A TEST OF STIMULUS GENERALIZATION MODELS

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ABSTRACT

A TEST OF STIMULUS GENERALIZATION MODELS

by Lance A. Harris

Two predominant theories of stimulus generalization, the Spence S-R theory and the Zeiler Adaptation Level theory, have had only limited experimental application in varying situations. In order to relate the theories outside the transposition problem a design was utilized that employed light intensity as the discriminative stimulus dimension and extinction as a special experimental manipulation.

After a brightness discrimination had been established in a conventional Skinner box, all Ss were given 5 minutes of warm-up followed by extinction with the stimulus lights off (extinction 1). This was followed in turn by 10 non-reinforced test trials with alternately presented training stimuli (extinction 2).

t-tests of the warm-up data indicated that none of the differences observed in extinction 1 and extinction 2 could be attributed to differences present in training.

In extinction 1 all D groups (training S^D = dim light) responded significantly more than all B groups (training S^D = bright light).

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In extinction 2 all B groups responded significantly more to the bright stimulus than all D groups.

The results were as predicted by the Spence model of generalization gradient summation. The Zeiler theory also predicts the outcomes if the value of the mathematical constant y is varied from .01 to .1 or from .9 to .99 with the most accurate prediction made when y approximately equals .9.

Further experimentation with both theories is indicated, but because of the greater generality of the Zeiler theory, it is probably a more potentially powerful formulization than the Spence model.

Approved M. Ray Denny

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by

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It is with love that I dedicate this effort to my wife Mary who, uncomplaining, became a research widow during the time the data was collected, and who, in the few hours that she was not working at her job, attending to our home, or loving our demanding cats, acted as my secretary-at-arms.

Special acknowledgment must be given to Maureen Hattle, Jenny Fidura, and Fred Fidura, without whose help in conducting the research, and more important, without whose comradeship, this thesis would likely have remained an idea.

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INTRODUCTION

A critical test of a stimulus generalization model as it pertains to a discrimination task has been the transposition problem. In a typical transposition situation, Ss are trained to respond differentially to two stimuli, and subsequently tested by presenting one or more new stimuli lying on the same physical dimension. As an example, if S has been trained to respond to an S^D (positive stimulus) of 430 cm^2 and not to respond to an S^Δ (negative stimulus) of 220 cm^2, then S is said to have transposed if a 240 cm^2 stimulus is preferred to a 110 cm^2 stimulus in test. In other words, transposition is defined behaviorally as the response to the relational properties (e.g. larger or brighter) of the stimuli.

Köhler (1938) conducted a series of experiments where chickens were trained to discriminate between two shades of gray. The Ss responded to a light gray stimulus as S^D and a dark gray as S^Δ. In the test with the S^Δ (dark gray) and a darker gray, the previous S^Δ was preferred. Köhler reasoned that "when an animal is trained, it may well be that . . . its choice is of one side of the pair which the colours together compose" (Köhler, 1938). Furthermore, since the Ss did not respond to the absolute properties of the stimuli (i.e. X foot-candles = S^D, 1/2 X foot-candles = S^{Δ}), the data was taken as evidence that the absolute, or S-R theories of discrimination were inadequate.

However, Spence (1937) points to several studies where transposition has failed to occur. As an explanation for the diverse findings Spence offers a S-R theory based on three postulates. These are: (a) learning is "a cumulative process of building up the strength of the excitatory tendency of the positive stimulus cue . . . by means of successive reinforcements of the response to it . . ."; (b) similarly, non-reinforced responses to the negative stimulus establish an inhibitory tendency for non response to it; (c) total response tendency to any particular stimulus can be predicted by subtracting the inhibitory gradient from the excitatory gradient at the value of the stimulus in question (Figure 1) (Spence, 1937).

