POSTDISCRIMINATION GENERALIZATION FOLLOWING RESPONDING TO BOTH DISCRIMINATIVE STIMULI¹

IN-MAO LIU

National Taiwan University

While attempting to control response speed, 2 experiments investigated the postdiscrimination generalization. In Exp. I, during the discrimination trials, 4 groups responded to S+ (70 db) by pushing a plate a distance of 20 cm, and to S- (80 or 90 db) by pushing a distance of 10 cm or not to respond at all. One group served as controls. It was found that the peak shift away from S- was also obtained with the groups trained to respond to S-, that the peak shift away from S- of these groups was no less than that of the groups trained not to respond to S-, and that more area shift as obtained with the former than the latter groups. In Exp. II, while partially replicating Exp. I, 5 groups were instructed in advance not to respond to the third tones. The generalization tests indicated that the peak shift was obtained only for the groups trained to respond to S-, and that, in comparison with Exp. I, the obtained peak shift was much smaller in magnitude. An extension of Spence's theory of discrimination was advanced to account for the present findings.

The general method required to produce a discrimination involves the extinction of generalized responses by withholding reward, while the strength of the response to some particular stimulus is maintained by reward. Based on this general scheme, some theories of discrimination assume the development of inhibitory tendency to the negative stimulus (S-) as essential in the formation of discrimination.

The term inhibition will be used interchangeably with not-responding tendency. Therefore, the concept of inhibition refers to the process of response onset only. The lengthening of response latency and the weakening of response magnitude at the time of response onset are measures of the amount of inhibition. The measure of response duration is irrelevant, since it is not a characteristic associated with response onset. Because the lengthening of response

latency signifies a stronger not-responding tendency, if the response to a given stimulus ceases to occur, this is a special case of lengthening of the response latency to an arbitrarily long time interval, and hence, meaning a complete inhibition. In this sense, a slower rate of responding signifies more inhibition, since the rate depends on the latency.

Experiments on postdiscrimination generalization (PDG) with animal Ss generally found that the peak of the gradient was displaced from the positive stimulus (S+) in the direction away from S- (e.g., Hanson, 1959; Honig, 1962; Honig, Thomas, & Guttman, 1959; Pierrel & Sherman, 1962; Thomas, Ost, & Thomas, 1960). The peak shift has been also found in studies with human Ss (Doll & Thomas, 1967; LaBerge, 1961; etc.). This finding supports the explanation of the peak shift as produced by the generalization effect of the not-responding tendency to S-.

Terrace (1963, 1964) trained pigeons not to respond from the beginning to S-

¹ This study was supported by a grant from the National Science Council. The author wishes to express his appreciation to Sin-tsi Lin and Yun-yen Shan for their assistance in collecting the data.

in a discrimination experiment, and found that the typical peak shift of a PDG gradient away from S— was not obtained with those Ss who learned the discrimination without errors. He concluded that if no (or few) responses to S— occur during the formation of discrimination, S— may function as a neutral stimulus instead of as an aversive one.

However, it is possible that the aversive characteristics of S— could have been neutralized gradually in the course of his special training procedure. A more direct approach might be to train Ss to respond to two stimuli. If the excitatory tendency is to be associated with each of two stimuli to be discriminated, the concept of inhibition would not be indispensable. Then, if the peak shift should be obtained in this situation, it could not be attributed to the operation of the not-responding tendency to S—.

Guttman's experiment (1959) came near to meet the above requirement. He trained a discrimination in which the discriminative stimuli were correlated with two different variable-interval schedules of reward, resulting in two different response rates. In other words, instead of signifying no reward, S— signified less frequent reward. The peak shift was also obtained in this situation.

In Guttman's experiment just cited, because of the very nature of using response rate as a dependent variable, S's response to S— could still be characterized by an inhibitory tendency. At the late stage of the experiment, he found that there was about a response every second to S+, while there was on the average less than a response every two seconds to S—. Thus, Terrace (1966a), based on his experiment similar to that of Guttman, inferred that the reduction of rate of responding in the presence of a discriminative stimulus relative to the rate of responding as maintained in the presence of another discriminative stimulus is a sufficient condition to make the stimulus

correlated with the reduction of response rate an aversive one.

