BIDIRECTIONAL GRADIENTS OF STIMULUS GENERALIZATION: A COMPARISON OF NORMALS AND RETARDATES ON A VISUAL-SPATIAL TASK

By

DAUN M. HACKETT

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1962

Submitted to the faculty of the Graduate School of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1964

BIDIRECTIONAL GRADIENTS OF STIMULUS GENERALIZATION:

A COMPARISON OF NORMALS AND RETARDATES ON A

VISUAL-SPATIAL TASK

Thesis Approved:

Henry A. Cross

Thesis Adviser

Julia L. McHale

J.H. Boggs

Dean of the Graduate School

ACKNOWLEDGMENT

The writer wishes to express her appreciation to Dr. Henry Cross, who served as major advisor, and to the members of the thesis committee, Dr. Julia McHale and Dr. Richard Rankin, for their guidance and assistance. A special thanks is due Dr. Rankin for his careful supervision and help during the construction of the apparatus employed in this investigation.

Acknowledgment is also due Dr. Henry Leland, Clinical Director, Parsons State Hospital and Training Center, for his cooperation in allowing the use of the hospital facilities, and in making the retarded subjects available. I would also like to express my thanks to Mr. Jim Crossen, Parsons State Hospital, for his sincere interest and excellent advice. The Principals of both the Stillwater Junior High and the Stillwater Senior High Schools were most helpful in making the normal subjects available. Finally, I would like to thank Mr. Larry Barr for drawing the figures that are employed in the body of the thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

It has been commonly observed in learning experiments that when an organism has been trained to respond to one stimulus or stimulus complex this response will, on subsequent occasions, be elicited by other similar stimuli. This behavior has been described variously as irradiation, transfer of training, and spread of effect. In Clark Hull's (1943, 1951) formulized theoretical system this particular effect has been conceptualized under the construct, stimulus generalization (SG). In <u>Essentials of Behavior</u> (1951) SG is defined as follows:

> When a stimulus (S) is connected with a response (R) in a learning situation, not only that stimulus acquires a capacity to evoke the response, but other adjacent stimuli on the same stimulus continuum also acquire the capacity, though to a diminishing degree (p. 86).

Stimulus generalization has been used on an intervening variable to describe the performance of many different types of organisms on a variety of tasks (Guttman & Kalish, 1956; Hovland, 1937a, 1937b, 1937c; Jenkins & Harrison, 1958). Though utility of this concept has often been questioned (Lashley & Wade, 1946; Prokasy & Hall, 1963; Razran, 1949), SG has, nevertheless, continued to carry a heavy explanatory burden in contemporary psychology.

The most recent critique (Prokasy & Hall, 1963) of this concept has dealt most thoroughly with the problems inherent in the continued use of the term stimulus generalization and has pointed up the need for further research. Their opinion is that the concept of SG adds nothing new to the field of psychology and they feel that terms like orienting reflex, attention, and failure to discriminate will account for the observed behavior.

Pavlov (1927) in his work with conditioning in dogs first observed the phenomenon now known as SG. Classical conditioning studies constitute the preponderance of the research in this area, although lately an instrumental conditioning approach has been utilized (Brown, Bilodeau & Baron, 1951; Brown, Clarke & Stein, 1958; Grice & Saltz, 1950; Guttman & Kalish, 1956; Kalish & Guttman, 1957, 1959). Generalization phenomena have been observed by researchers manipulating pitch (Hovland, 1937a; Humphreys, 1939; Wickens, Schroder & Snide, 1954), light intensity (Bass, 1958; Brown, 1942), sound intensity (Fink & Patton, 1953; Hovland, 1937b), size (Grive & Saltz, 1950), temporal factors (Rosenbaum, 1951), pattern (Gibson, 1941; Postman, 1951), hue (Guttman & Kalish, 1956; Kalish & Guttman, 1957), and cutaneous (Bass & Hull, 1934). It has been the general conclusions of the above research that SG-like gradients can be obtained in a variety of sense modalities with human Ss.

Hull (1947) and Mednick & Freedman (1960) provide comprehensive review articles of the research in the area of SG. These articles indicate that there is a considerable lack of agreement with respect to the basic aspects of SG.

Although the utility of SG has been seriously questioned by many researchers it would seem profitable to investigate the variables that influence it, as it plays an important role in modern behavior theory. According to Cross (1959), whether SG is learned or innate, whether the behavior observed is due to generalization or sensitization is relatively unimportant, in view of the large amount of valuable research that has been generated by this construct.

Brown, Bilodeau & Baron (1951) were the first to deal with SG as a strictly empirical construct. They demonstrated a phenomenon similar to tactual generalization with a visual-spatial task requiring a voluntary response. Their apparatus consisted of seven lamps, horizontally spaced at 8° intervals. The S was told to respond to the lighting of the center lamp but not to respond to the lighting of the peripheral lamps. Brown, Clarke & Stein (1958) using the same apparatus, attempted to eliminate a procedural problem raised by Andreas (1954) relating to the possible effect of inhibitory instructions on the generalization gradients. The S's task was to identify each lamp as a horse, with each trial being a race. The S was to guess which horse would win. The Ss showed regularly decreasing gradients as a function of the distance from the center lamp. The center lamp "won" 80% of the time compared to the peripheral lamps which, collectively, "won" 20% of the time, each with equal frequency.

