STIMULUS SATIATION AND MENTAL RETARDATION

Thesis for the Degree of Ph. D.

MICHIGAN STATE UNIVERSITY

Leif G. Terdal

1965

This is to certify that the

thesis entitled

STIMULUS SATIATION AND MENTAL RETARDATION

presented by

Leif G. Terdal

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Psychology

M. Ray Denny
Major professor

Date May 21, 1965

O-169

STIMULUS SATIATION AND MENTAL RETARDATION

By

Leif G. Terdal

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

1965

ACKNOWLEDGMENTS

The writer wishes to express his appreciation to all those who made this study possible.

The writer is especially grateful to Dr. M. Ray Denny, Chairman, whose insights in the field of mental retardation inspired the writer to investigate this field.

Members of the dissertation committee--Dr. Paul Bakan, Dr. R. E. McMichael, and Dr. Stanley Ratner--deserve special thanks for their helpful suggestions and constructive criticisms.

In collecting data, the writer appreciated the assistance he received from Elsie Berdach, Phil Snett, and his wife Marjorie Terdal, who also gave many hours of her time. The writer is also grateful to Roy Olson for his assistance with apparatus equipment and to Jim Clark for his computer assistance.

To the many people who cooperated with the writer in obtaining subjects for his study go the writer's special thanks--Dr. Maureen Bailey, Plymouth State Home and Training School; Dr. James Louisell and Mrs. Virginia Young, Fort Custer State Home; Mrs. E. Sandborn, Tower Garden School; Dr. Gerald Walker, Kellogg Community College; Mrs. Mariella Aikman, Spartan Nursery School; and Mr. Harry Groulx and Harvey Tilker, Wardcliff Elementary School.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

ABSTRACT

STIMULUS SATIATION AND MENTAL RETARDATION

by Leif G. Terdal

This study compared both retarded and normal subjects on measures of stimulus satiation in an experiment in which one geometric design was repeated for twenty-seven consecutive trials and paired with a varied design. In all 115 subjects were tested. These included twenty control subjects in each of the following age groups: Young adult, Pre-adolescent, and Pre-school; twenty each of Young adult and Pre-adolescent institutional retarded, and fifteen non-institutionalized Pre-adolescent retarded. The groups were arranged to provide approximate CA and MA controls for two age levels of retarded subjects, as well as to provide a control for effects of institutionalization.

Specifically, the hypotheses were that the retarded are slower satiators than normals, and that, within both normal and retarded groups, there is a developmental relationship with younger individuals being slower satiators than older individuals. In this study slow satiation was equated with relatively high responding to a <u>constant</u> design, and to background stimuli. Conversely, fast satiation was equated with increasingly higher rates of responding

to novel stimuli— the varied design. The data consisted of looking times on a constant design, a varied design and neither design, i.e., away from both designs. The results were analyzed by means of analysis of variance and the Duncan's multi-range test.

The results supported the hypotheses. Developmentally, the three control groups and two retarded samples were ordered with respect to age with the younger showing slower satiation than the older groups. The obtained difference was significant between the Pre-school control group and the two older control groups. Regarding the effect of retardation, both CA control groups showed significantly faster satiation than the corresponding retarded samples. Furthermore, the Pre-adolescent control group showed significantly faster satiation than the Young adult retarded group for whom it served as a MA control. The Pre-school control group also showed faster satiation than its MA counterpart, the Pre-adolescent retarded group, but the obtained difference was not significant.

One hypothesis was not supported; the hypothesis stated that normal subjects would show more avoidance learning to a constant stimulus than retarded subjects. The results showed that neither the control nor the retarded groups showed avoidance learning in the context of the present study. The negative finding was attributed to the particular conditioning paradigm (trace conditioning) that was used.

The effect of slow satiation on the behavior of retardates

Leif G Terdal

was discussed as being detrimental to learning in three ways: (1) it hinders adaptation to irrelevant cues—particularly in complex learning situations, (2) it impedes incidental learning, i.e., learning in which consistent pairing between stimulus and response depends on the maintenance of internal sets, and (3) it reduces contacts with new stimuli.

Some implications for future research and education were also discussed.

Approved M. Ray Denny
Major Professor

Date May 21, 1965

CHAPTER I

INTRODUCTION

In this study the performance of mentally retarded and normally intelligent subjects was compared on two stimulus satiation variables: (1) amount of stimulus satiation, and (2) avoidance learning mediated by stimulus satiation. This was done in an experiment in which a series of designs were projected in pairs onto a screen so that one design of each pair was projected repeatedly and one design was new with each pair. Because stimulus satiation, as a basic psychological process, may enter into intellectual activity, a careful investigation of this variable may clarify the nature of learning and performance in humans of widely different intelligence levels. More specifically, stimulus satiation may operate differently for different levels of intelligence. Hopefully, the investigation of stimulus satiation may ultimately aid in the development of improved educational and rehabilitation programs for the mentally retarded.

Stimulus satiation represents a reduction of responsiveness to a stimulus as a result of exposure to the stimulus. Glanzer employed the concept to account for spontaneous alternation behavior in rats, and stated the following postulate about stimulus satiation:

> When an organism observes a stimulus, a quantity of stimulus satiation is built up. This quantity reduces the responsiveness of the organism to the stimulus. The longer the stimulus is present, the greater the amount of stimulus satiation is built up. In the absence of the stimulus, the quantity dissipates. It is also postulated that stimulus satiation generates to similar stimuli. (Glanzer, 1958, p. 305)

The phenomenon has been observed among a wide range of species and investigated in numerous ways. The most intensive investigations have involved spontaneous alternation studies, using typical T and + mazes, in which rats show a strong tendency to avoid entering the same arm on successive trials. Other investigations include the use of exploratory situations in which an animal is placed in a complex environment (as in a Dashiell maze), and reactivity tests, in which the approach, manipulatory, and avoidance behavior of animals is seen to vary in accordance with the introduction of objects into an otherwise very familiar environment. The essential point in stimulus satiation studies is that a stimulus is presented repeatedly and responsiveness to it--or to alternative stimuli--is noted on successive presentations.

Recent work on the tendency to avoid encountering the same stimuli on successive trails (stimulus satiation) has shown the following: Stimulus satiation increases with (1) long exposure time (Glanzer, 1953), (2) short intertrial interval (Walker, 1956), and (3) frequency of presentation (Berlyne, 1958).

Studies have also shown that with the passage of time the stimuli regain their elicitation value (Walker, 1956), and that some stimuli are more resistant to stimulus satiation than others (Welker, 1956). Denny (1957) and Leckart (1963) have shown that stimulus satiation can mediate avoidance learning.

Background. Both clinical observation and theoretical lines of thought point to stimulus satiation as both a characteristic of and a contributing factor to mental retardation.

Clinically, a complex of behaviors including perseveration, stereotyped movements, and distractibility, all of which are frequently attributed to the mentally retarded, may be related to slow stimulus satiation. Davenport and Berkson (1963) have observed and recorded stereotyped behaviors among severely retarded institutionalized subjects and reported that subjects high on stereotyped behavior show little responsiveness to novel and manipulable objects. In other words, novel stimuli compared to the elicitation value of background stimuli have relatively low elicitation value for the severely retarded because familiar or background stimuli do not undergo much satiation and habitual responses are attached to them. While behaviors such as rocking, pacing, posturing, head banging, and repetitive hand movements do not generally characterize the less severely retarded, perseverative behaviors are frequently reported as contributing a large number of errors in the performance of even the mildly retarded in learning and performance tasks. This may be interpreted as reflecting an inability to shift attention and a tendency to repeat behaviors when different tasks are presented in relatively rapid succession. Feldman (1953) reported such findings regarding the performance of retardates on the Bender Gestalt test, and Barnett (1960) on a variety of verbal and visual-motor tasks. Distractibility like perseveration can be attributed to a failure to inhibit responding to stimuli that one has encountered innumerable times; therefore, it, too, may be interpreted as representing slow stimulus satiation. Lewin (1935) reported that distractibility and excess numbers of responses to irrelevant stimuli accounted for much of the poor performances of mentally retarded children in his studies. Berkson and Mason (1964) studied the feasibility of repeatedly introducing retardates to a testing situation in order to habituate them to the surroundings and reduce interfering orienting behaviors. They found no habituation of stereotyped behaviors accompanying six repeated exposures to the test situation.