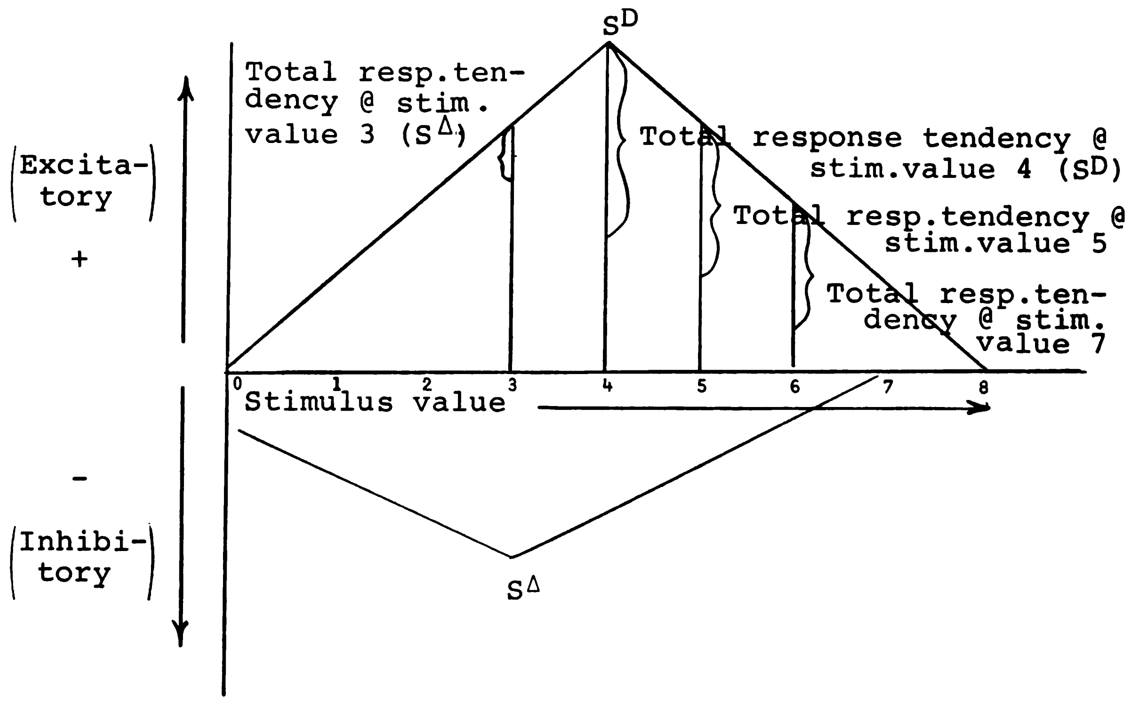

Figure 1. Example of the Spence model of total response tendency.

In an attempt to support his theory, Spence (1937) trained chimpanzees to respond differentially to 160 cm^2 (+) and 256 cm^2 (-) white squares. After a criterion of 90% correct responses was met the Ss were presented with two white squares of either 256 and 409 cm^2 or 100 and 160 cm^2, with responses reported as the percentage of transposition in the test trials, i.e. a preference for the smaller test stimulus of the pair. In the critical test, 100 and 160 cm^2, percent transposition was only 53.3%. This confirmed the prediction made by the Spence model as illustrated in Figure 2. Since the Ss did not prefer the smaller of the two stimuli as predicted by the relationist' position, the results demonstrate the superiority of the Spence theory in explaining the simple two choice transposition test procedure.

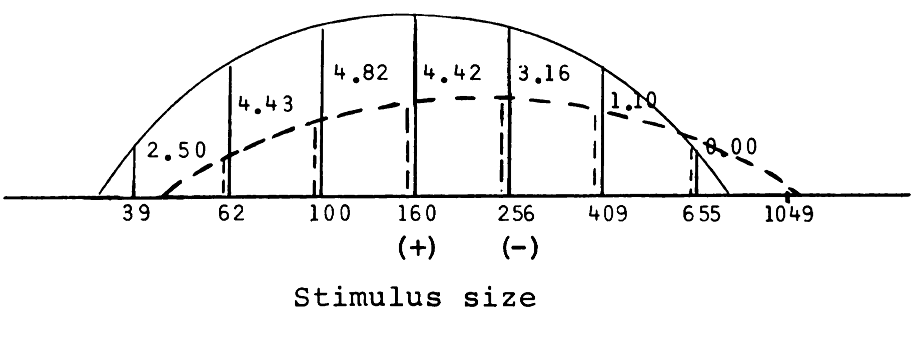

Figure 2. Diagrammatic representation of relations between the hypothetical generalization curves, positive and negative, after training on the stimulus combination 160 (+) and 256 (-). The numbers above the stimulus size numbers represent total response tendency. (Spence, 1937)

Perkins (1953) noted that although studies using differential conditioning have consistently found the stimulus intensity dynamism effect postulated by Hull (1943), studies using a simple, or non-differential response technique have often found that an increase in stimulus intensity often depresses response rate. Perkins postulated that stimulus intensity dynamism was an artifact of the differential conditioning technique that could be explained by the Spence model as illustrated in Figure 3. Perkins' interpretation of this model is "although generalization of the effects of positive training are the same, there is greater response strength to stimulus G [a stimulus of greater intensity than S^D] than to stimulus L [a stimulus of less intensity than S^D]. This difference is the result of greater generalization of extinction [non-reinforcement] effects to L than to G" (Perkins, 1953). A subsequent test with rats in a simple versus a differential response training model supported this interpretation.

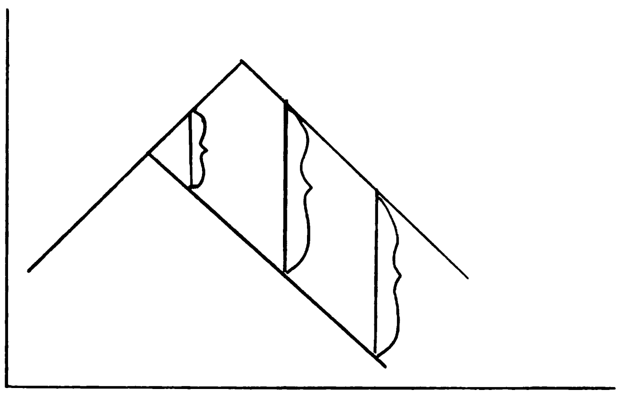

Figure 3. Diagrammatic representation of the hypothetical generalization curves, present in all differential conditioning situations according to the Spence model of discrimination. (Perkins, 1953)

In a critical review of transposition by Hebert and Krantz (1965), the authors point to various inadequacies inherent in the Spence formulation. One very important weakness is that the shape of the gradients has a profound effect on the predictions made by the model. It is unlikely that enough research on specific gradient shapes will be done in the near future to enable the exact selection of the appropriate gradient.