An experimental study dealing with SG on a visual-spatial task using retardates as Ss was done by Barnett (1959). He compared the performance of normals and retardates with two different levels of original training. The results indicated that the number of original training trials had a significant effect on the generalization gradients, i.e., there was a significantly greater amount of SG following a high number of training trials then with a low number of training trials. The intelligence groups failed to differ significantly in magnitude of SG.

The method employed in the above mentioned studies dealing with spatial generalization on visual-spatial tasks was utilized in the present investigation. It has appeared that it would be a fruitful way to investigate generalization phenomenon with retarded Ss.

Purpose of the Study

The purpose of the present study was to experimentally investigate the generalization behavior of normal and intellectually retarded Ss. Specifically, the following were considered: (1) the shape of the generalization gradient of response frequency obtained on a visual-spatial task; (2) the shape of the generalization gradient of latency of response; (3) a comparison of these gradients in normal and retarded Ss; and (4) changes in the shape of the generalization gradients over repeated trials.

It was assumed that the training trials would build up a tendency to react to the centrally located stimulus which would generalize to the peripheral stimuli. This tendency would decrease as a function of the distance away from the center stimuli. It was expected that the normal Ss would make fewer generalized responses than the retardates initially, and that this would be reflected in a significant Lights X Groups interaction, i.e., the overall generalization gradients for the retardates would be flatter. It was predicted originally that the performance of the two groups would differ, but at the same time it was also expected that generalized responses would decrease for both groups over the repeated trials until their performance coincided. It was predicted that both groups would show regularly decreasing response latencies with the retarded Ss showing a significantly longer response latency for the entire experiment.

CHAPTER II

METHOD

Sixteen retarded institutionalized patients and 16 normal junior high and high school students were used as Ss. The Peabody Picture Vocabulary Test (PPVT), Form A, was administered as a criterion to provide a verbal measure of intelligence across all Ss. Chronological age (CA) was held constant across both groups.

Ten male and 6 female retarded Ss were drawn from the population of Parsons State Hospital and Training Center, Parsons, Kansas. The mean age of the sample was 15-8 yrs. and the mean IQ was 68.87 on the PPVT (for standard deviation and range see Table I). All available patients were used that met the selection criteria of: (1) CA between 14.5 yrs. and 16.5 yrs.; and (2) IQ's between 45 and 70 on the Wechsler Intelligence Scale for Children. The Wechsler was used in the initial selection of Ss, as all of the patients had been administered this particular test within the last two years. The IQ range on the Wechsler was 46 to 70, with a mean IQ of 59.25.

Nine male and 7 female normal Ss were drawn from the Stillwater Junior High School and the Stillwater Senior High School. The mean age of the normal sample was 15-4 yrs. and the mean IQ was 113.3 on the PPVT (for standard deviation and range see Table I).

TABLE I

Means, Standard Deviation, and Range of Intelligence and Chronological Age for Normal and Retarded Subjects

Normal <u>S</u>s	IQ			CA		
	M	S.D.	Range	M	S.D. (mos.)	Range (yrs.)
	113.3	9.6	100-125	15-4	4.8	14.1-16.2
Retarded <u>S</u>s	**IQ**			**CA**		
	M	S.D.	Range	M	S.D. (mos.)	Range (yrs.)
	68.87	8.9	54-87	15-8	6.4	14.8-16.6

Subjects not meeting the following criteria were eliminated from the study: (1) no observable motor and/or visual impairments; (2) ability to verbalize their understanding of the instructions on the first and second replication; and (3) ability to verbalize the task they had been performing on the last replication. The third criterion was incorporated to determine if <u>S</u> had retained the instructions over the ten trials. Three <u>S</u>s were dropped from the study. One normal <u>S</u> and one retarded <u>S</u> were dropped because they could not repeat the essential instructions and one retarded <u>S</u> was not used because of gross motor problems.

Apparatus

The apparatus (Figure 1) employed in the present study was a modified form of the apparatus used by Brown, et al, 1951. The major component of the apparatus was a 6 ft. X 1.5 ft. X .75 in. curved, flat black, 3/4 in. plywood panel. The apparatus was