Theoretically, slow stimulus satiation can relate to inefficient learning in three related ways: (1) slow habituation to learning conditions, (2) poor incidental learning and (3) reduced contact with new stimuli. These are discussed as follows:

Adaptation. Historically, the importance of adaptation in learning was perhaps first recognized by Pavlov, who found that even in simple classical conditioning experiments, his experimental animals did not show acquisition of conditioned responses until they were thoroughly habituated to the experimental setting, i.e., so that extraneous stimuli were not eliciting competing responses in the context of the CS - UCS - response paradigm. More recently Bindra (1959) has elaborated on this point by stating that in new learning situations a large part of the incorrect responses are reactions to irrelevant stimuli. As the animal habituates to these stimuli, such incorrect responses are eliminated. In incidental learning situations habituation must occur rapidly for learning to take place because, by definition such learning situations are likely to be transient, changing, and lacking in structured, defined tasks.

Poor incidental learning. The principle of stimulus satiation or adaptation is central to elicitation theory (Denny and Adelman, 1955). According to this theory, learning occurs only when a response is consistently elicited in a given stimulus situation. To elaborate, the response must be elicited in some way which involves the afferent nervous system, and it must be elicited each time the stimulus in question is present. Since contiguity of response and stimulus is postulated as the critical factor in learning,

it follows that adaptation to irrelevant elicitors is imperative. Denny (1964) has asserted that mental retardates have, in comparison with normals, a very small backlog of information because they are poor incidental learners. In incidental learning an individual must maintain sets which are not established for him as they are in intentional learning. Because the mentally retardate is stimulus bound and may be distracted by almost any stimulus, he shows poor ability to establish sets, and thus does not encounter consistent pairings of stimulus and response. Singer (1963) tested and verified the hypothesis that mental retardates are poor incidental learners; at the same time he found no significant differences between his mentally retarded subjects and normally intelligent subjects on an intentional learning task.

Reduced contact with new stimuli. Berlyne states that novelty seeking also affects learning and behavior in that it widens the scope of stimulus selection, that is it "....enables stimuli that are not at present acting on receptors to be placed in command of behavior." (Berlyne, 1960, p. 134) This advantage is forfeited by individuals who are stimulus bound and who respond indiscriminately to stimuli regardless of recent or past exposures to the stimuli. Berlyne has done a lot of research with human subjects in this area. He prefers the concept of novelty seeking which stresses approach behavior to new or novel stimuli, rather than the concept of stimulus satiation, which stresses the avoidance of recently encountered stimuli. By and large both sets of concepts have similar applicability. The differences will not be discussed in this study.

Relevant research. While no research involving mentally retarded subjects has been reported in the specific area of the effects of repeated exposure to a stimulus on its elicitation value, related research involving a complex of behaviors has yielded related findings. Lewin (1935) tested "...the process of satiation," (p 198) by having mentally retarded children and normally intelligent children, each divided into three age groupings, draw moon faces for as long a time as they could. As the name implies the moon faces consisted of a circle, two dots for eyes, one dot for a nose, and a line for a mouth. In Lewin's study slow satiation is represented by high persistence on the tedious task of drawing moon faces. He found that young normal children, aged 8-9, showed more persistence than older normal children, aged 10-11, and that older retardates, aged 10-11, showed more persistence than all three groups of normally intelligent subjects, as well as more persistence than the younger retardates. After drawing moon faces, his subjects were encouraged to draw anything they liked for as long as they wished. In this less structured task, many of the older retardates refused to draw and as a group they drew for only two - three minutes. The normally intelligent controls drew many times as long as the retardates.

Lewin's study is somewhat different from those investigating stimulus satiation variables; i.e., in his study a task was repeated until it apparently became so unpleasant that it was stopped. In stimulus satiation studies a stimulus--not a task--is presented, and responsiveness to the stimulus is observed to decrease with repeated exposure. Lewin's study is reported here because there may be a relationship between the behaviors he investigated and those of this study.

Kounin (1941) varied Lewin's study to test the generality of satiation effects. He had three groups of subjects: old feeble minded (42.0 years old), young feeble minded (14.5 years old), and a normal group (6.8 years old). All groups had comparable mental ages. The subjects were required to draw a cat repeatedly until they tired of it, and in turn to draw a bug, and then a turtle, and then a rabbit--each until they wanted to draw no more. Mild pressure and encouragement were applied. Kounin hypothesized that older individuals and mentally retarded individuals would show least amount of generalization; i.e., they would show a high rate of drawing response on the bug, turtle, and rabbit. His findings supported his hypotheses, as he found that older retardates showed less generalization of satiation than younger retardates and both retardate groups showed less generalization of satiation than the normal control.

Unfortunately, he did not have an older group of children of average intelligence to further test his hypothesis that older individuals show less generalization of satiation than younger children. Actually his prediction regarding age is the opposite of that of this study. This will be discussed below in the section containing hypotheses. In addition, however, Berlyne (1958) has shown with humans, and Welker (1956) with chimpanzees, that younger animals satiate slower than older.

More recently Zigler, Hodgen, and Stevenson (1958) repeated aspects of Kounin's study with some variations: the principal one is that one half of their subjects received no support from the experimenter during the experiment, while the other half were given both verbal and non-verbal encouragement and support. As in Kounin's study, the mentally retarded and M.A. control subjects were presented with a series of simple, repetitive games with the instructions to play each one in turn until they wanted to play no more. Zigler, et. al., found that the retarded subjects spent longer times on the games under both support and non-support conditions than the M.A. control subjects; but that, unlike the control subjects, the retardates showed longer play times under the conditions of support than non-support. Their interpretation is that mental retardates are more compliant and more responsive to social rewards than normals, and that this high motivation for social interaction among

retardates rather than a basic deficit of slow satiation can account for their own and for Kounin's findings.

The three studies reported above used the term satiation in its more general meaning of behavioral boredom. In contrast Spitz has incorporated a concept of satiation as representing a neurophysiological process a la Köhler and Wallach, using visual figural after effects and reversible figure tests. In a series of studies investigating such satiation phenomena among retardates and control subjects, Spitz has reported that retardates satiate slower than control subjects, that satiation effects when they occur last longer among retardates, and that retardates show high perceptual rigidity (on the Rubin Vase-Profile Reversible Figure Test). (Spitz and Blackman, 1959; Spitz, 1963). Lipman and Spitz (1961) have suggested a similarity between satiation as postulated by Köhler and Wallach (1944) and inhibition in learning. The present study, as well, postulates that slow satiation is related to failure to inhibit responding.

Several studies have shown a relationship between intelligence factors and satiation in animals. Thompson and Kahn (1955) compared bright and dull rats in an experiment in which both groups were tested successively in a black T maze, a gray Y maze, and then the original black T maze. They found that the bright rats showed a sharper rate of decline of exploratory behavior in the first T maze test (faster stimulus satiation than the dull rats), but that the dull rats showed less activity in the interposed Y maze--this was attributed to poorer discrimination, on the part of the dull rats, between the two situations.

Thompson and Woodburn (1954a) have shown that early restriction of activity in dogs has a lasting effect of prolonging their exploratory behavior of even the simplest of new situations--a bare room. If we accept Sarason's assertion (1953) that severe restrictions during early life permanently affect learning and intelligence, then this study further indicates a relationship between intelligence and stimulus satiation. Thompson and Woodburn (1954b) also found that the dogs reared in a restrictive environment showed hyperactivity, perseverative behavior, and poor performance on problem solving tasks, as compared with a control group of dogs.

Hoats, Miller, and Spitz (1963) reported a study which has some similarities with this study both in behaviors investigated and procedures employed. They investigated the looking behavior of normal and retarded children on stimulus materials which were projected in pairs onto a screen. The stimulus materials consisted of thirty pairs of figures—one simple and one complex figure in each pair. The complexity factor was broken down into six variables: irregularity of arrangement, amount of material, heterogeneity of elements, irregularity of shape, incongruity, and incongruous juxtaposition. The task was presented as follows: the E presented the stimulus pairs one at a time for three seconds. The subjects were instructed to bring back one of the two figures by pressing and holding down a lever corresponding to the figure of his choice--for any time up to thirty seconds. The critical measures were the number of complex as compared with simple designs chosen for repeat viewing, and their exposure time.