In the present experiments, there was a condition in which S had to respond to either discriminative stimulus on every trial. Moreover, at the moment of response evocation, responses to the discriminative stimuli were exactly the same. Only difference was that the response to S+ was of a longer duration than that to S—. Hence, not-responding tendency was never associated with the discriminative stimuli at the moment of response evocation. Here, of course, the designations of S+ and S— are quite arbitrary.

EXPERIMENT I

According to Terrace's view (1963, 1964, 1966a) of the peak shift as produced by the aversive characteristic associated with S—, a group of Ss trained to respond to S— exactly in the same way to S+ at the moment of response evocation should not exhibit a peak shift in PDG tests. Moreover, the group trained not to respond to S— should manifest at least more peak shift away from S— than the group trained to respond to S—. The purpose of Exp. I was to test these implications. Besides, the difference between S+ and S— was manipulated in order to see whether the peak shift, if obtained, is related to the magnitude of difference between S+ and S—.

Method

Subjects. The Ss were 76 freshmen (27 male, 49 female) from introductory psychology classes. They participated in the experiment to fulfill the course requirement.

Apparatus. The apparatus, described elsewhere (Liu, 1968), was constructed with an eye to control response speed. Briefly, it consisted of a plate coupled to a weight by means of a piece of wood and a string passing over pulleys. The plate could be pushed in the forward direction by the right-hand thumb. In parallel with the push direction and 20 cm apart was

a belt of 2.5 cm width. The speed of the belt, which passed over two wheels 70 cm apart, could be controlled by an adjustable-speed motor. There was a pointer attached to the stem of the push plate, allowing *S* to push the plate at a pace of the forward movement of the belt.

It was necessary to control response speed on the following grounds. First, response speed has been found to be a variable having effect on response latency (Liu, 1968), and the latter in turn determines generalization gradient (Liu, 1966). Therefore, without controlling response speed, the results might be attributed to a difference in response speeds rather than the experimental manipulations. Second, since the kinetic energy associated with the push response depends on its speed, in order to assure the magnitudes of response to *S*+ and *S*— about equal at least at the moment of response evocation, it was essential to control response speed.

Procedure. In order of their appearance, *S*s were divided into five groups. Six *S*s could not reach within 30 trials the discrimination criterion to be described below, and were discarded, resulting in five groups of 14 *S*s each. Special attention was paid to make men and women about equally distributed in each group.

For *S* in the control condition (Group C), a tone (70 db, SPL, 1,000 cps, 200-msec duration) was first presented through the right earphone. After he heard the tone, he was instructed to start pushing the plate, upon hearing this tone later, at a pace determined by the speed of the belt, and to return to the original place slowly as soon as his response reached a distance marked. The speed of the belt was 37.2 cm/sec. The weight coupled to the push plate was 1,000 gm, and the required distance of push was 20 cm. After three trials of pushing the plate to the 70-db tone, seven test tones (40, 50, 60, 70, 80, 90, 100 db) were administered without interruption by keeping the same average intertrial interval of 10 sec (range: 8–12 sec). There were 14 orders of administering the test tones: seven orders each starting with one of the

seven tones, and the other seven orders obtained by reversing the orders of the former. Each *S* was tested with a different order.