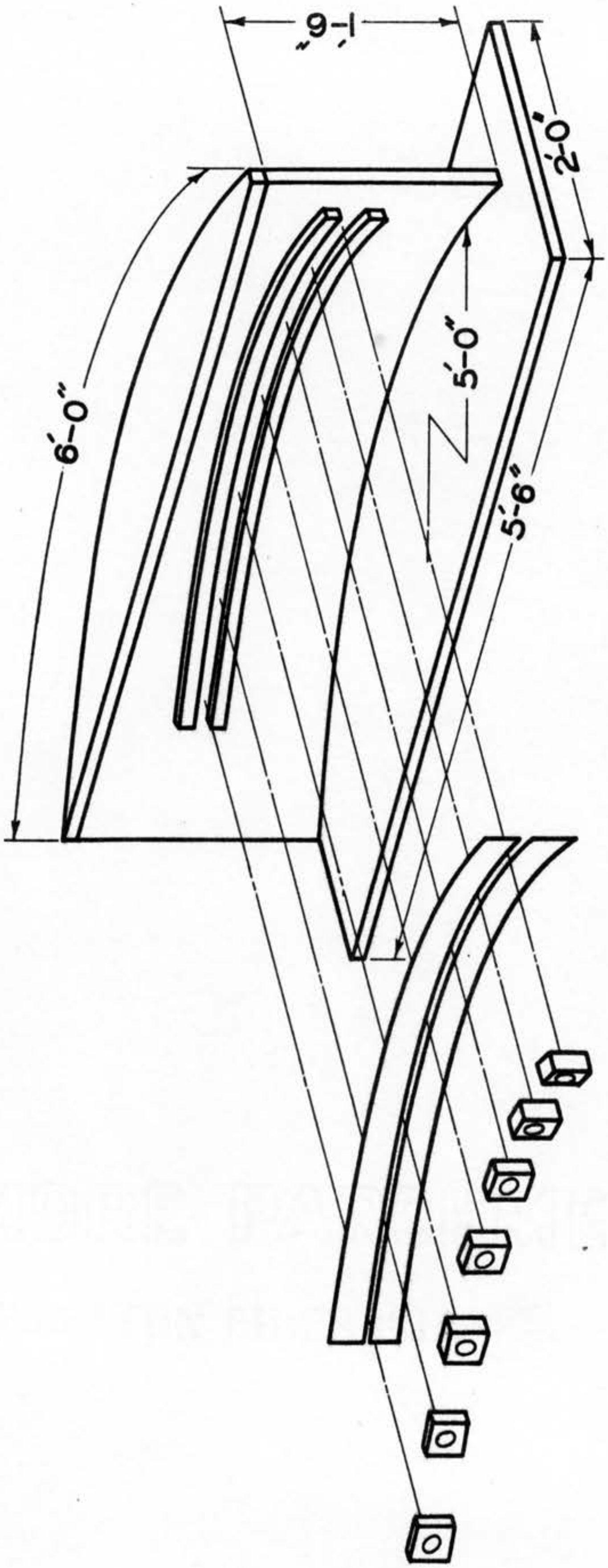

FIG. 1

mounted on a base that was 5.5 ft. X 2 ft. X 1 in., which was placed on a standard laboratory table 29 in. high. Seven lamps (6 v., 0.9 w.) were fastened to the panel in a horizontal row, uniformly spaced at 8° intervals. The lamps were 38 in. from the floor. The panel was curved along a 5 ft. radius so that all lamps were equidistant from the S's nose when he was seated directly in front of and 5 ft. away from the center lamp. A telegraph key attached to a school desk on the S's right side was used as a reaction key. E sat behind the apparatus and could turn on any of the seven lamps by means of a selector switch. Frequency and latency of response were measured by E to the nearest 1/100 sec. by means of a Standard Electric Timer. A step relay was attached to the apparatus to prevent S from correcting a generalized response. The light duration was calibrated to 3/100 sec. by a Hunter interval timer.

Procedure

Each S was randomly assigned to a 15-min. experimental period during which he was seen individually by E. This initial experimental period consisted of both pre-training trials and a test series. Following experimental periods were devoted to test series only.

After S was seated instructions were given to respond as rapidly as possible to the lighting of the center lamp, but not to respond to the lighting of any of the peripheral lamps. A response consisted of S lifting his finger from the reaction key. If S did not respond within 2 sec. after the lighting of a lamp, it was scored as no response. After reading of the instructions E flashed the center lamp and waited for S to respond. Then, one of the six peripheral lamps was presented with E correcting S if he responded. The instructions were read again and 20 training trials were administered followed without interruption by the first test series. A test series consisted of 25 conditioning trials on the center lamp interspersed with one presentation of each of the six peripheral lamps in a random series. Five randomly ordered data sheets were prepared with the stipulation that at least three but never more than seven trials with the center lamp separate each presentation of a peripheral lamp. The data sheets were assigned at random to the ten replications. Frequency of response and latency of response were recorded.

The instructions were:

> This is what I want you to do. See this key? Now, hold it down with your finger. Now, when this light (E points to center lamp, S4) comes on, you let go of the key as fast as you can. But, when these other lights (E points in general to the peripheral lamps) come on, you don't let go of the key. Okay? Let's try it. (E gives one presentation of S4 and waits for the S's response, then E gives one presentation of one of the peripheral lights.) Got it? Now, when this light comes on, you let go of the key and when these come on, you don't. (The E again points out the light.) Okay? Let's try it? Ready?

After the first replication S was asked to verbalize the instructions with the essential components being: (1) that he was to lift his finger from the keys when the center lamp was lit; and (2) he was not to remove his finger from the key when any of the six peripheral lamps were lit. If S stated he was to push down on the key when the center lamp was lit, E corrected him by repeating that part of the original instructions, i.e., "you let go of the key." As S was seated for the second replication he was asked to repeat the instructions from the previous replication and then administered a test series after E said "Ready?" When this replication was completed S was again asked to repeat the instructions. The following replications began with E saying "Ready?" At the completion of the ten replications, S was again asked to verbalize the task. After each replication, E said, "Good! Fine!" or "Very good!"

The time between the "ready" signal and the lighting of the first lamp was approximately one second. The time between the presentations of each trial was approximately 5 sec. A generalized response was defined as one where S lifted his finger in response to the lighting of one of the six peripheral lamps within the specified time limits.

CHAPTER III

RESULTS

The statistical analysis of the data indicated that the modes of responding were significantly different for the two groups. An extended Alexander Trend Test (Grant, 1956) supported the hypothesis that a parabola would yield the line of best fit for the data, i.e., the predicted generalization gradients were found. This is indicated by a significant ($P < .001$) quadratic component (see Table 2). The gradients are illustrated in Figure 2.

It may also be observed in Figure 2 that there is a significant ($P < .01$) difference between the intelligence groups, with the retarded group having a heightened generalization gradient.