Their results were equivocal: there were no group differences regarding the choice of complex versus simple figures for re-viewing. Furthermore, both the retarded and the CA and MA control groups showed a preference for bringing back simple designs for re-viewing. The normal groups, however, held down the button significantly longer for the complex than for the simple designs. The retarded did not show such a differentiation. A puzzling finding was a significant negative correlation between preference for bringing back complex figures and IQ among retardates,i.e., in their study the low IQ retardates performed more like the normals than the high IQ retardates.

Assuming that retardates differ from normals regarding their looking behavior on complex versus simple designs, certain aspects of their procedure may have served to minimize such differences. For example, the initial three-second exposure time of the figures was probably not long enough to reflect the retardates' alleged inability to attend effectively for any length of time, nor long enough for the nommal groups to have satiated to the simpler designs. This problem is handled in this study by having figures exposed for longer time periods--12.30 seconds.

<u>Terminology and hypotheses</u>. Slow satiation is equated with comparatively long attending to repetitious stimuli and to non-task or background stimuli. Fast satiation is equated with aversion to repetitious stimuli and to background stimuli--as a function of exposure to such stimuli--and by high rates of attending to varied stimuli.

In this study the repetitious stimulus was a geometric design (from the point called the <u>constant design</u>) which was shown to each subject for 27 successive trials of 12.30 seconds per trial. Non-task or background stimuli were not specifically identified in this study, but were indicated by seconds per trial during which a subject was not attending to one or the other of two geometric designs. Such times were recorded as looking times on <u>neither</u> design. Looking times on <u>neither</u> design were interpreted in this study as distractibility, i.e., as a failure to inhibit responding to familiar background stimuli and therefore as indicating slow stimulus satiation.

The varied stimuli in this study were fourteen different geometric designs which were shown no more than twice in 27 trial exposures of 12.30 seconds per trial. These were identified as <u>varied designs</u>.

The specific procedures involved in using the stimulus material is discussed in the following chapter.

The hypotheses are the following:

(1) Retardates show slower rates of increase of

attending to new stimuli than individuals of average or higher intelligence. That is, in the looking time study the retardates will not show an increase over 27 trials of looking times on the <u>varied</u> design, as marked as that of control groups.

(2) Retardates show higher rates of attending to repetitious stimuli and to non-task or background stimuli than individuals of average or higher intelligence. That is, in the looking time study the retardates spend relatively high looking times away from both designs--on <u>neither</u> design--and on the <u>constant</u> design.

(3) Developmentally, comparing young retardates with older retardates--and young normals with older normals, younger subjects will show slower satiation than older subjects. Measures of slow and fast satiation remain as described in <u>Hypotheses One</u> and <u>Two</u>; i.e., slow satiation is equated with (1) slower rate of increase of attending to the <u>varied</u> design, and (2) higher looking times on <u>neither</u> design and the <u>constant</u> design.

(4) Due to their slower stimulus satiation, retardates show less avoidance learning in the context of stimulus satiation than individuals of average intelligence. The experimental context of this hypothesis is that the subjects were permitted to push a buttom as many times as they wished to see brief slide exposures of three individual geometric designs. Relatively low response

rates of pushing a button to see a design that was paired with a constant color stimulus, in comparison with response rates to see designs that were paired with varied color stimuli, indicated avoidance learning.

A minor and subsidiary hypothesis to Hypothesis Four is as follows:

(5) In a free responding situation, retardates show higher response rates than normal control subjects. That is, they show high response rates of pushing a button to see individual slides.

This study incorporated both chronological age (C.A.) and mental age (M.A.) control groups, to allow for more specific pin pointing of retardates' deficits than when only one control group is used. In this study poorer performance on the part of retardates than corresponding M.A. control groups is described as a Low-IQ deficit. In the same manner poorer performance on the part of retardates than corresponding C.A. control groups is described as a Low-M.A.--Low-IQ deficit.

It is expected that on the three hypotheses described above, comparing retarded with normal subjects, that the retardates will perform at or below the level of corresponding M.A. subjects.

CHAPTER II

METHOD

<u>Subjects</u>. Six groups, including three retarded groups and three control groups, totaling 115 subjects were used in this study. The six groups were chosen to allow for three kinds of comparisons involving stimulus satiation variables regarding:

(1) Development -- to test for relationships between chronological age and rate of stimulus satiation among both retarded and control groups.

(2) Intelligence -- to provide both mental age and chronological age control groups for each of two age groups of retarded subjects. This permits a pin pointing of the relative severity of behavioral deficit, if any, of retardates as compared with control subjects. A pre-adolescent control group serves a double function of a M.A. control for a young adult retarded group and a C.A. control for a pre-adolescent retarded group.

(3) Effects of institutionalization -- to provide a control for possible effects of institutionalization on stimulus satiation variables. This was done because the

normal control groups were not institutionalized, whereas two retarded groups were institutionalized.

Descriptive data regardingthe six groups are given in Table 1.

TABLE 1. - The means and standard deviations of the chronological ages for the six groups, and the mean IQs and mental ages for the retarded subjects.

Groups	N	C.A. in Years & Months	S.D. of C.A. in Years & Months	M.A. in Years & Months	IQ	IQ Range
Young Adult Control	20	19-6	1-5		*	
Young Adult Institutionalized Retarded	20	20-5	2-9	10-3	57	34-70
Pre-adolescent Control	20	10-8	-5		*	
Pre-adolescent Institutionalized Retarded	20	11-4	1-7	5-0	44	24-72
Pre-adolescent Non-Institutionalized Retarded	15	10-7	2-6	4-11	46	26-67
Pre-school Control	20	4-9	-4		*	

*See Text

As is indicated in Table 1, the chronological ages of the normal control groups were essentially similar to the chronological ages and to the mental ages of the retarded groups for whom they servedas C.A. and M.A. controls. Individual intelligence test data was not available

for the control subjects as they were for the retarded subjects; however, comparable information was available which indicates that the control subjects as a group have average to slightly above average intelligence levels. The following describes the control subjects.

The twenty young adult control subjects were selected from the Kellogg Community College in Battle Creek, Michigan. Actually, twenty-six were selected because six of the initial twenty who were selected chose not to participate. The college students were enrolled in the technical and secretarial programs at the college. Data from the California Mental Maturity Test, The Detroit Advanced Form V, and the Otis Gamma I.Q. Tests was available for eighteen of the subjects. The range was from 91 to 122 and the mean IQ was 104.

The pre-adolescent control subjects were drawn randomly from the fifth grade classes at the Wardcliff Elementary School in Okemos, Michigan. Data from the Iowa Basic Achievement Test was available for all the subjects. The scores in per centiles ranged from 18 to 85 with a mean of 60. This test is used nation wide and correlates fairly well with intelligence tests (Stake, 1961). On this basis it is assumed that as a group the pre-adolescent control subjects are at least within the average range of intelligence, and probably not much above average.

The pre-school children were selected randomly from the Spartan Nursery on the Michigan State University campus. All the children in the Nursery are children of Michigan State University students. No data is kept on file regarding these children. However, a nursery school staff member reported that previous testing with individual intelligence tests on comparable children at the Nursery school have generally yielded IQ scores ranging from 90 to 120.

Sixteen of the young adult retardates came from the Plymouth State Home and Training School in Northville, Michigan. The remaining four young adults were selected randomly from the Fort Custer State Home in Augusta. Ten of the Pre-adolescent subjects were also selected from the Plymouth State Home and Training School. Again, the remaining ten institutionalized, pre-adolescent retardates were drawn randomly from the population of the Fort Custer State Home.

Four of the non-institutionalized, pre-adolescent retardates came from the Woodhaven Center in Lansing. The remaining eleven were selected from the Tower Garden School, also in Lansing, Michigan.

No differentiation was made in this study between "organics" and alleged "non-organics."

Test materials and equipment. The test materials consisted of 35mm slide photos which elicit looking behavior from subjects. The photos were of geometric designs and squares of color. A standard size was used throughout, so all designs and squares of color cover an equal area of a slide screen, when projected from comparable distances by a slide projector.