In addition, the Spence model is incapable of explaining the results of the intermediate size problem. In this situation Ss are trained to differentially respond to one S^D (the intermediate sized stimulus) and two S^{Δ} stimuli, with three stimuli instead of two presented in the test set.

In an experiment by Gentry et al. (1959), monkeys trained to respond to an intermediate sized box preferred an intermediate sized box in subsequent transposition tests even when the intermediate member of the test set was not the original S^D. The Spence model should predict that regardless of its new relational position, the training S^D would be preferred (Figure 4).

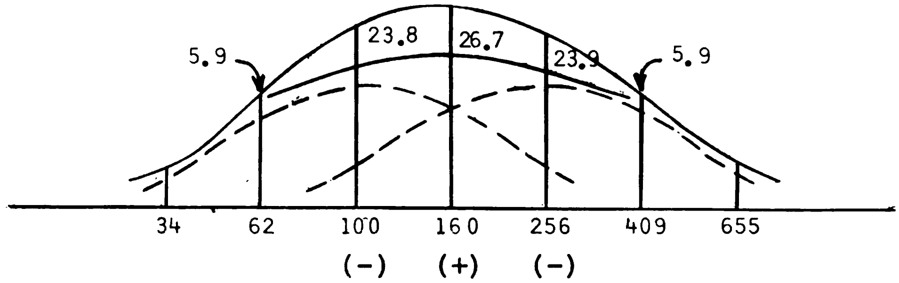

Figure 4. The Spence model for the intermediate size problem. The solid line below the positive gradient represents a summation of the two negative gradients. (Spence, 1942)

A recent formulation of the process of discrimination by Zeiler (1963) utilizes certain basic postulates of the AL theory first proposed by Helson (1947). The Zeiler AL theory has been found to be capable of explaining the results of the intermediate size problem where the Spence theory has failed, and because Zeiler's theory does not involve generalization gradients, the difficulty in specifying the shape of the gradients is not encountered.

In the Zeiler theory discrimination is seen as a process of learning to respond to the ratio of the positive (S^D) stimulus to the AL instead of learning to respond to a particular absolute stimulus value. The specific postulates of the Zeiler theory (Zeiler, 1963) are:

1. The AL is the weighted log mean of the disciminative stimuli and residual AL (previous AL). Let Xi represent the discriminative stimuli, R the residual AL., y the constant applied to the log mean of the discriminative stimuli, x the constant applied to the residual AL, y + x = 1.00, and n the number of discriminative stimuli. The AL is:

$$\text{Log AL} = y \left(\frac{\Sigma \log Xi}{n}\right) + x \log R$$

(a) The S enters training with a residual AL which exerts an extra-experimental effect on the AL. With each successive trial, R becomes increasingly a function of the series stimuli since R is primarily dependent upon immediate past stimulation. The effect of irrelevant prior stimulation in negligible by the completion of training so that:

$$\text{Log Training AL} = \frac{\Sigma \log Xi}{n}$$

(b) The AL on the first test trial immediately after the completion of training is expressed by the formula:

$$\text{Log Test AL} = y \left(\frac{\Sigma \log Xi}{n}\right) + x \log \text{Training AL}$$

2. Each stimulus in the series is defined as the ratio of the stimulus area to the AL.

3. The S learns in training to respond to the ratio of the positive stimulus to the AL.

4. (a) Probability of response on the first test trial is a function of the degree of similarity between the individual test stimulus ratios and the positive training ratio whenever all of the test stimulus ratios are not either larger or smaller than the positive training ratio.

   (b) When all of the test stimulus ratios are either larger or smaller than the positive training ratio, response will be divided randomly among the test stimuli.

Since the weighting constants x and y must sum to a total of 1.00, as the value of one constant increases the other must decrease. Thus the formula for the test AL indicates that as the impact of the discriminative stimuli becomes greater on the establishment of the new Al, the importance of the residual AL in the determination of the new AL must decrease and vice versa.

Zeiler (1963) has noticed that as the distance separating the values of the test stimuli becomes larger, the value of y increases, and to date this is the extent of the information available on the determining factors of the weighting constants.

It should be noted that the Zeiler theory makes no mention of the negative or non-reinforced stimulus. In constrast to Spence, Zeiler assumes that transfer is primarily of the positive stimulus and that "While learning of the negative stimulus may and undoubtedly does occur, the re-analysis of the data in the literature and the results of the author's experiments do not require consideration of the negative ratios in order to deduce the test response" (Zeiler, 1963).

Besides predicting the results of various intermediate size problem experiments by Spence (1942), Gonzales et al. (1959), Gentry et al. (1959), and Stevenson and Bittermann (1955), Zeiler has conducted a series of experiments using 4 and 5 year old children in the intermediate size problem. He was able to find six basic phenomena that, at this point, only the Adaptation Level theory is able to integrate under a single unified explanation. "They are: (a) relational choice (tranposition); (b) systematic absolute response; (c) systematic choice of neither an absolute nor relational stimulus; (d) equal preference for two of the three [test set] stimuli; (e) random response; and (f) the points of transition between each of these modes of response" (Zeiler, 1963).