For *S*s in two experimental groups, Groups 80–10 and 80–0, two stimuli to be discriminated were 70-db and 80-db tones. The *S* in either of these groups first heard the two tones and was asked whether he could discriminate the two on whatever basis. The *E* never gave him any hint as to how the two tones might differ. If *S* could not tell any difference, the two tones were presented again until he could find a difference. Then, as in the case of Group C, *S* was shown how to push the plate to a prescribed distance. For the first kind of tone he heard (always 70 db, *S*+), he was to push a distance of 20 cm. For the second kind of tone (always 80 db, *S*—), *S* in Group 80–10 was instructed to push a distance of 10 cm, while *S* in Group 80–0 was not to push at all. The *S* was told that *E* would occasionally tell him when his responses were “right” or “wrong”. Then the discrimination trials began. At a clearly audible volume, *E* said “right” every time *S* responded correctly to *S*+ and *S*— and “wrong” every time *S* responded incorrectly to *S*+ and *S*—. The order of administering *S*+ and *S*— was according to the following cycle: 70, 70, 80, 70, 80, 80, 70, 80, 70, 80 db. When *S* correctly responded to three 70-db and three 80-db tones consecutively, the discrimination trials were terminated and, without interruption, the test tones were presented as for *S*s in Group C, during which *S*'s responses were neither rewarded nor punished. During the discrimination trials, a response to the 70-db tone was scored correct if the push distance was in the range of 15–25 cm with the latency of less than 3 sec. A response to the 80-db tone was scored correct if the push distance fell in the range of 5–15 cm for Group 80–10, and no response at all for Group 80–0.

For *S*s in the other two experimental groups, Groups 90–10 and 90–0, they received the same treatments as in Groups 80–10 and 80–0, respectively, except that, during discrimination trials, 90-db tone served as *S*—.

Results

Trials to discrimination criterion. Although *Ss* could notice the difference of the two tones to be discriminated at the beginning, they did not necessarily respond correctly from the outset. Table 1 shows the mean number of trials to the discrimination criterion for each group. If *S* reached the criterion in six trials, he made no errors. There was a tendency for the 80-db groups (Groups 80-10 and 80-0) to take more trials to reach the criterion than the 90-db groups, but the tendency was not significant, $F(1, 52)=2.44$. Groups 80-10 and 90-10 did not differ appreciably from Groups 80-0 and 90-0, $F(1, 52)<1$.

Response speed. In order that response measures be comparable, for each *S*, an average response speed was obtained only from the last response to 70-db tone during the discrimination training. The average response speed was defined as follows: the maximum push distance divided by the time interval from the onset of the push response to the moment of attaining the maximum push distance. A push response from the polygraph was characterized first by the response onset followed by an acceleration, then by a fairly constant speed, and lastly by a deceleration to the maximum distance. Since the deceleration occurred at the last portion of a

TABLE 1

Number of trials to discrimination criterion

Group	80-10	80-0	90-10	90-0
<i>M</i>	9.14	8.07	6.86	7.93
<i>SD</i>	3.70	2.70	1.75	3.12

TABLE 2

Response speed (cm/sec)

Group	80-10	80-0	90-10	90-0	C
<i>M</i>	24.0	25.9	26.3	28.7	25.4
<i>SD</i>	6.87	7.69	9.06	11.49	6.36

push response, the average response speed was usually slower than the speed of the belt. The mean of these measures for each group is shown in Table 2. An analysis of variance indicated that group differences were not significant, $F(4, 65)<1$.

PDG gradients. The mean push distance to each test tone for each group is shown in Table 3. The mean was obtained over all trials, irrespective of whether a response occurred. An analysis of variance indicated that the between-*Ss* treatments produced significant differences among groups, $F(4, 65)=38.87$, $p<.001$. The *Ss* responded differently to the test tones, resulting in the obtained generalization

TABLE 3
Mean generalization gradients of Exp. I

Test Tone (db)	Group									
	80-10		80-0		90-10		90-0		C	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
40	14.4	9.50	5.6	9.31	4.2	8.46	2.7	6.98	5.8	9.24
50	20.1	0.94	15.6	8.51	19.6	0.69	13.7	9.10	17.2	7.36
60	20.1	0.77	19.9	0.72	19.7	0.66	18.1	5.37	20.1	1.30
70	17.5	3.99	17.0	0.72	19.5	0.89	19.6	1.34	19.8	0.78
80	12.4	4.03	6.8	9.51	18.8	2.68	12.7	9.81	20.3	1.44
90	10.4	1.00	0	0	11.1	3.75	0.3	0.96	20.0	0.96
100	10.3	1.08	1.5	5.03	9.8	0.89	0.2	0.75	20.3	0.98

Note. Entries are in units of cm. A distance of 1 cm is equivalent to 1,000 gm cm of energy.

gradients, $F(6, 390)=80.77$, $p<.001$. The interaction between the test tones and the between-Ss treatments was also significant, $F(24, 390)=9.61$, $p<.001$, indicating that the shapes of gradients depended on the treatment groups.