The prediction that the performance of the two groups would meet over trials was supported (see Figure 3). There were no significant differences between the groups when the data for the last five trials were analyzed utilizing a simple Analysis of Variance test (Table 3, $P < .05$).

The latency measures for the normal _S_s show that the average time to respond did not decrease over trials. The latency measures indicated a tendency for the retarded _S_s to initially show longer response latencies which decreased over trials as predicted.

The prediction that the SG of the retardates would be flatter

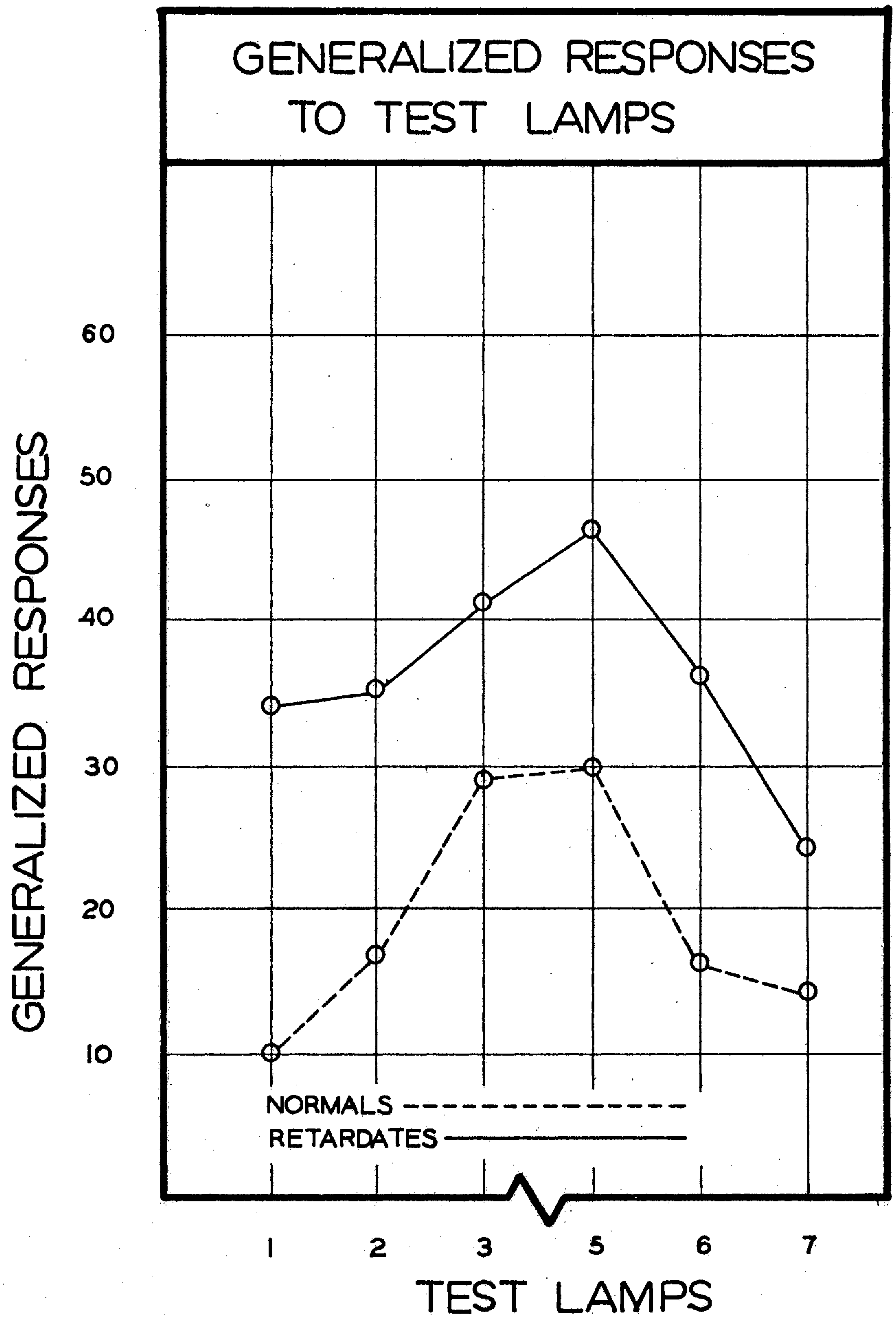
GENERALIZED RESPONSES TO TEST LAMPS
GENERALIZED RESPONSES
60
50
40
30
20
10
NORMALS
RETARDATES
1
2
3
5
6
7
TEST LAMPS