The following describes in detail the kinds of photos that were used:

(1) 35mm slide photos of pairs of geometric designs. Slide photographs were taken of pairs of designs made from Color Cubes, a block design game produced by the Embossing Company in Albany, New York. The slides were taken as follows: One-inch square, wooden, multi-colored blocks were arranged into symmetrical, geometric designs. Two designs, each constructed from 49 blocks, were placed seven inches apart, adjacent to each other, on a green vinyl material which served as a background. They were then photographed.

From a large number of slides four series of fourteen slides each were selected and arranged as follows: Each slide in a series had one design repeated throughout all of the fourteen slides; this constant design was paired with a design that was varied, i.e., appeared only once, throughout each of the fourteen slides. The four series

were based on four different constant designs, each of the four series shared the same fourteen varied designs.

The four series, consisting of different constant designs, were developed to offset an effect should groups which differ in intelligence show either consistent initial preference or aversion to a particular constant design. For example, perhaps the mentally retarded, as a group, would show preference for a particular constant design and show aversion to another constant design, and vice versa for the brighter control groups. Therefore the use of several designs, in this case four, enhanced the probability that the mean elicitation value of the four constant designs relative to the varied designs would be comparable for both retarded and control groups.

(2) 35mm slide photos of <u>individual</u> <u>geometric</u> <u>designs</u>. These pictures were similar to the slide photos of pairs of designs, described above, except that each slide contained one, not two designs. As stated above, each design consisted of 49 one-inch square, colored, wooden blocks. A green vinyl material served as background for the block designs. To assure that the green background would not predominate, when only one design appeared on the screen, aluminum foil was placed over the slide covering all but the design, plus a small area of green background. Three slides of this kind were developed.

(3) 35mm slides of pairs of homogenous squares of color. Two slides were developed to project square patches of blue and red colors. The color squares were the same size as the geometric designs described above; they were also similarly positioned adjacent to and apart from each other. When projected from comparable distances by a slide projector, the squares of colors cover the same area as the designs.

(4) 35mm slides of individual squares of color. These slides were similar to the slides of pairs of squares of color, described above, except that each slide contained one, not two, squares of color. Three slides were developed to illuminate the colors red, blue, and yellow. When shown at comparable distances, the individual squares of color cover the same area on a screen as the three slide photos of individual geometric designs.

A photo of one slide of a pair of geometric designs used in this study appears on the following page. As is true of all the pictorial material, each design covered about 12 inches square on the slide screen. Drawings of this and the other pictorial material are given in Appendix A.

Slide projectors and related apparatus. In addition to the slides described above, the following equipment was used: Two remote control slide projectors, two electric

Plate 1. Photo from one slide of a pair of geometric designs. The design on the right is the constant design. The projected size of each design was twelve inches with a twelve inch space separating the two designs. Drawings of this and other pictorial material are given in Appendix A.

timers (Hunter, model 115D), two electric clocks which record events in seconds and hundreds of seconds, a standard height table to support the projectors, and a 50" X 50" slide screen. The Hunter timers were set in series and wired to respond to electric impulse and to turn on the light of one projector for 2.00 seconds and then simultaneously to turn off the first projector and to turn on the second projector, and after 12.30 seconds to turn off the second projector. Both slide projectors were rewired so that the power source for the lights was independent of the power source for the remote control slide changer, automatic focus, and air blower. This enabled the assistant to change slides after the Hunter Timers turned power off for the lights. The electric clocks were solenoid operated and "clicked" when started. To reduce the noise, the clocks were encased in a box made from one-inch thick sound proofing material.

<u>Procedure</u>. Two tasks were presented to the subjects; however, the apparatus set-up and the seating position of subject, experimenter, and assistant were essentially the same for both of the experimental tasks. The experiments were conducted in the various institutional or school settings of the subjects. In each case a room was used which was as bare as possible, to prevent unusual stimuli from distracting the subjects from looking at the pictures.

The rooms were long enough so that the slide projector could be placed 12 feet away from the screen; this provided a standard image size for the 35mm slides for all subjects. Illumination was controlled and kept dim to provide for easy viewing of the slides, which were shown from a pair of 500 watt slide projectors.

The two slide projectors were placed on a standard height table, facing a slide screen which was 12 feet away. The subject was seated five feet in front of and slightly to the right of the screen. An assistant sat next to the slide projectors, behind the subject, and was responsible for changing slides and making minor adjustments on the focus when necessary. Both of those operations could be done by remote control, and therefore without commotion. The experimenter sat behind a partition which was attached to the bottom of the screen and extended to the floor. He was not visible to the subject; however, he could observe the subject by looking through a one-inch square opening in the partition. The air blowers on the slide projectors, which cool the projector bulbs, were running continuously, even when the subject was first brought into the room. This was done to help the subject adapt to the noise and prevent him from turning around each time the projector lights were turned off or on. In an additional effort to help the subject adapt to the situation comfortably, he was encouraged to explore the room, talk to the experimenter and assistant,

look at the equipment, etc., if he showed any inclination at all to do so before the pictures were shown to him. The subject was seated and shown pictures only after it appeared he was ready to do so.

Phase 1. The purpose of Phase 1 was to test for satiation effects of repeated exposure to one design when an alternative, novel design was available, and to set the stage for testing for avoidance learning mediated by stimulus satiation. The subject was introduced to the testing situation in the manner described above. When ready for the pictures, he was told: "We are going to show you some pictures. They will appear on the screen in front of you (pointing to the screen). Look at the pictures." Whenever necessary the experimenter used gestures to insure that the subject understood the task.

The visual materials used were the pairs of squares of colors, and the fourteen pairs of geometric designs. Twenty-seven trials were run with each subject. Each trial consisted of a 2.00 second exposure to pairs of color squares, one red and one blue color. Simultaneously with the turning off of the color squares, a pair of geometric designs would flash on the screen over the area which was just previously occupied by the color squares. The designs would remain exposed for 12.30 seconds. Each trial consisted of slide exposures of both color squares and geometric designs, and was followed by a 10 second inter-trial interval. The twenty-seven trials were based on showing the fourteen pairs of geometric designs in forward succession, and, after the fourteenth, showing the remaining thirteen designs in reverse order from the first showing. Thus, each design except the fourteenth was shown twice.

Three critical factors in the procedure are the following: (1) one of the designs (the _constant design_) was repeated in each of the twenty-seven trials, and was paired in each trial with a design (the _varied design_) that was shown no more than twice in twenty-seven trials; (2) the color squares were paired with the geometric designs in a consistent manner, i.e., one color was always paired with the _constant_ design, while the other color square was always paired with the _varied_ design. For one-half of the subjects in each group, red was paired with the constant and blue with the varied designs. The converse was true for the other half of the subjects. The use of color squares in this manner served to direct the subject's eyes back to the screen in time to view the geometric designs when they flashed on after each 10 second inter-trial interval, more importantly, it enabled a test of the hypothesis that stimulus satiation may mediate avoidance learning. In this case the hypothesis was that avoidance learning will be built up to the color that is consistently paired with the constant design; and (3) the _constant_ and _varied_ geometric designs were shown alternately on one side and then on the other side of the screen in runs of three. For all subjects the design on the left side of the screen was constant for the first three trials. During the next three trails the constant design appeared on the right side of the screen, and so forth for the twenty-seven trials. Alternating the sides on which the constant and varied designs appeared was done to counter balance the effect of position preference, i.e., the tendency to look at one side of the screen throughout the twenty-seven trials regardless of what design appeared there or adjacent to it.

The data was recorded by the experimenter who sat behind a partition attached to the slide screen. He was not visible to the subject but could observe the subject by looking through a one-inch square hole in the partition. Although the room was darkened, the slide screen reflected back sufficient light to enable the experimenter to observe the subject's eye movements. The data consisted of the amount of time in seconds and fractions of seconds that the subject's eyes were focused on the <u>constant</u> design, the <u>varied</u> design, or neither design of each of the 27 slide exposures.

More specifically, the experimenter observed continuously during each slide exposure whether the subject's eyes were focused on the picture area on the left side of the screen, right side of the screen, or neither side. Of course the subject generally looked at one design, then the

other, back again, or away from both, and so forth. The experimenter observed this behavior and recorded it by pressing one of two buttons which were wired to a pair of electric clocks--each clock summed up the time for one of the two designs. Since each slide exposure was fixed at exactly 12.30 seconds by electric (Hunter) timers, the amount of time of each slide exposure that the subject spent looking at neither picture was indicated by the examiner releasing hold of both buttons wired to the electric clocks, and recorded by totaling the times recorded on the two clocks and subtracting that figure from 12.30 seconds.