Since S in each group was instructed to respond differentially only to some S —stronger than 70 db, the main interest of this experiment was in finding out how the responses to 70-db tone and weaker ones (left wing) were affected. When the responses to the test tones stronger than 70 db were excluded from consideration, an analysis of variance indicated that the between-Ss treatments, the test tones, and their interaction all produced significant effects, $F(4, 65)=4.02$, $p<.01$, $F(3, 195)=71.77$, $p<.001$, and $F(12, 195)=2.49$, $p<.01$, respectively. With respect to the left wings of the gradients under consideration, Group 80–10 differed significantly from Group C, $t(65)=3.31$, $p<.01$. As is clear from Table 3 the difference came from stronger responses to the weak tones for Group 80–10 than for Group C, producing an area shift. Group 80–10 also responded to the weak tones with higher magnitude than Group 80–0, $t(65)=4.97$, $p<.001$. Similarly, Group 90–10 responded to the weak tones with higher magnitude than Group 90–0, $t(65)=3.12$, $p<.01$. On the other hand, Group 80–10 showed higher magnitude of response to the weak tones than Group 90–0, $t(65)=3.26$, $p<.01$.

Peak shift. To see the nature of the peak shift, the mode of responding of the gradient for each S was arbitrarily obtained as

follows. First, for each S , the tones to which he responded with a magnitude of more than 15 cm (70-db response) were determined. Then, the average of these tones was calculated and used as the tone of the peak response tendency. This means that, in calculating the mode of responding for each S , responses with a push distance of less than 15 cm were disregarded. Otherwise, for instance, if Group 80–10 and Group 80–0 responded correctly to S —, every other thing equal, there would still be a peak shift of one group relative to the other. In other words, since different groups had S — of different loci as well as were instructed to respond to S — in different ways, the mode of responding was calculated in the above way to avoid the superficial effect due entirely to the actual response tendencies to S —.

Table 4 shows the mean of the individual modes for each group. The mean mode of Group C was stronger than 70 db, displaying the so-called stimulus intensity effect. The differences between Group C and each of the discrimination groups, Groups 80–10, 80–0, 90–10, and 90–0, were all significant, $t(65)=10.38$, 7.50, 5.77, and 6.18, all $ps<.001$, in their order. Thus, a peak shift in the direction away from S — was obtained with each discrimination group. Moreover, larger peak shift was obtained with Group 80–10 than Group 90–10, $t(65)=4.61$, $p<.001$. However, a difference in the same direction between Groups 80–0 and 90–0 failed to reach a significant level, $t(65)=1.32$. Against expectation, the peak shift of

TABLE 4
Mode of responding (db)

Group	80–10		80–0		90–10		90–0		C	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Exp. I	56.28	4.03	61.28	6.80	64.28	3.31	63.57	4.57	74.28	3.31
Exp. II	66.93	9.31	72.14	4.69	67.71	7.08	72.14	3.23	74.64	4.14

Group 80-10 in the direction away from S- was more marked than that of Group 80-0, $t(65)=2.88$, $p<.01$.

Discussion

The results of Exp. I showed that, although the response strengths to S+ and S- were about equal at the time of response evocation, the peak shift in the direction away from S- was still obtained. In addition, the groups trained not to respond to S- during the discrimination trials did not manifest more peak shift away from S- than the groups trained to respond to S-. On the contrary, more peak shift was obtained with the group trained to respond to S- than the group trained not to respond to S-, when the difference between S+ and S- was small (80-db as S-). Terrace's inference (1963, 1964, 1966a) that the peak shift is produced by S- for its acquiring aversive characteristic would have difficulties in explaining the present findings.