FIG. 2

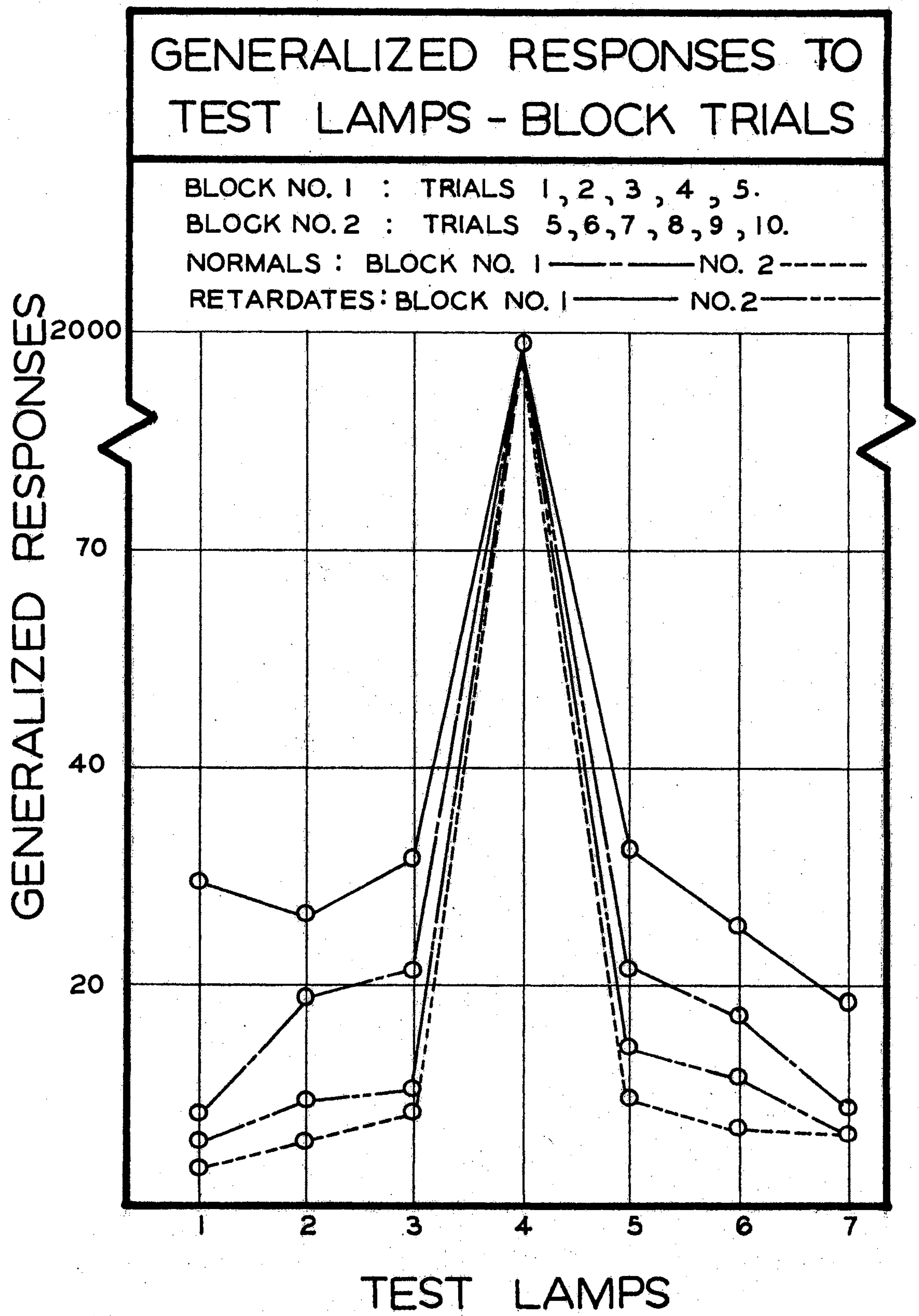
GENERALIZED RESPONSES TO TEST LAMPS - BLOCK TRIALS
BLOCK NO. 1 : TRIALS 1, 2, 3, 4, 5.
BLOCK NO. 2 : TRIALS 5, 6, 7, 8, 9, 10.
NORMALS : BLOCK NO. 1 NO. 2
RETARDATES: BLOCK NO. 1 NO. 2
GENERALIZED RESPONSES
2000
70
40
20
1
2
3
4
5
6
7
TEST LAMPS

FIG. 3

Table 2

Alexander Trend Test Over Number of Generalized Responses for Normal and Retarded Subjects (N = 32)

Source	df	MS	F	P
Groups	1	52.08	7.99	$<.01$
Ss/Groups	30	6.52		
Lights	5	6.85	5.84	$<.001$
1. Linear	1	.26	.35	ns
2. Quadratic	1	28.75	37.15	$<.001$
3. Residual	3	1.72	1.19	ns
Groups X Lights	5	.83	.71	ns
Ss/Groups X Lights	150	1.17		
1. Linear	30	.74		
2. Quadratic	30	.77		
3. Residual	90	1.45		
Total	191			

Table 3

Analysis of Variance for Number of Generalized Responses for Normal and Retarded Subjects Over the Last Block of Trials (Trials 6-10) (N = 32)

Source	df	MS	F	P
Total	31			
Mean	1			
Treat	1	10.13	1.21	ns
Error	29	8.39		

than the corresponding normal Ss was not substantiated in that there was not a significant Lights X Groups interaction.

CHAPTER IV

DISCUSSION

The finding of the present study support results by Brown, et al (1951) that SG may be obtained with human Ss on a visual-spatial task.

Since the instructions stated that S was to respond to the lighting of the center lamp and not to respond to the lighting of the peripheral lamps; it is assumed that the obtained gradients were due to a strong set to respond to the lighting of the center lamp. This set to respond showed a generalization-like spread, with those lights nearest to the center lamp being responded to more frequently. It appears from the evidence presented that the obtained gradients for the retarded Ss were actual differences and not a lack of understanding of the instructions in that they were able to verbalize the essential components of the instructions on three ocassions.