All of the previous research and predictions with the Zeiler Adaptation Level theory has involved size discriminations. In the same vein the Spence theory has not been experimentally verified much outside the transposition problem. The present design will introduce intensity as the discriminative stimulus dimension and extinction as a special experimental manipulation. Specifically, after the brightness discrimination has been established, all Ss will be extinguished with the stimulus light off and .125 foot-candles of ambient light present (extinction 1). Following this, non-reinforced responses will be recorded with the original discriminative stimuli presented (extinction 2).

Given this situation the Spence model is constructed as in Figures 5A (groups with a bright light S^D in training) and 5B (groups with a dim light S^D in training). In extinction 1 it can be seen that the total response tendency with the stimulus lights off is much greater for the D groups than for the B groups. Therefore the D groups should respond more to the stimulus lights off than the B groups (prediction 1). In extinction 1, a second inhibitory gradient is being established. The subtraction of both inhibitory gradients gives the total response tendency to S^D in extinction 2. Thus the response tendency to S^D should be much greater in the B groups than in the D groups (prediction 2).

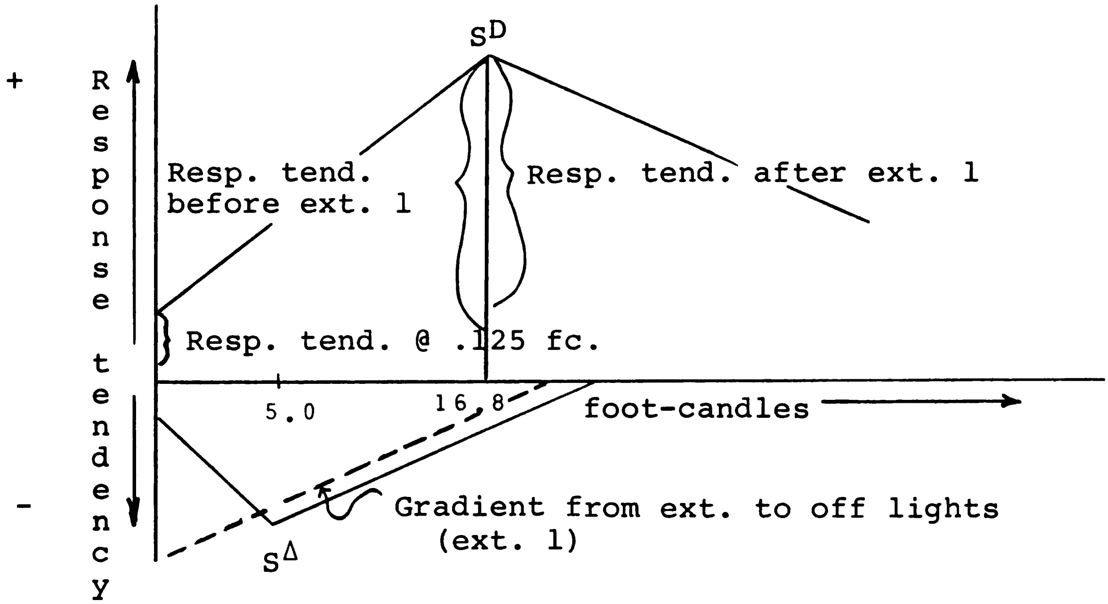

Figure 5A. Summation of gradients for all B groups.

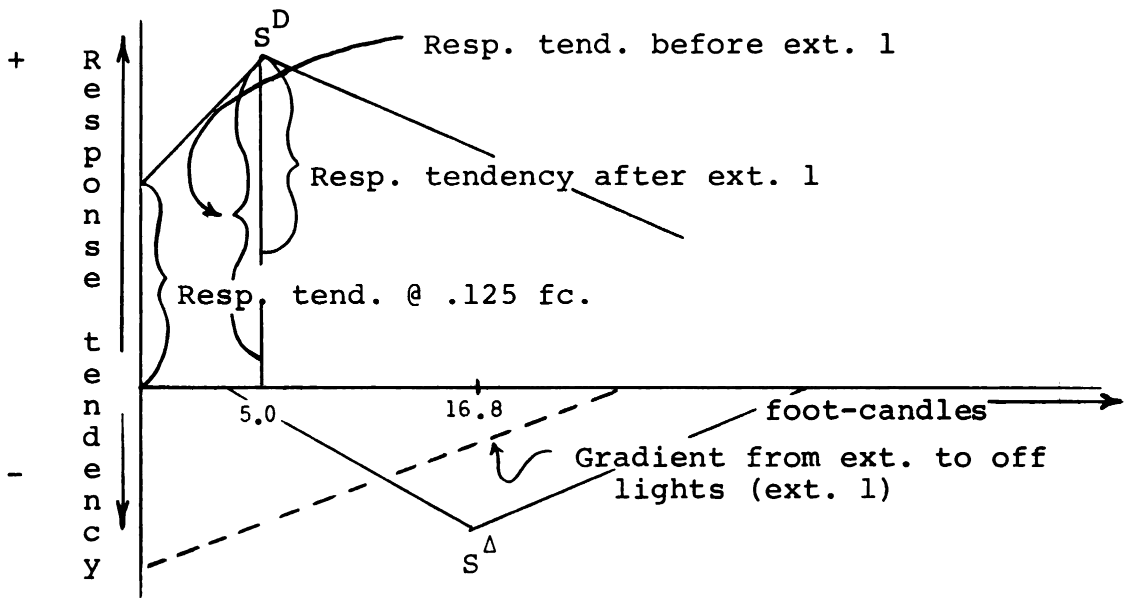

Figure 5B. Summation of gradients for all D groups.

