extinction. Although some studies have indicated such a change (e. g., Grant & Schiller, 1953; Jenkins & Harrison, 1961; Wickens et al., 1951), not all do (cf. Guttman & Kalish, 1956). It seems strange that few studies have attempted to directly compare the results of comparison and non-comparison testing. Two recent experiments have made such an attempt with contradictory findings, and it is this discrepancy which set the occasion for the present investigation.

Kalish and Haber (1963) gave pigeons VI training with a monochromatic stimulus light and then tested separate groups for response strength to a number of lights of shorter wavelength. Their comparison group, exposed to wavelengths both longer and shorter than the CS, generated a steeper gradient than did the non-comparison groups. Hiss and Thomas (1963) also used pigeons and VI training and also tested separate groups of Ss at a number of stimuli of shorter wavelength. Their comparison group, however, was only exposed to the CS and shorter wavelengths. Hiss and Thomas found no consistent difference in the steepness of comparison and non-comparison gradients.

Two methodological differences may account for the discrepancy in results noted above. Hiss and Thomas reported data obtained during the first few minutes of

extinction, whereas Kalish and Haber tested for more than an hour. Friedman and Guttman (1963) have re-analyzed Kalish and Haber's comparison group data and have indicated that the gradient became reliably steeper during extinction. Also, Thomas and Jones (1962) have reported with human Ss that there is a tendency for increased responding to stimuli near the center of the series of generalization test stimuli. If such a "central tendency effect" also occurs with pigeons, it would have steepened the comparison gradient in the Kalish and Haber experiment (where the CS was centrally located) while it flattened Hiss and Thomas' comparison gradient (where the CS was at one end). The present study compared the steepness of uni-directional and bi-directional generalization gradients during the course of extinction in order to assess the feasibility of these two interpretations.

Method

The Ss were 18 experimentally naive homing pigeons, maintained at approximately 75% of ad lib weight. Two identical Skinner boxes were used, with stimuli provided by Bausch and Lomb monochromators. On the day following 14 consecutive daily half-hour sessions of VI 1 (1 min. mean inter-reinforcement interval), the Ss were divided at random into 2 groups ($n = 9$, each). Group I was tested for generalization uni-directionally first, retrained for 2 additional daily VI sessions with 550 $m\mu$, and then tested bi-directionally; this order was reversed for Group II.

A warm-up period of 3 min. with VI 1 preceded each generalization test. The uni-directional test employed the values 550, 540, 530, 520, 510, and 490 $m\mu$, randomized in a series with 12 different random series presented to each S. The bi-directional test included the above values plus 610, 590, 580, 570, and 560 $m\mu$, all randomized in a series with 12 different series presented to each S. Throughout the last 7 VI sessions, the warm-up periods, the VI sessions between tests, and the tests themselves, stimuli were presented for 30-sec. periods separated by 10-sec. blackouts.

Results

Since only the left wing of the bi-directional gradient was of interest to us, responses to stimulus values higher than 550 $m\mu$ were omitted from the analysis. In order to study differences in relative generalization under the two test conditions, and also to equate for individual differences in response level, the measure of generalization slope used for each gradient was the proportion of all generalized responses (regardless of stimulus) to responses to the CS. An analysis of

variance was performed which included the dimensions of test number (one of two) and uni-directional vs. bi-directional test condition. The difference between test conditions was significant $F(1, 32) = 4.52, p < .05$, but neither the test number nor the interaction was. This made possible a more sensitive analysis in which we directly compared the steepness of each S's two gradients regardless of the order in which they had been obtained. The result was at (16 df) $= 3.02, p < .01$, again indicating significantly more generalization (a flatter gradient) with the uni-directional test condition. Fifteen of the 18 Ss yielded flatter uni-directional gradients.

To study the influence of extinction on gradient slope each gradient of each S was divided in half on the basis of total number of responses in the test (following the method suggested by Friedman and Guttman (1963). The measure of gradient slope employed earlier was separately applied to gradients from the first half and second half of extinction testing for both procedures and in both cases the gradient was reliably steeper in the second half of the test [uni-directional: $t(17 \text{ df}) = 2.41, p < .05$; bi-directional: $t(17 \text{ df}) = 5.81, p < .01$].

Because the bi-directional test included more stimulus values it took longer than the uni-directional test and thus permitted more extinction; the possibility must therefore be considered that the steeper gradient in the former case is an artifact of this additional extinction. To evaluate this possibility the data were re-analyzed as follows: For each test the total number of responses to the first series of test stimuli (including only the left wing of bi-directional tests) was used as an index of base-line response rate. When in the course of extinction testing the total number of responses for a test series fell below 1/2 of the initial rate for 2 consecutive series the test was terminated, i. e., data from subsequent test series were excluded from the analysis. In the case of 6 of the 36 tests (5 of them uni-directional) this criterion was never achieved, and the data of these Ss were discarded. In this manner, not only the two test conditions, but all of the gradients in both conditions were equated for relative extinction during testing. Of the 12 remaining Ss, 7 had flatter uni-directional gradients but 5 had steeper ones. The $t(11 \text{ df}) = 1.06$ does not approach significance. Thus the difference in gradient slope reported earlier for the two test conditions may be entirely attributed to differences in amount of extinction during testing.

Discussion

These results are in agreement with Guttman's (1956) tentative observation (based on 2 pigeons tested with 3 stimuli below the CS and 6 above it) that the generalization gradient in the pigeon is independent of such context effects. In this regard the results are also consistent with Friedman's (1963) failure to find a "units effect" in pigeons' generalization gradients after Thomas and Hiss (1963) had demonstrated such an effect with humans.

In all probability the steepening of Kalish and Haber's (1963) comparison gradient during the course of extinction testing fully accounts for the discrepancy between their study and the one by Hiss and Thomas (1963).

The finding of an extinction effect with a comparison test procedure should be of concern to users of this procedure, but need not lead to its rejection in favor of the non-comparison method. A preferable alternative (as employed by Hiss & Thomas) may be the restricting of generalization testing to a short period early in extinction so that extinction effects can be discounted without sacrificing the methodological advantages of comparison testing.

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