A word about what was involved in looking at neither picture is in order. Looking at neither picture is interpreted in this study as a measure of distractibility, and included such behavior as looking about the room, turning around to look at the slide projector, looking and scratching oneself, closing one's eyes, etc., while a slide is projected on the screen. Momentary eye blinks were not regarded nor recorded as looking at neither picture. Specific behaviors involved will be discussed in the Results Section, but the data in terms of time will be inclusive and will not be differentiated into various activities engaged in while not looking at the designs.

Reliability of recording looking time behavior. The experimental procedure was subjected to a series of pilot studies to determine the reliability of coding looking time behavior. This was accomplished by two coders recording independently the looking behavior of subjects. The procedure was continued until the agreement, expressed in product moment correlation, reached .85 or better. The writer served as one coder, and Elsie Berdach, a graduate student in psychology, as the other coder.

The experimental procedure in the pilot study was similar to that, described above, which was subsequently used with the retarded and control subjects that made up the body of data reported in this study. In short, the subjects, tested one at a time, were seated in a darkened room facing the slide screen, and were asked to look at pictures. One variation in procedure was that the coders were not positioned behind the screen, but sat on opposite sides of the slide screen and faced the subject. The reason for the variation in procedure was to eliminate the possibility that the coders would be influenced by each other's recording, i.e., by hearing a "click" or some movement as times were being recorded. By sitting several feet apart from each other, the background noise from the air blowers on the slide projectors satisfactorily masked whatever sounds might have been involved in recording, both from the subject and from the other coder. A second variation in procedure was that, for each subject, the fourteen slides of pairs of geometric designs were shown through once, not twice.

Twenty undergraduate students who were enrolled in an introductory psychology course at Michigan State University served as subjects. The first nine were used for practice in recording looking time behavior, and the data obtained was not statistically analyzed. The independent time recordings taken by the two coders for the last eleven subjects were statistically analyzed.

The formula used was the product moment correlation in which 142 measures of time spent viewing both constant designs and varied designs, recorded by the two coders, were correlated. The resultant correlation was .915. This was regarded as satisfactory and the remaining data were recorded by the writer.

Phase 2. The second phase of the study was designed to test the hypothesis that stimulus satiation can mediate avoidance learning involving looking behavior. The stage for testing the hypothesis was set up during the showing, in Phase 1, of 27 exposures of pairs of geometric designs. Each of the 27 exposures was immediately preceded by a 2.00 second exposure of pairs of color squares, one red and one blue color. The color squares were paired with the geometric designs in a consistent manner; i.e., one color (red for one half, blue for the other half of subjects in each group) was always paired with the constant design, while the other color was always paired with the varied design. Avoidance learning would be indicated by aversion, on subsequent trials, of designs paired with a color that had previously been paired with a <u>constant</u> design.

This was tested by showing three slides of individual geometric designs and pairing each one of the designs with a slide of an individual square of color, of either red, blue, or yellow. A difference in procedure in Phase 2 was that the subject had control over his seeing the pictures; he was instructed that he could see a picture as many times as he wished by pushing a button--once for each exposure. Each press of a button resulted in a color square being illuminated for 2.00 seconds and simultaneously with its turning off, a geometric design would be flashed on the screen over the same area and be turned off after 1.50 seconds.

Specifically, avoidance learning would be indicated by a subject's pushing a button less frequently for a design paired with a color square that had previously been paired with the constant design, and, conversely, more frequently for a design paired with either a color square that previously was paired with the varied designs or a color square (yellow) that was not shown previously.

The instructions given to the subjects were the following: "We have three more pictures to show you, but this time you must push a button to see a picture. Each time you push this button (showing the child the button) a picture will go on and off by itself. Push the button as many times as you want to see the picture. When you don't want to see the picture any more say, 'next picture,' or stop pushing the button. Then I will get the next picture ready for you." When necessary the instructions were repeated. For a few young retarded children, the task was demonstrated once by the experimenter pushing the button. A limit was set at 30 exposures per picture. If a child pressed the button 30 times, he was told: "Now I will put the next picture on, push the button to see it, and when you don't want to see it any more say 'next picture,' or stop pushing the button."

To assure that preferences for a particular design would not affect group averages, the order of showing the three slides of designs, and the color squares they were paired with, were systematically varied.

CHAPTER III

RESULTS

Phase 1. Looking times on pairs of geometric designs. Figures 1-6 graphically represent the mean looking times for the varied design, constant design, and neither design for all six groups. The graphs indicate widely different looking behaviors among the groups. All groups showed higher mean looking times on the varied, than on the constant design. However, the retarded groups in comparison with the control groups had more trials in which the mean looking times for the constant was higher than for the varied designs. The two older control groups had low mean looking times away from both designs. In contrast the young adult retarded group and the pre-school control group had higher mean looking times away from both designs than they had on the constant designs, but not as high as on the varied designs. The two pre-adolescent retarded groups spent about as much time looking away from the designs as looking at them.

A separate analysis of variance was computed for each of the three looking time measures. Table 2 gives the over-all analysis of variance for looking times on the varied designs for five groups, over four blocks of six

Mean Looking times on Varied, Constant and Neither designs for two groups: each trial block representing means of six trials

Figure 1. Young adult control

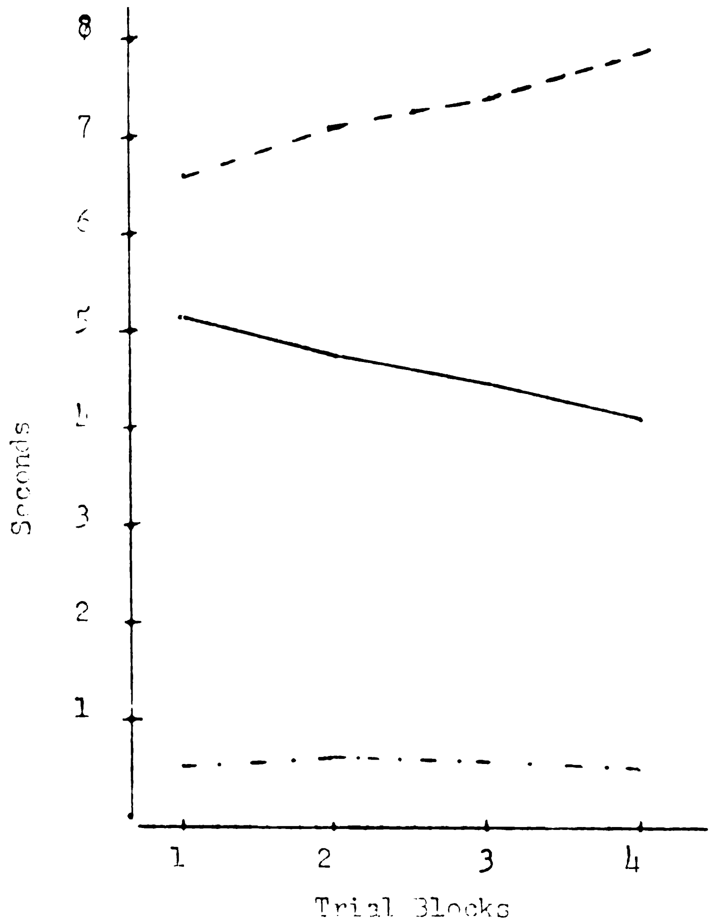
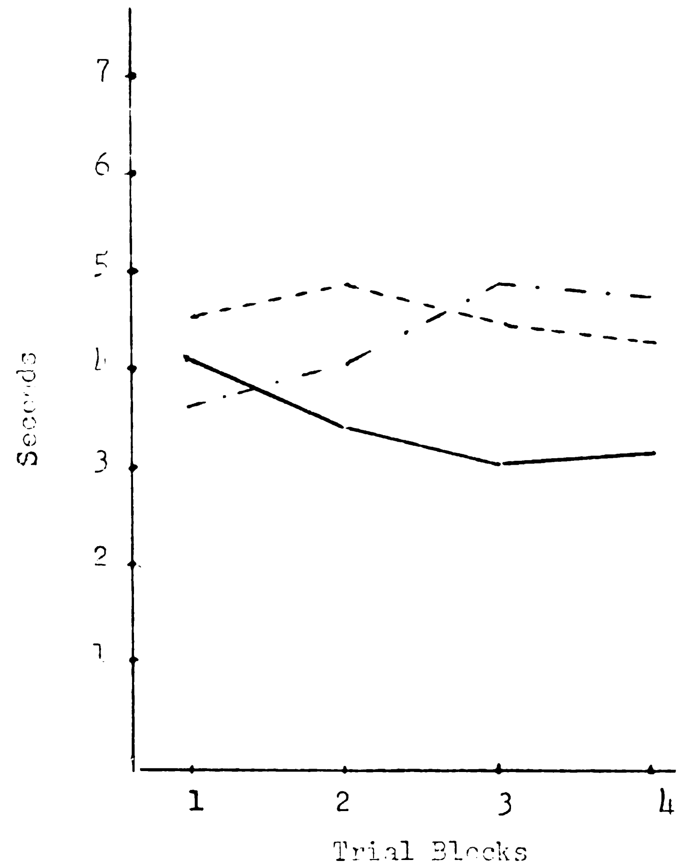