The differences obtained between the intelligence groups, in the present study, are in contrast to Barnett (1959). He reported no differences in the generalization gradients of normal and retarded Ss utilizing a similar procedure. The failure to support Barnett's findings may be due to procedural differences. He used four more stimulus lamps (11 lamps) and seated the Ss closer (3.5 ft.) to the apparatus. Each S was seen only once whereas in the present study each S was seen 10 times by E. There were basic differences in the populations. Barnett's Ss had a higher mean CA. The retarded Ss had a mean age of 18.41 yrs. and the normal Ss had a mean age of 17.03 yrs. His normal Ss had a mean IQ of 102.27 and the retarded Ss had a mean IQ of 50.08. In the present study the normal Ss had a mean IQ of 113.3 and the retarded Ss had a mean IQ of 68.87. Since Barnett did not report which intelligence test he used to obtain his Ss' IQ scores, it is impossible to draw any comparisons between the populations in terms of IQ's.

Stimulus generalization studies utilizing a classical conditioning paradigm, i.e., requiring an involuntary response, have been able to demonstrate regularly decreasing response latencies. This finding has not been supported in studies that require a voluntary response. The latency measures in the present study indicated a tendency for the retardates to show regularly decreasing response latencies. This same tendency was not found for the normal Ss.

The failure to find a significant Lights X Groups interaction would seem to suggest a basic similarity in the response patterns of the two groups and indicate the lack of important qualitative differences in modes of responding. Such information, corroborated in other areas of research, would make more feasible the extensive use of retarded Ss in the general investigations of learning phenomena.

Many investigators (Ellis, 1958; Ellis & Girardeau, 1962; Girardeau, 1959; Zeaman, House & Orlando, 1958; Zeaman & House, 1959, 1962) have utilized mental retardates as Ss in experimental research on learning problems.

CHAPTER V

SUMMARY AND IMPLICATIONS FOR FURTHER RESEARCH

The present study was an attempt to determine whether the performances of normal and retarded subjects yielded different stimulus generalization gradients on a visual-spatial task. The stimuli were seven lamps mounted horizontally on a 6 ft. black plywood board. There were 16 subjects in each group, each being tested individually. The task required that the subject lift his finger from the reaction key when the center lamp was flashed but not to react when one of the six peripheral lamps was lighted. Performance was measured in terms of number of generalized responses and latency of response.

The results show significant differences ($P < .01$) between groups but the predicted (Lights X Groups) interaction effects were not found. A tendency toward regular decreasing response latencies were found for the retarded subjects but the normal subjects showed no corresponding decrease in latencies.

Discussion of the results emphasized the potential importance of mental retardates as subjects in learning experiments.

There are many implications for further research generated by this study. Kimble (1961) reviews four studies which indicate that SG cannot be accounted for in terms of failure to discriminate. Prokasy (Prokasy, et al, 1963) states that Kimble's arguements are not sufficient to negate the failure to discriminate hypotheses. Prokasy criticizes Brown's (Brown, et al, 1951) emphasis on speed of performance which may have obtained the observed gradients through failure to discriminate rather than SG. Knopf and Fager (1959), using an apparatus similar to the one employed in the present study, found significant differences (P = .001), between psychotics and neurotic patients, in terms of their SG gradients. Buss (1955) using the Taylor Manifest Anxiety Scale (TMAS) found no significant differences between high and low anxious Ss. It is felt that this variable needs further empirical research before the issue can be dismissed.

The experimenter is currently investigating two of the issues raised in the above discussion. The projected experimental design will emphasize three levels of speed in the instructions and the Ss will be selected in terms of their scores on the TMAS, i.e., low vs high anxious Ss.

Other researchers (Brown, 1964) have suggested that SG may be due either to retinal disparity or a failure of E to indicate specific fixation points. An investigation of the influence of these variables on SG gradients is also underway.

These types of investigations could very well be set up in institutions and schools for the retarded and furnish the basis for a series of similar experimental studies.

References

Andreas, B. G. Empirical gradients of generalization in a perceptual motor task. J. exp. Psychol., 1954, 48, 119-122.

Barnett, D. D. Stimulus generalization in normals and retardates on a visual-spatial task requiring a voluntary response. Unpublished Ph.D. Dissertation, George Peabody College for Teachers, 1959.

Bass, B. Gradients in response percentages as indices of nonspatial generalization. J. exp. Psychol., 1958, 278-281.

Bass, M. J., & Hull, C. L. The irradiation of a tactile conditioned reflex in man. J. comp. Psychol., 1934, 17, 47-66.

Brown, J. S. The generalization of approach responses as a function of stimulus intensity and strength of motivation. J. comp. Psychol., 1942, 33, 209-226.

Brown, J. S., Bilodeau, E. A., & Baron, N. R. Bidirectional gradients in the strength of a generalized voluntary response to stimuli on a visual-spatial dimension. J. exp. Psychol., 1951, 41, 42-61.

Brown, J. S., Clarke, F. R., & Stein, L. A new technique for studying spatial generalization with voluntary responses. J. exp. Psychol., 1958, 55, 359-362.

Brown, L. T. Personal communication. Oklahoma State University, 1964.

Buss, A. H. Stimulus generalization as a function of clinical anxiety and direction of generalization. J. abnorm. soc. Psychol., 1955, 50, 271-273.

Cross, H. A. The influence of spatial factors on stimulus generalization effects as indicated by a method employing voluntary responses. Unpublished Ph.D. Dissertation, Ohio State University, 1959.

Ellis, N. R. Object-quality discrimination learning sets in mental defectives. J. comp. physiol. Psychol., 1958, 51, 79-81.

Ellis, N. R., & Girardeau, F. L. Analysis of learning sets in normal and severely defective humans. J. comp. physiol. Psychol., 1962, 55, 860-865.