A slight extension of Spence's theory of discrimination (1936), however, could account for the present findings. The extension runs as follows. (1) When responses R_1 and R_2 become associated with stimuli S_1 and S_2 , respectively, there result in the generalization gradients $g_1(S_1; S)$ and $g_2(S_2; S)$, where $g_i(S_i; S)$ is the level of response tendency to test stimulus S , after R_i becomes associated with S_i . (2) The two gradients interact not in the manner of algebraic summation postulated by Spence, but in such a way to produce an intermediate gradient in the following way: if for $S=S_0$, $g_1(S_1; S_0) \leq g_2(S_2; S_0)$, then the composite gradient is such that $g_1(S_1; S_0) \leq g_c(S_1 \& S_2; S_0) \leq g_2(S_2; S_0)$, and the decreased level of response tendency to S_0 from g_2 , $g_2 - g_c$, is inversely related to the distance between S_1 and S_0 .

Spence's classical theory is a special case of the present version in which R_2 is a not-responding tendency. It is not dif-

ficult to see that the present findings all follow from the above two assumptions. For instance, Groups 90-10 and 90-0 trained with 90-db tone as S- did not show a difference in the peak shifts because the distance between S+ and S- was larger, while a difference in the peak shifts was obtained with Groups 80-10 and 80-0, because the intermediate response to a tone weaker than 70 db would be of larger magnitude in the case of Group 80-10 than Group 80-0, resulting in more peak shift as well as area shift farther away from S- for Group 80-10 than Group 80-0.

EXPERIMENT II

In order that the extended version of Spence's theory of discrimination can account for when a peak shift does not occur as well as when it does, it suffices to note the following empirical fact: Any training procedure which provides S with more experience with the stimulus continuum underlying the discriminative stimuli results in steeper generalization gradients associated with the stimuli (e.g. Peterson, 1962). Obviously, with a steeper generalization gradient associated with S-, its effect will not go far in distance, resulting in less prominent, or absence of, the peak shift. There are experimental evidences which can be interpreted as supporting this implication. With extended discrimination training, S will have more experience with the discriminative stimuli. In this situation, the amount of peak shift would gradually decrease. This is what was obtained by Terrace (1966 b). In another experiment, Terrace (1964) provided S with experience of various stimulus characteristics (duration and brightness) of the discriminative stimulus in the course of training, and found that no peak shift was obtained with this training procedure. Terrace's observation that S s trained to make discrimination with errors displayed emotional behavior suggests another factor

contributing to the peak shift, since it is well known that the response latency of highly emotional *S* is relatively short. The short response latency in turn is associated with a less steep generalization gradient.

Presumably, any procedure which demands *S* to pay closer attention to the discriminative stimuli would result in the steeper generalization gradient, hence producing a smaller peak shift. Exp. II was designed to test this conjecture. Specifically, *S* in this experiment was told in advance that later he would hear some tones other than *S*+ and *S*−, and was instructed not to respond to these third tones.

Method

Subjects, apparatus, and procedure. The *Ss* were 77 freshmen (27 male, 50 female) from the same introductory psychology classes as in Exp. I. The same apparatus was used. Except minor changes in the instructions, the procedure followed that of Exp. I. For Group C, *S* was told that he would later hear some other tones than the one he heard, and was instructed not to respond to those tones. For the other discrimination groups, *S* was told that, in addition to the two kinds of tones he heard, he would later hear other tones as well, and was instructed not to respond to those tones.

Five *Ss* failed to reach the discrimination criterion, and two *Ss* responded to none of the test tones. With these seven *Ss* excluded there were 14 *Ss* in each group.