Figure 2 Young adult retarded



------ = Varied
——— = Constant
- · - · - = Neither

Mean Looking times on Varied, Constant and Neither designs for two groups: each trial block representing means of six trials

Figure 3. Pre-adolescent control

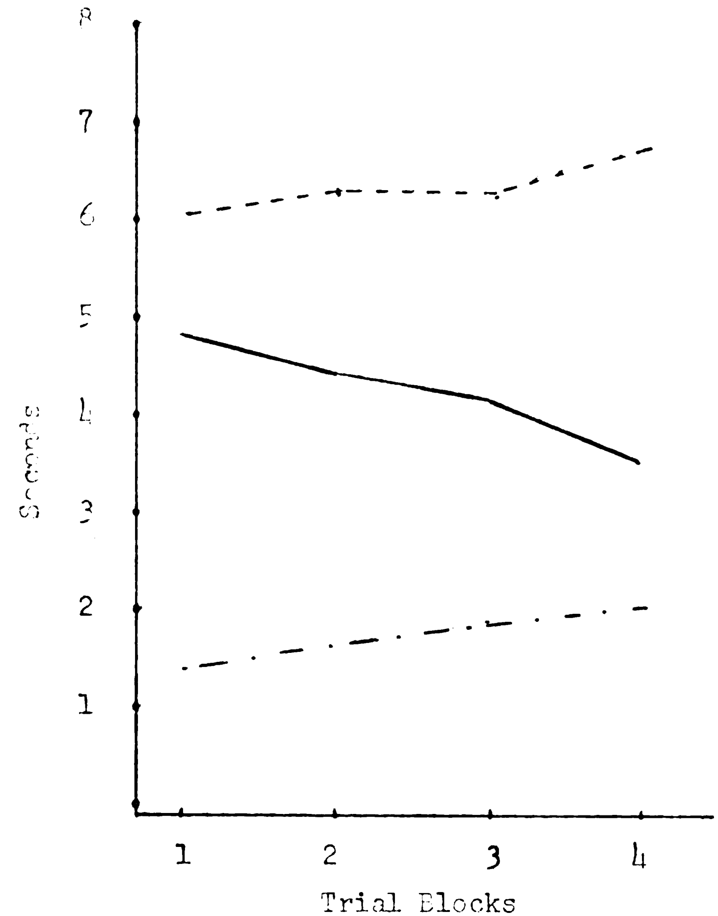
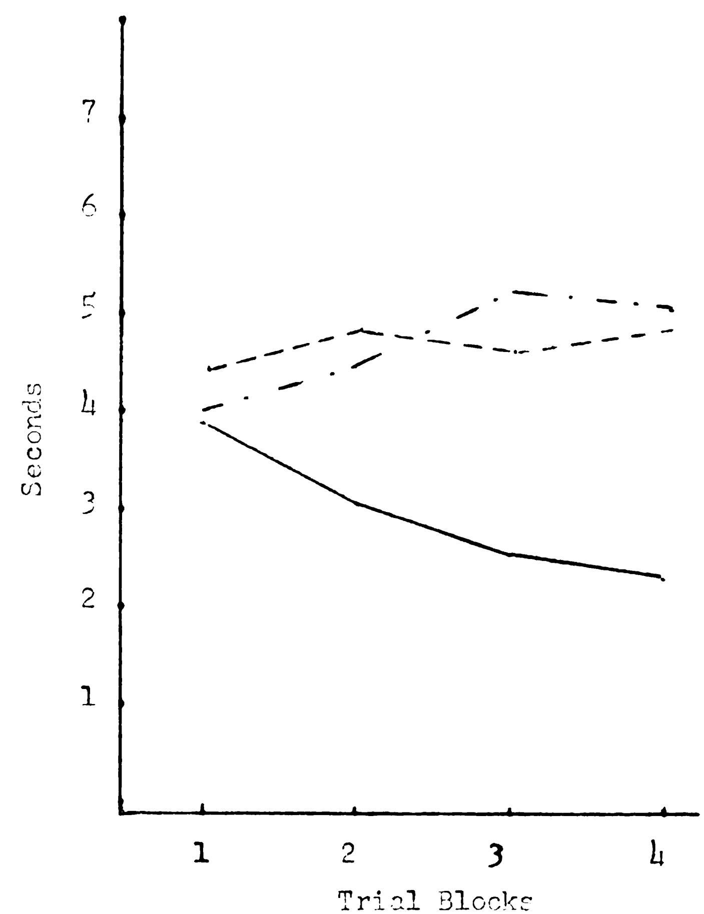


Figure 4. Pre-school control



- - - - - - - = Varied
———— = Constant
— · — · — = Neither

Mean Looking tires on Varied, Constant and Neither designs for two groups: each trial block representing means of six trials

Figure 5. Pre-adolescent retarded institutionalized

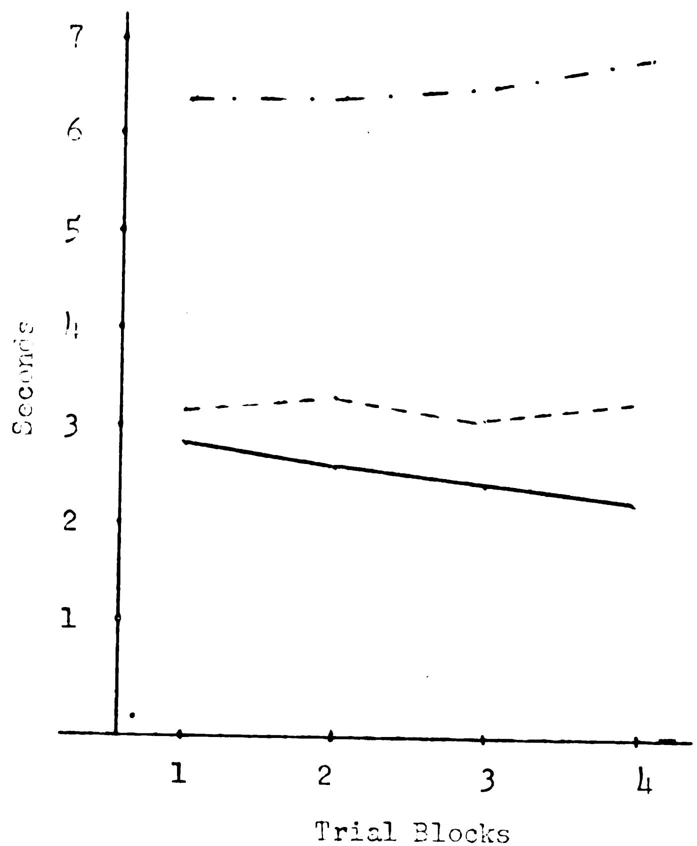
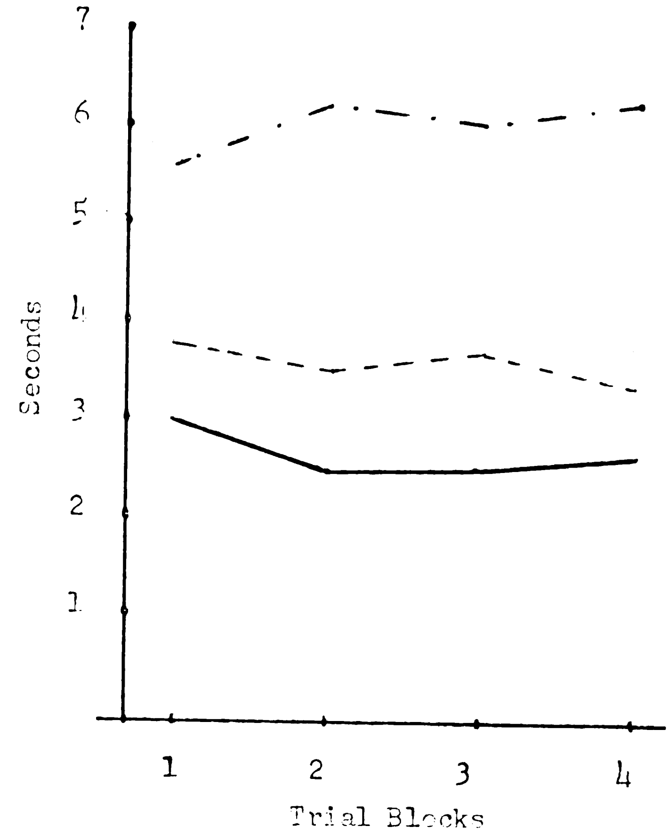