Fink, J. B., & Patton, R. M. Decrement of a learned drinking response accompanying changes in several stimulus characteristics. J. comp. physiol. Psychol., 1953, 46, 23-27.

Gibson, E. J. Retroactive inhibition as a function of degree of generalization between tasks. J. exp. Psychol., 1941, 28, 93-115.

Grant, D. A. Analysis-of-variance tests in the analysis and comparison of curves. Psychol. Bull., 1956, 53, 141-154.

Grice, G. R., & Saltz, E. The generalization of an instrumental response to stimuli varying in the size dimension. J. exp. Psychol., 1950, 40, 702-708.

Guttman, N., & Kalish, H. I. Discriminatability and stimulus generalization. J. exp. Psychol., 1956, 51, 79-88.

Hovland, C. I. The generalization of conditioned responses: I. The sensory generalization of conditioned responses with varying frequencies of tone. J. gen. Psychol., 1937a, 17, 125-148.

Hovland, C. I. The generalization of conditioned responses: II. The sensory generalization of conditioned responses with varying intensities of tone. J. gen. Psychol., 1937b, 51, 279-291.

Hovland, C. I. The generalization of conditioned responses: IV. The effects of varying amount of reinforcement upon the degree of generalization of conditioned responses. J. exp. Psychol., 1937c, 21, 261-276.

Hull, C. L. Essentials of behavior. New Haven: Yale University Press, 1951.

Hull, C. L. Principles of behavior. New York: D. Appleton-Century Co., 1943.

Hull, C. L. The problem of primary stimulus generalization. Psychol. Rev., 1947, 54, 120-134.

Humphreys, L. G. Generalization as a function of method of reinforcement. J. exp. Psychol., 1939, 25, 361-372.

Jenkins, H. M., & Harrison, R. H. Auditory generalization in the pigeon. Final Report, Air Force Contr., 1958, AF 18 (603)-85.

Kalish, H. I., & Guttman, N. A test of the summation hypothesis. J. exp. Psychol., 1959, 57, 268-273.

Kalish, H. I., & Guttman, N. Stimulus generalization after equal training on two stimuli. J. exp. Psychol., 1957, 53, 139-144.

Kimble, G. A. Hilgard and Marquis' conditioning and learning. New York: Appleton-Century-Crofts, 1961.

Knopf, I. J., & Sherman, Julia. Changes in the gradient of stimulus generalization as a function of two procedural variations. Psychol. Rep., 1960, 7, 253-258.

Lashley, K. S., & Wade, Marjorie. The Pavlovian theory of generalization. Psychol. Rev., 1946, 53, 72-87.

Mednick, S. A., & Freedman, J. L. Stimulus generalizatin. Psychol. Bull., 1960, 57, 169-200.

Pavlov, I. P. Conditioned reflexes, (Trans. by G. V. Anrep). London: Oxford University Press, 1927.

Postman, L. The generalization gradient in recognition memory. J. exp. Psychol., 1951, 42, 231-235.

Prokasy, W. F., & Hall, J. F. Primary stimulus generalization. Psychol. Rev., 1963, 70, 310-322.

Razran, G. Stimulus generalization of conditional responses. Psychol. Bull., 1949, 46, 337-365.

Rosenbaum, G. Temporal gradients of response strength with two levels of motivation. J. exp. Psychol., 1951, 41, 261-267.

Wickens, D. D., Schroder, H. M., & Snide, J. D. Primary stimulus generalization of the GSR under two conditions. J. exp. Psychol., 1954, 47, 52-26.

Zeaman, D., & House, B. J. Approach and avoidance in the discrimination learning of retardates. Child Develpm., 1962, 33, 355-372.

Zeaman, D., & House, B. J. Discrimination learning in retardates. Train. sch. Bull., 1959, 56, 62-67.

Zeaman, D., House, B. J., & Orlando, R. Use of special training conditions in visual discrimination learning with imbeciles. Amer. J. ment. Defic., 1958, 63, 453-459.

APPENDIX A

RAW DATA - NORMALS

S	CA	IQ	Test Lamps	Replication 1-5	Replication 6-10	Total GR
S_1	14-11	100	1	---	---	---
			2	---	---	---
			3	1	---	1
			5	1	2	3
			6	---	1	1
			7	---	---	---
S_2	15-6	125	1	---	---	---
			2	---	---	---
			3	1	---	1
			5	---	---	---
			6	---	---	---
			7	---	---	---
S_3	14-11	103	1	---	---	---
			2	3	---	3
			3	1	---	1
			5	---	1	1
			6	2	---	2
			7	2	---	2
S_4	15-11	101	1	1	1	2
			2	1	---	1
			3	1	1	2
			5	3	---	3
			6	1	---	1
			7	---	1	1
S_5	14-10	123	1	---	---	---
			2	---	---	---
			3	1	1	2
			5	2	---	2
			6	---	---	---
			7	1	1	2
S_6	14-11	124	1	---	1	1
			2	1	---	1
			3	---	---	---
			5	---	1	1
			6	---	1	1
			7	---	2	2