Because the values of the weighting constants x and y cannot be determined before the data is collected, no predictions can be derived from the Zeiler theory. Instead the Zeiler theory will be applied to the results and in this way it is hoped that information can be gathered concerning limitations and indications for further research. In addition, if the Zeiler theory is able to handle the obtained data, some further information on the parameters determining the values of x and y may be found.

In the application of both models, it is assumed that the S̲ is responding to the total amount of light in the box which is a direct reflection of the intensity of the stimulus lights. Thus, with the discriminative stimuli off it is assumed that the rat is responding to the .125 foot-candles of ambient light rather than that reflected by the stimulus patch.

METHOD

Subjects: The Ss were 32 male Sprague-Dawley rats, 90-120 days old.

Apparatus: The apparatus consisted of a typical one-bar Skinner box provided with a grid floor. A 1 x 1-1/2 inches white painted lucite stimulus patch was located midway between the bar and dipper 4 inches from the floor of the box. The patch was illuminated by a 28 volt light bulb located outside the training chamber. The discriminative stimuli, lights of 5.0 and 16.8 foot-candles, were presented in a random sequence programmed on a 64 pole stepper switch which was advanced every 30 seconds. Either the S^D or S^Δ stimulus was present at all times during training. With the stimulus lights off .125 foot-candles of ambient light was present inside the training chamber, provided by a 7-1/2 watt house light located outside the chamber. A white noise of 79 decibles served a masking function.

Procedure in original learning: Discrimination training was given 45 minutes per day, typically 5 days per week, until criterion was met. The only water available on running days was that obtained in the experiment, while on days the Ss were not run 45 minutes of water was made available at the home cage. Food was given on an ad libitum basis.

The Ss were randomly assigned to 8 sub groups (Table 1), and by the method of successive approximations were trained to bar press in the constant presence of the S^D. After the bar press response was established, one additional session was given with all responses reinforced and with S^D stimulus present during the entire session.

Table 1. Designation of groups.

Training Stimuli	Bright S^D				Dim S^D			
Extinction criterion in off lights (Ext. 1), consecutive minutes with no response	10 min.		5 min.		10 min.		5 min.	
Type of stimulus presented in Ext. 2	S^D	S^Δ	S^D	S^Δ	S^D	S^Δ	S^D	S^Δ
Group name abbreviation	$B10^D$	$B10^\Delta$	$B5^D$	$B5^\Delta$	$D10^D$	$D10^\Delta$	$D5^D$	$D5^\Delta$
Number of subjects	4	4	4	4	4	4	4	4
	B Groups				D Groups			

The conditions were then programmed for discrimination, and Ss were allowed to learn the discrimination to a criterion of 2 out of 3 consecutive days at 85% correct responses or better. All Ss reached criterion in 4 to 20 days of discrimination training.

Procedure on test day: On the day following criterion performance all Ss were given 5 minutes of warm-up consisting of 5 presentations each of the S^D and S^Δ in a pre-determined order (Table 2). This was followed by extinction to criterion (refer to Table 1) with the stimulus lights off (extinction 1), followed in turn by 10 non-reinforced test trials with the training S^D and S presented alternately for 30 seconds each (extinction 2).

Table 2. Order of presentation of stimuli in warm-up.

Minute	B Groups	D Groups
1	S^D S^Δ	S^D S^D
2	S^Δ S^D	S^Δ S^D
3	S^Δ S^D	S^Δ S^D
4	S^Δ S^D	S^Δ S^Δ
5	S^D S^Δ	S^D S^Δ

RESULTS

The mean responses in warm-up for all groups to S^D and S^Δ are given in Table 3A. t-tests of the data (Table 3B) indicate that there are no significant differences between the various groups that would tend to produce the results obtained in extinction 1 and extinction 2.

Table 3A. Group mean response to S^D and S^Δ in warm-up trials.

	Mean Responses	
Group	S^D	S^Δ
$B10^D$	39.5	13.0
$B10^\Delta$	46.3	10.5
$B5^D$	41.3	8.8
$B5^\Delta$	37.5	11.5
$D10^D$	38.0	5.8
$D10^\Delta$	41.0	6.3
$D5^D$	40.3	6.0
$D5^\Delta$	35.8	9.0

In extinction 1 the group mean responses, given in Table 4A, were greater for the B groups than for the D groups. An analysis of variance (Table 4B) showed the difference to be significant ($P<.001$). No other effects were significant.

Table 3B. 2-tailed t-Tests of S^D and S^Δ responses in warm-up.

Test				
Groups	Response Type	t-Value	d.f.	Significance
B10 vs B5	S^D	.838	14	N.S.
D10 vs D5	S^D	.371	14	N.S.
B10 vs B5	S^Δ	.619	14	N.S.
D10 vs D5	S^Δ	1.034	14	N.S.
pooled B10,B5 vs D10,D5	S^D	.852	30	N.S.
pooled B10,D10 vs B5,D5	S^D	.110	30	N.S.
pooled B10,B5 vs D10,D5	S^Δ	2.68	30	$P<.02$
pooled B10,D10 vs B5,D5	S^Δ	.528	30	N.S.