Figure 6. Pre-adolescent retarded non-institutionalized



------- = Varied
——— = Constant
- · - · - = Neither

trials in each block. The non-institutionalized pre-adolescent retarded group was not included in any of the over-all analysis, but was compared, given below, with the institutionalized pre-adolescent retarded group.

TABLE 2. - Over-all analysis of variance for looking times on the varied designs for five groups over four blocks of trials. Mean scores are indicated in Figures 1-5, given above.

Source	F	P
Groups	23.373	.001
Trial blocks	3.489	.05
Groups X Trials	1.149	NS

As is indicated in Table 2, the analysis of variance between-groups effect was significant well beyond the .001 level. The trial blocks effect was significant at the .05 level indicating different overall mean looking times as a function of trials. No significant interaction effect was indicated.

The Duncan's test for differences between group means was computed for each of the four blocks of six trials. Table 3 presents the Duncan analysis for the first block of six trials, and it includes the mean looking times for each group for the first six trials, the differences between each group and every other group, and the minimum significance range for the .05 level. In this analysis the two

C.A. control groups have significantly higher mean looking times on the varied designs than the corresponding mentally retarded groups. However, the M.A. control groups approached but did not attain significantly higher mean looking times on the varied designs than the corresponding retarded subjects. Also, while the young adult control group differed significantly from the pre-school control group, the pre-adolescent control group was not significantly above the pre-school, or below the young adult control groups in mean looking times on the varied designs for the first six trials. No change in significance levels between groups occurred until Block 4. The analysis for Block 4 (trials 19-24) is given in Table 4. The mean looking times in Block 4

TABLE 3. - Duncan's Multiple Range Test applied to the differences between five group means for Block 1 of looking times on the varied designs. The analysis of variance for the same data is given in Table 2.

			(1) A	(2) B	(3) C	(4) D	(5) E	(6) Shortest Significance Ranges Each .05 Level
		Means	3.10	4.45	4.54	6.04	6.73	
Pre-adoles. Retarded	A	3.10		1.35	1.44	2.94	3.63	1.82
Pre-school Control	B	4.45			.09	1.59	2.28	1.92
Young Adult Retarded	C	4.54				1.50	2.19	1.98
Pre-adoles. Control	D	6.04					.69	2.03

Any two group means not underscored by the same line are significantly different.

Any two group means underscored by the same line are not significantly different.

indicate that the pre-adolescent control group at that point had higher looking times on the varied designs than both the young adult retarded and the pre-school control groups. The pre-adolescent control group, however, did not have significantly lower looking times on the varied design than the young adult control group. The pre-school control group did not differ significantly from either of the two retarded samples, although its difference from the pre-adolescent retarded group approached significance. The two retarded samples did not differ significantly from each other.

Table 4. - Duncan's Multiple Range Test for Block 4 of looking times on the varied designs.

		Means	(1) A 3.44	(2) B 4.34	(3) C 4.78	(4) D 6.76	(5) E 7.80	(6) Shortest Significance Ranges Each .05 Level
Pre-adoles. Retarded	A	3.44		.90	1.34	3.32	4.36	1.82
Young Adult Retarded	B	4.34			.44	2.42	3.46	1.92
Pre-school Control	C	4.78				1.98	3.02	1.98
Pre-adoles. Control	D	6.76					1.04	2.03

Table 5 presents the over-all analysis of variance for looking times on the <u>constant</u> design for the five groups, over four blocks of six trials each. In this analysis, the trials effect was greater than the between-groups effect, but both were significant beyond the .001 level. As can be seen in Figures 1-5, given above, all the groups showed a consistent downward trend in looking times on the constant design. The significant trials effect reflected that trend.

TABLE 5. - Over-all analysis of variance for looking times on the <u>constant</u> <u>designs</u> for five groups over four blocks of trials. Mean scores are indicated in Figures 1-5.

Source	F	P
Groups	13.203	.001
Trial blocks	28.218	.001
Groups X Trials	1.13	NS

The Duncan's Multiple Range Test for differences between group means was computed, and the results for Block one and Block four are presented in Tables 6 and 7, respectively. The analysis for Block one indicates that the two older control groups have significantly higher looking times on the constant design than the pre-adolescent retarded group. No other differences between group means were significant. By Block four (Table 7) the two older control groups continued to have higher looking times on the constant design than the pre-adolescent retarded group, but, by that time, they also had higher looking times than the pre-school control group. It may seem paradoxical that the older control groups had longer looking times on the <u>constant</u> design, than a relatively young retarded group, especially considering that looking time on the <u>constant</u>

TABLE 6. - Duncan's Multiple Range Test applied to the differences between five group means for Block 1 of looking times on the constant designs. The analysis of variance for the same data is given in Table 6.

			(1) A	(2) B	(3) C	(4) D	(5) E	(6) Shortest Significance Ranges Each .05 Level
		Means	2.88	3.82	4.18	4.88	5.16	
Pre-adoles. Retarded	A	2.88		.94	1.30	2.00	2.28	1.40
Pre-school Control	B	3.82			.36	1.06	1.34	1.46
Young Adult Retarded	C	4.18				.70	.98	1.51
Pre-adoles. Control	D	4.88					.28	1.54

TABLE 7. - Multiple Range Test for Block 4 of looking times on the constant designs.

			(1) A	(2) B	(3) C	(4) D	(5) E	(6) Shortest Significance Ranges Each .05 Level
		Means	1.97	2.35	3.21	3.55	4.10	
Pre-adoles. Retarded	A	1.97		.38	1.24	1.58	2.13	1.40
Pre-school Control	B	2.35			.86	1.20	1.75	1.46
Young Adult Retarded	C	3.21				.34	.89	1.51
Pre-adoles. Control	D	3.55					.55	1.54

design is interpreted as an indication of slow satiation. However, the reason is quite clear. The pre-adolescent retarded group had much lower times than the two older control groups on the *varied* designs, and also very high times looking away from both designs.

Table 8 presents the over-all analysis of variance for the looking times on *neither design*. Again both Between-Groups effects and Trial blocks effects were significant beyond the .001 level, with no significant Groups X Trials interaction. All the groups show progressively higher scores on *neither design* over the four blocks of trials (see Figures 1-5), which accounts for the significant Trial blocks effects. However, the two older control groups show a less marked increase over the trials than did the other three groups.

TABLE 8. - Over-all analysis of variance for looking time on *neither design* for five groups over four blocks of trials. Mean scores are indicated in Figures 1-5.