Results

PDG gradients. The data analysis follows the pattern of Exp. I. The mean response strength to each test tone for each group is shown in Table 5. An analysis of variance showed that the between-*Ss* treatments, the test tones, and their interaction had significant effects, $F(4, 65)=9.09$, $p<.001$, $F(6, 390)=75.35$, $p<.001$, and $F(24, 390)=3.07$, $p<.001$, respectively.

As before, since our main interest was in the left wings of the gradients, a further analysis of variance was done exclusively for the data corresponding to the left wings. It was found that the between-*Ss* treatments and the test tones had significant effects, $F(4, 65)=4.77$, $p<.001$, $F(3, 195)=103.67$, $p<.001$, while their interaction was not significant, $F(12, 195)<1$. Pairwise comparisons indicated that Group C did not differ significantly from Group 80–10, nor from Group 90–10, $t(65)=.42$, and $.92$, respectively. However, Group C had a significantly higher level of responding than Groups 80–0 and 90–0, $t(65)=2.76$, $p<.01$, and $t(65)=2.22$,

TABLE 5
Mean generalization gradients of Exp. II

Test Tone (db)	Group									
	80–10		80–0		90–10		90–0		C	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
40	2.8	7.19	0	0	3.0	7.64	0	0	1.4	5.34
50	8.5	10.20	0	0	4.3	8.50	1.4	5.34	9.8	10.18
60	11.3	10.15	5.6	9.26	11.5	10.41	7.0	9.80	14.0	9.20
70	18.3	5.28	18.6	5.40	18.5	5.40	19.7	0.75	18.6	5.47
80	11.3	5.18	7.0	9.71	14.6	6.27	17.0	7.24	19.9	1.20
90	9.1	4.66	0.1	0.40	9.4	2.85	0	0	14.0	9.21
100	5.1	5.31	0.5	1.31	4.8	5.28	0	0	8.8	10.26

Note. Entries are in units of cm. A distance of 1 cm is equivalent to 1,000 gm cm of energy.

$p < .05$, respectively. Although Group 90-10 did not differ significantly from group 90-0, $t(65) = 1.30$, Group 80-10 exhibited a higher level of responding to the weak tones than Group 80-0, $t(65) = 2.35$, $p < .05$.

Peak shift. Table 4 also shows the mean mode of responding for each group in Exp. II. Since there was an overall difference in the modes of responding for various groups, $F(4, 65) = 4.03$, $p < .001$, further comparisons were made. While Groups 80-10 and 90-10 showed significant peak shifts with respect to Group C as a reference level, $t(65) = 3.34$, $p < .01$, and $t(65) = 3.00$, $p < .01$, respectively, Groups 80-0 and 90-0 did not.

Comparison of Exp. I and II. Since the Ss of Exp. I and II were from the same introductory psychology classes, the results were comparable. A comparison of the two control groups of Exp. I and II (2 ways of instructions $\times$ 7 test tones) indicated that the difference in the instructions produced a significant effect, $F(1, 26) = 12.24$, $p < .01$. The interaction between the instructions and the test tones as well as the gradients produced by the latter was significant, $F(6, 156) = 3.06$, $p < .01$, and $F(6, 156) = 26.52$, $p < .001$, respectively. As is clear from Table 3 and 5, these indicate that the gradient of Group C of Exp. I is flatter than that of Group C of Exp. II.

For the eight discrimination groups of Exp. I and II, the left wings of the gradients were subjected to an analysis of variance (2 modes of instructions $\times$ 2 ways of responding to S- $\times$ 2 loci of S-). All the two-way and three-way interactions were not significant. The instructions of Exp. II produced a low level of responding to the weak tones, $F(1, 104) = 104.59$, $p < .001$. As was noted before, the way of responding to S- also had a significant effect, $F(1, 104) = 17.89$, $p < .001$. However, the locus of S- did not produce a significant effect, $F(1, 104) = 1.27$.