Table 4A. Group mean responses in extinction 1.

Group	Mean R's
B10	47.5
B5	50.2
D10	78.1
D5	72.7

Table 4B. Summary table of the analysis of variance of extinction 1.

Source	SS	df	MS	f	Sig
Extinction criterion	38.28	1	38.28	.111	N.S.
Bright or dim S^D	7110.28	1	7110.28	20.59	$P<.001$
Interaction	457.53	1	457.53	1.33	N.S.
Error	9669.63	28	345.34		
Totals	17275.72	31			

A graph of the cumulative responses to S^D in extinction 2 is given in Figure 6A, and it can be seen that the B groups responded significantly more than the D groups. An analysis of variance (Table 5) indicated the difference was significant ($P<.05$). No other effects, including S^Δ responses (as cumulatively graphed in Figure 6B) were significant.

Table 5. Summary table of the analysis of variance of extinction 2.

Source	SS	df	MS	f	Sig
Between					
Bright or dim training S^D (A)	558.13	1	558.13	8.14	$P<.01$
S^D or S^Δ first in ext. 2 (B)	3.51	1	3.51	.051	N.S.
Extinction 1 criterion (C)	2.63	1	2.63	.038	N.S.
A X B	3.52	1	3.52	.051	N.S.
A X C	21.40	1	21.40	.312	N.S.
B X C	1.27	1	1.27	.019	N.S.
A X B X C	5.64	1	5.64	.082	N.S.
Error	1646.23	24	68.59		
Total	2242.13	31			
Within					
S^D or S^Δ response (D)	456.88	1	456.88	8.63	$P<.01$
A X D	228.78	1	228.78	4.32	$P<.05$
B X D	1.90	1	1.90	.036	N.S.
C X D	.78	1	.78	.015	N.S.
A X B X D	1.88	1	1.88	.036	N.S.
A X C X D	9.78	1	9.78	.185	N.S.
B X C X D	.38	1	.38	.007	N.S.
A X B X C X D	3.53	1	3.53	.067	N.S.
Error	1270.50	24	52.94		
Total	1974.41	32			

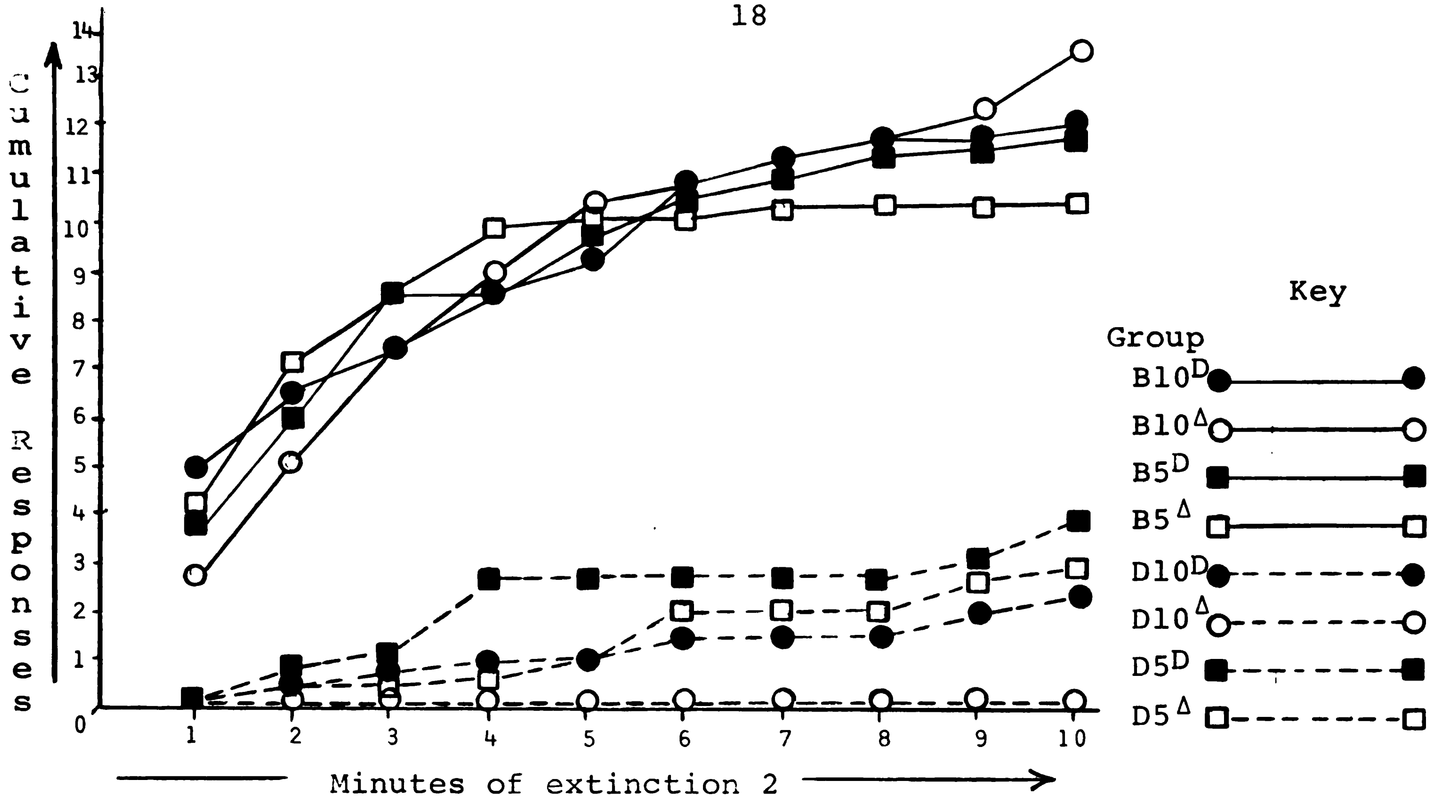

Figure 6A. Number of cumulative responses to S^D, extinction 2.