S	CA	IQ	Test Lamps	Replication 1-5	Replication 6-10	Total GR
S_7	14-11	102	1	---	1	1
			2	1	1	2
			3	3	---	3
			5	1	1	2
			6	---	1	1
			7	1	1	2
S_8	15-7	125	1	1	---	1
			2	1	1	2
			3	1	---	1
			5	---	1	1
			6	1	---	1
			7	---	1	1
S_9	15-5	117	1	1	---	1
			2	---	---	---
			3	1	1	2
			5	3	1	4
			6	1	---	1
			7	1	---	1
S_{10}	15-6	125	1	---	---	---
			2	1	1	2
			3	1	2	3
			5	2	---	2
			6	1	---	1
			7	---	---	---
S_{11}	15-2	100	1	---	---	---
			2	1	1	2
			3	3	---	3
			5	3	---	3
			6	---	---	---
			7	2	---	2
S_{12}	15-2	108	1	1	---	1
			2	1	---	1
			3	1	1	2
			5	1	2	3
			6	1	---	1
			7	1	---	1
S_{13}	15-1	112	1	1	---	1
			2	---	---	---
			3	1	---	1
			5	---	---	---
			6	---	1	1
			7	---	---	---

S	CA	IQ	Test Lamps	Replication 1-5	Replication 6-10	Total GR
S_{14}	16-2	121	1	---	---	---
			2	---	1	1
			3	2	---	2
			5	2	---	2
			6	---	---	---
			7	---	---	---
S_{15}	15-11	111	1	---	---	---
			2	---	---	---
			3	1	1	2
			5	1	---	1
			6	1	1	2
			7	---	---	---
S_{16}	15-3	116	1	2	---	2
			2	2	---	2
			3	2	1	3
			5	2	---	2
			6	2	1	3
			7	---	---	---

APPENDIX B

RAW DATA - MENTAL RETARDATES

S	CA	IQ	Test Lamps	Replication 1-5	Replication 6-10	Total GR
S_{17}	15-10	58	1	5	1	6
			2	3	4	7
			3	4	1	5
			5	3	3	6
			6	4	4	8
			7	2	2	4
S_{18}	15-8	62	1	---	---	---
			2	---	---	---
			3	3	1	4
			5	1	1	2
			6	2	---	2
			7	1	---	1
S_{19}	16-5	67	1	---	---	---
			2	---	---	---
			3	1	---	1
			5	---	---	---
			6	---	1	1
			7	---	---	---
S_{20}	14-8	68	1	3	---	3
			2	2	---	2
			3	1	1	2
			5	4	1	5
			6	2	1	3
			7	---	---	---
S_{21}	16-5	73	1	---	---	---
			2	3	---	3
			3	2	---	2
			5	---	---	---
			6	---	---	---
			7	---	---	---
S_{22}	15-3	87	1	2	1	3
			2	2	---	2
			3	3	---	3
			5	3	2	5
			6	2	---	2
			7	2	---	2

S	CA	IQ	Test Lamps	Replication 1-5	Replication 6-10	Total GR
S_{23}	15-3	75	1	3	---	3
			2	2	---	2
			3	3	---	3
			5	4	1	5
			6	4	1	5
			7	3	---	3
S_{24}	15-11	72	1	3	1	4
			2	---	1	1
			3	2	---	2
			5	3	2	5
			6	1	---	1
			7	1	2	3
S_{25}	15-10	76	1	---	---	---
			2	---	1	1
			3	1	---	1
			5	1	---	1
			6	1	---	1
			7	1	---	1
S_{26}	15-11	58	1	1	---	1
			2	---	---	---
			3	2	---	2
			5	1	---	1
			6	---	---	---
			7	---	---	---
S_{27}	15-9	78	1	1	1	2
			2	2	1	3
			3	1	3	4
			5	2	3	5
			6	---	---	---
			7	2	---	2
S_{28}	14-11	77	1	2	1	3
			2	3	1	4
			3	2	1	3
			5	4	1	5
			6	1	---	1
			7	1	1	2
S_{29}	15-3	73	1	3	---	3
			2	4	---	4
			3	1	---	1
			5	2	---	2
			6	4	2	6
			7	2	---	2

$\underline{S}$	CA	IQ	Test Lamps	Replication 1-5	Replication 6-10	Total GR
S_{30}	15-4	59	1	2	---	2
			2	2	1	3
			3	2	2	4
			5	---	---	---
			6	1	1	2
			7	---	---	---
S_{31}	15-1	54	1	2	---	2
			2	1	---	1
			3	1	---	1
			5	3	---	3
			6	2	1	3
			7	2	1	3
S_{32}	16-6	65	1	2	---	2
			2	2	---	2
			3	2	1	3
			5	1	---	1
			6	1	---	1
			7	1	---	1

VITA

Daun M. Hackett

Candidate for the Degree of

Master of Science

Thesis: BIDIRECTIONAL GRADIENTS OF STIMULUS GENERALIZATION: A COMPARISON OF NORMALS AND RETARDATES ON A VISUAL-SPATIAL TASK

Major Field: Psychology

Biographical:

Personal Data: Born in Westen Mills, New York, January 13, 1939, the daughter of John Maynard and Elnor White Hackett.

Education: Attended grade school at Ceres, and at Bolivar, New York, and at Russellville, Missouri; graduated from Springfield Township High School, Holland, Ohio, in 1955; received college credit from the University of Toledo, Toledo, Ohio, Concord College, Athens, West Virginia, Florida State University, Tallahassee, Florida, and received the degree of Bachelor of Science from Oklahoma State University, Stillwater, Oklahoma, in May, 1962, with a major in psychology; completed the requirements for the Master of Science degree at Oklahoma State University in May, 1964.

Professional Experience: Worked at Parsons State Hospital and Training Center, Parsons, Kansas, as a Psychologist, Trainee, from June, 1963 until August, 1963.

Professional Organizations: Member of Psi Chi, National Honorary Society in Psychology.