In order to see the effect of difference in

the instructions on the peak shift, the corresponding groups of Exp. I and II were compared. The two control groups of Exp. I and II did not differ significantly from each other, $t(26) = .25$. Groups 80-10, 80-0, 90-10, and 90-0 of Exp. I each had its mode of responding displaced in the direction farther away from S- than its corresponding group of Exp. II. With one exception, this tendency was all significant, $t(26) = 3.93$, $p < .001$, $t(26) = 4.91$, $p < .001$, $t(26) = 1.64$, $p < .10$, and $t(26) = 5.71$, $p < .001$, respectively.

Discussion

The finding that the extent of the peak shift for each discrimination group was smaller in comparison with that of the corresponding group of Exp. I supports the hypothesis that a training procedure demanding S's paying attention to the attributes of discriminative stimuli steepens the generalization gradient and decreases the amount of peak shift. These results are in line with the experiment of Jenkins and Harrison (1960). In their experiment, when the 1,000 cps tone was correlated with a variable-interval schedule of reward, and the absence of the tone was correlated with extinction, a steep generalization gradient was obtained. However, without differential reward in which the absence of the tone was correlated with extinction, the obtained gradient was flat. The function of the absence of the tone as correlated with extinction is similar to instructing S not to respond to the tones other than the discriminative stimuli in the present Exp. II.

Significantly higher level of responding to the weak tones of Group 80-10 than Group 80-0 and the similar tendency found in Group 90-10 compared to Group 90-0 are in accord with the extended version of Spence's theory.

REFERENCES

- DOLL, T. J., & THOMAS, D. R. 1967 Effects of

- discrimination training on stimulus generalization for human subjects. *J. exp. Psychol.*, **75**, 508-512.
- GUTTMAN, N. 1959 Generalization gradients around stimuli associated with different reinforcement schedules. *J. exp. Psychol.*, **58**, 335-340.
- HANSON, H. M. 1959 Effects of discrimination training on stimulus generalization. *J. exp. Psychol.*, **58**, 321-334.
- HONIG, W. K. 1962 Prediction of preference, transposition, and transposition-reversal from the generalization gradient. *J. exp. Psychol.*, **64**, 239-248.
- HONIG, W. K., THOMAS, D. R., & GUTTMAN, N. 1959 Differential effects of specific extinction and discrimination training on the generalization gradient. *J. exp. Psychol.*, **58**, 145-152.
- JENKINS, H. M., & HARRISON, R. H. 1960 Effect of discrimination training on auditory generalization. *J. exp. Psychol.*, **59**, 246-253.
- LABERGE, D. 1961 Generalization gradients in a discrimination situation. *J. exp. Psychol.*, **62**, 88-94.
- LIU, I. 1966 Generalization and response latency. *Percept. & Psychophys.*, **1**, 366-368.
- LIU, I. 1968 Response latency depends on response speed. *Jap. psychol. Res.*, **10**, 174-178.
- PETERSON, N. 1962 Effect of monochromatic rearing on the control of responding by wavelength. *Science*, **136**, 774-775.
- PIERREL, R., & SHERMAN, J. G. 1962 Generalization and discrimination as a function of the S^D - S^+ intensity difference. *J. exp. anal. Behav.*, **5**, 67-71.
- SPENCE, K. W. 1936 The nature of discrimination learning in animals. *Psychol. Rev.*, **43**, 427-449.
- TERRACE, H. S. 1963 Discrimination learning with and without "errors." *J. exp. anal. Behav.*, **6**, 1-27.
- TERRACE, H. S. 1964 Wavelength generalization after discrimination with and without errors. *Science*, **144**, 78-80.
- TERRACE, H. S. 1966a Stimulus control. In W. K. Honig (Ed.), *Operant behavior: areas of research and application*. New York: Appleton-Century-Crofts.
- TERRACE, H. S. 1966b Behavioral contrast and the peak shift: effects of extended discrimination training. *J. exp. anal. Behav.*, **6**, 613-617.
- THOMAS, D. R., OST, J., & THOMAS, D. 1960 Stimulus generalization as a function of time between training and testing procedures. *J. exp. anal. Behav.*, **3**, 9-14.

(Received Dec. 26, 1969)