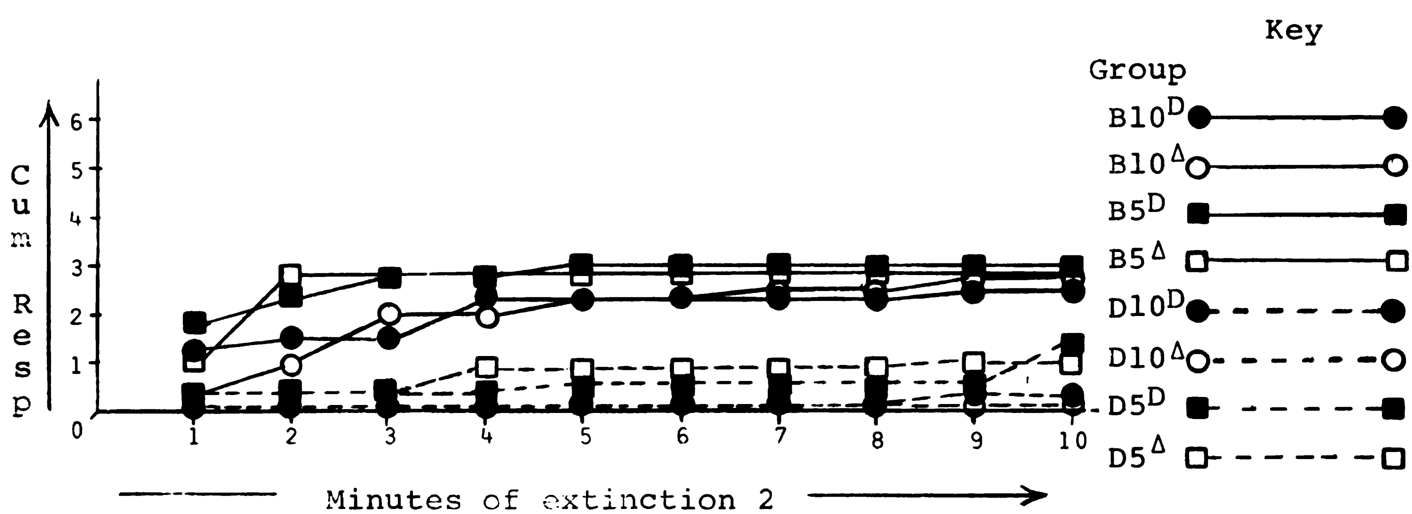

Figure 6B. Number of cumulative responses to S^Δ, extinction 2.

DISCUSSION

The first prediction derived from the Spence model was that all D groups would respond more than the B groups in extinction 1. This prediction was supported by the analysis of the data. The second prediction; that the B groups would respond more in extinction 2 than the D groups was also confirmed by the data.

It should be noted that in the t-test analysis of the warm-up data, the significant t-ratio obtained between the pooled B10, B5 versus D10, D5 groups (S^{Δ} responses) was produced by a greater response level to S^{Δ} in the B groups. This would tend to work against the predicted results and therefore poses no problem to the interpretation of the data obtained in extinction 1 and extinction 2.

For a detailed mathematical analysis of the data by the Zeiler theory, the values of the constants x and y must be determined. Since the method of obtaining these values is basically an after the fact computation followed by a re-test, x and y cannot be precisely employed in this design. However, the various adaptation levels and stimulus to adaption level ratios have been computed with y varied from .01 to .99 and are presented in Table 6. For the B groups it can be seen that at a value of y of .85 to .9, the B groups would definitely be responding to the ratio

Table 6. Various adaptation levels and ratios of stimuli to adaptation levels with y varied from .01 to .99.

y Value	Adaptation Levels			Ratios (Stimulus/AL)				
	Training (AL_T)	Extinction 1 (AL_{E1})	Extinction 2 (AL_{E2})	Bright/AL_T	Dim/AL_T	Off(.125fc)/AL_{E1}	Bright/AL_{E2}	Dim/AL_{E2}
.01	9.21	8.82	8.82	1.82	.54	.014	1.91	.51
.10	9.21	6.00	6.25	1.82	.54	.02	2.69	.80
.15	9.21	4.37	4.89	1.82	.54	.029	3.44	1.02
.20	9.21	3.70	4.63	1.82	.54	.032	3.61	1.08
.50	9.21	1.08	3.14	1.82	.54	.12	5.35	1.59
.70	9.21	.454	3.73	1.82	.54	.28	4.50	1.34
.85	9.21	.238	5.33	1.82	.54	.53	3.15	.94
.90	9.21	.192	6.26	1.82	.54	.65	2.68	.80
.99	9.21	.130	8.82	1.82	.54	.96	1.90	.57

of the original training S^{Δ} in extinction 1. For the remaining y values it is questionable whether the ratios in extinction 1 are close enough to the original S^{Δ} ratio to warrant the assumption that further extinction to S^{Δ} is taking place. However, since it is certain that there is no effect of extinction 1 on extinction to the S^D training ratio, the response of the B groups in extinction 2 can be predicted by finding the ratio of the bright and dim stimulus values to AL_{E2} that most closely correspond to the training S^D ratio. Thus, if the ratio of the bright light to AL_{E2} is more similar to the training S^D ratio than the training S^{Δ} ratio, response to the bright light in extinction 2 would be predicted. If, however, the ratio of the dim light to AL_{E2} is closer to the training S^D ratio, response to the dim light would be predicted in extinction 2. It can be seen from the table that if y were equal to .01 to .1 and .9 to .99 the predicted response for the B groups would be to the bright stimulus. Values of y from .15 to .85 would result in a prediction of response to the dim light.

For the D groups response in extinction 1 can be predicted by noting that all ratios computed in extinction 1 are nearer to the training S^D ratio than the training S^{Δ} ratio. However it is difficult to specify how close is close enough to warrant the assumption that the <u>S</u>s are responding to the original training S^D ratio, but y values of .85 and .9 result in extinction 1 ratios that are very close to the training S^D ratio. In this case the D groups should respond a great deal in extinction 1.

Prediction of response of the D groups in extinction 2 must take into account whether extinction 1 actually produced extinction to the training S^D ratio. Thus, if a S has been extinguished in extinction 1 to the training S^D ratio, and if the ratio of S^D to AL_{E2} is similar to the original training S^D ratio, no response would be predicted to the dim light. This is certainly the case where y = .85 to .9. If, however, the value of y is varied from .01 to .7 it is questionable whether extinction 1 would produce extinction to the original training ratio, and if it did not, response to the dim light would be predicted.

By pooling all of the preceding considerations it can be seen that values of y from .15 to .85 will result in erroneous predictions. If y is varied from .01 to .1 the predictions resulting are weak but largely correct, while y values of .9 to .99 are very accurate. In summary, with y $\approx$ .9 extinction 1 will result in extinction to a ratio very similar to that of the dim stimulus in training. This results in the prediction of more response in the D groups than in the B groups in extinction 1 (prediction 1). In extinction 2, the B groups will respond to the training S^D stimulus because extinction 1 has only served the purpose of further extinguishing responses to S^Δ. However the D groups will have been extinguished to their training S^D ratio in extinction 1 resulting in little response to the dim light in extinction 2. In addition there should be little response to the bright stimulus because a ratio of 1.82 had not been reinforced in original training. This results in more response to the bright stimulus in the B groups than the D groups in extinction 2, with little or no response to the dim light in either group (prediction 2). Both predictions were supported by the data.

The uncommonly large value of y (.9) necessary to account for the results seems to indicate that since the two extinction situations are so drastically different from the situation immediately preceding it the residual AL has little bearing on the establishment of the new AL. This conclusion seems logical in that it might be expected that the radical change in the stimulus conditions from warm-up to extinction 1, and extinction 1 to extinction 2 would tend to make the new AL more dependent on the present stimulation than the residual AL. In addition, as previously mentioned Zeiler (1963) found that as the separation of the values of the test stimuli becomes larger, the value of y increases, and this type of distance interaction could reasonably be true across stimulus sets as well as within.

While the Spence theory is able to predict the results of the present experiment, it is limited not only by its non applicability to the intermediate size problem, but also by the extent to which the shape of the generalization gradients can be specified.

On the other hand, the Zeiler theory appears to be more general than the Spence theory as shown by its ability to apply to the results of the intermediate size problem as well as the results of the present experiment. The major limitation of the Zeiler theory is that until sufficient information can be gathered on the parameters of x and y to allow their a priori computation, its predictive value is limited to a test re-test design.

Zeiler (1963) feels that in the future a specific probability statement may possibly be derived concerning response on the first test trial, and this combined with an a priori computation of x and y would make the Zeiler theory a precise instrument for prediction.

Because of the apparently greater generality of application and the potential precision of prediction, the Zeiler theory would seem to be more preferable than the Spence theory at this time.

In applying Zeiler's mathematical model it was noticed that a simple extension of the present design should provide a difficult, if not impossible situation for the application of the Zeiler theory. If extinction 1 were done in total darkness, the log Σ Xi (the discriminative stimuli) in extinction 1 would equal minus infinity. This value would enter into the computation of AL_{E2} as residual AL thus making the mathematical manipulations at best difficult. It is impossible to predict how the Zeiler theory might handle this problem, and the results of such an experiment could prove to be valuable.

Because the large value of the y constant can be defended by previous data some consistency of the distance effects is indicated. This could be easily checked in two ways: varying the intensity difference between the discriminative stimuli; and varing the difference between the training situation and extinction 1, between training and extinction 2, and between extinction 1 and extinction 2. If the value of y does not vary with a fair degree of correspondence as the separation vaires, the weighting constants would be suspect.

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