Source	F	P
Groups	27.671	.001
Trial blocks	10.483	.001
Groups X Trials	1.351	NS

The Duncan Test analysis for Block One, presented in Table 9, indicates that the young adult control group has significantly lower fixation times away from both designs than all the groups except the pre-adolescent control group. The pre-adolescent control group differs significantly from the pre-adolescent retarded group, but not (in Block 1) from the young adult retarded or the pre-school control groups. By Block 3 the means for the young adult retarded and the pre-school control groups had risen sufficiently above that of the pre-adolescent control group to be statistically reliable. Table 10 presents the Block 3 Analysis. The groups maintained comparable relationships with each other in Block 4, which for that reason is not presented in table form.

TABLE 9. - Duncan's Multiple Range Test applied to the differences between five group means for Block 1 of looking times on neither design. The analysis for variance for the same data is given in Table 9.

		(1) A	(2) B	(3) C	(4) D	(5) E	(6) Shortest Significance Ranges Each .05 Level
	Means	.54	1.40	3.58	4.04	6.31	
Young Adult Control A	.54		.86	3.04	3.50	5.77	2.59
Pre-adoles. Control B	1.40			2.18	2.64	4.91	2.72
Young Adult Retarded C	3.58				.46	2.73	2.81
Pre-school Control D	4.04					2.27	2.88

TABLE 10. - Duncan's Multiple Range Test for Block 3 of looking times on neither design.

		Means	(1) A .59	(2) B 1.78	(3) C 4.80	(4) D 5.20	(5) E 6.67	(6) Shortest Significance Ranges Each .05 Level
Young Adult Control	A	.59		1.19	4.21	4.61	6.08	2.59
Pre-adoles. Control	B	1.78			3.02	3.42	4.89	2.72
Young Adult Retarded	C	4.80				.40	1.87	2.81
Pre-school Control	D	5.20					1.47	2.88

Possible effects of institutionalization on the looking behavior of retarded children are of interest because any such relationship would limit the generality of our findings. A control was provided in this study by having a non-institutionalized retarded group which served as a control for a comparable institutionalized retarded group. Figures 5 and 6, given previously, suggest that the two groups have quite similar looking times with respect to the experiment reported in this study. This was subjected to separate analysis of variance tests for possible differences in looking behaviors on the constant, varied, and neither constant nor varied designs. To satisfy requirements for the particular analysis of variance design which was used, five subjects from the institutionalized group were eliminated by a random process. This left an equal number of fifteen subjects each in the two groups. Table 11 presents the analysis for all three comparisons.

TABLE 11. - Analysis of variance comparisons between two pre-adolescent retarded samples, one institutionalized and one non-institutionalized with fifteen subjects in each group. The table presents separate analysis for looking times on each of three variables. Mean scores for the two groups are indicated in Figures 5 and 6.

Variable	Source	F	P
Constant Design	Groups	.273	NS
	Trial Blocks	1.861	NS
	Groups X Trials	.740	NS
Varied Design	Groups	1.192	NS
	Trial Blocks	.150	NS
	Groups X Trials	.477	NS
Neither Design	Groups	.142	NS
	Trial Blocks	1.090	NS
	Groups X Trials	.139	NS

None of the analysis approached significance, so we can conclude that the variable of institutionalization has not influenced in a major way the findings regarding the performance of the pre-adolescent institutionalized retarded group. A comparable analysis was not made regarding the effects of institutionalization on stimulus satiation variables for the young adult retarded group; however, there would seem to be no reason to assume a significant effect for that group when none was demonstrated for the younger retardates.

Phase 2. The main purpose of Phase 2 was to test for avoidance learning mediated by stimulus satiation. This would have been indicated by relatively few button presses (each button press corresponding to a slide exposure) for designs paired with a color stimulus which was originally matched with the constant design during Phase 1 of the experiment. Table 12 presents the frequencies of button presses for the five groups for each of three individual geometric designs.

TABLE 12. - Frequencies grouped in clusters of five representing response rates by subjects in each of five groups for button presses with each button press corresponding to a slide exposure.

Group	Variable	1-5	6-10	11-15	16-20	21-25	26-30	Zero *
Young Adult Control	Constant	20						
	Varied	19	1					
	Yellow	19	1					
Young Adult Retarded	Constant	6	1	1	2		9	1
	Varied	6	2		2		8	1
	Yellow	6	3		2		8	1
Pre-adoles. Control	Constant	19					1	
	Varied	19	1					
	Yellow	19	1					
Pre-adoles. Retarded	Constant	3	1				10	6
	Varied	3	3				8	6
	Yellow	5					9	6
Pre-school Control	Constant	13	2		1		3	1
	Varied	11	3	1	2		2	1
	Yellow	10	2	5	1		1	1

*See Text

The variables *constant*, *varied*, or *yellow*, as listed in Table 12, correspond to the color stimulus with which the three individual geometric designs were paired. The frequencies range from 1 to 30, but are grouped in six clusters of five in each cluster. As was stated in the Procedure chapter, a subject was stopped if he pressed the button 30 times for any particular design. Inspection of the data in Table 12 reveals no indications of avoidance behavior to the constant stimulus, and no tests of significance were computed to test for it.

However, the retarded groups clearly showed higher response rates than did the control groups. A Chi-square analysis of differences between groups on button presses is presented in Table 13. The Chi-squares were computed on the basis of frequencies of five or fewer button presses versus six or more button presses. Since the three sets of data were redundant, the analysis was made for only one of the three sets of data--the data corresponding to the *varied color stimulus*.

The results of Table 13 indicate that both C.A. and M.A. control subjects had lower response rates than corresponding retarded subjects. This perseverative behavior of the retarded subjects again reflects an inhibition deficit. Developmentally, the pre-adolescent control group had significantly lower response rates than the pre-school control group. The two older control groups did not differ significantly from each other, nor did the two retarded groups.

TABLE 13. - Chi-square analyses for individual comparisons of response rates for Phase 2 of experiment. Data on which the Chi-squares are based are given in Table 12.

Comparison	Chi-square (1 df)	P
C. A. Control		
Young Adult Normal vs Young Adult Retarded	15.8	.001
Pre-adolescent Normal vs Pre-adolescent Retarded	17.4	.001
M. A. Control		
Pre-adolescent Normal vs Young Adult Retarded	15.8	.001
Pre-school Normals vs Pre-adolescent Retarded	4.56	.05
Developmental		
Young Adult Normal vs Pre-adolescent normal	.00	NS
Young Adult Retarded vs Pre-adolescent Retarded	2.50	NS
Pre-adolescent normal vs Pre-school Normal	7.70	.01

Of interest is that one of the older retarded subjects, and five of the pre-adolescent retarded children were not strong enough to push the button. Another pre-adolescent retardate did not understand the task. All of the pre-school children could push the button, but one subject refused to do so. It took a pressure of about two pounds to operate the button. By and large, the retardates who could not push the button in Phase 2 of the experiment did not otherwise appear to be obviously physically handicapped; however, they could not perform on this particular task involving a relatively simple manual manipulation. Muscular weakness and poor fine motor coordination frequently relate to neurological damage.

CHAPTER IV

DISCUSSION

The main purpose of the study was to provide data on the attending behavior of retardates as compared with normals in a standard experimental situation. The task chosen for this involved looking behaviors on repeated and varied designs. The principal hypotheses were that within both retarded and control groups there would be a developmental relationship between age and stimulus satiation measures, with younger subjects showing slower satiation than older subjects, and that retarded subjects would show slower satiation than normal control subjects.

The data supported those hypotheses. Developmentally, on the two variables of looking time on the varied design and looking time away from both designs, the three control groups and the two retarded groups were ordered with respect to age with the younger groups showing the slowest satiation rates. The difference between the youngest control group and the two older control groups was marked and statistically significant. The obtained difference between the two older control groups was not statistically significant, which may indicate that the development of the capacity to satiate rapidly and efficiently, and hence attend to stimuli effectively, is more rapid between the ages of five and ten, than between the ages of ten and twenty.

The differences between the control groups and retarded groups were marked on even the first set of trials, and the differences became more extreme over the 27 trials. The major differences between retarded and control groups involved the measure of looking at <u>neither</u> design, which is interpreted in this study as a failure to inhibit responding to background stimuli. The specific behaviors involved in looking at neither design varied from subject to subject. Some of the retarded subjects looked at the designs, then away from them, and back to them again. Others never refixated at the slides after looking away until the next slide exposure. Some of the subjects appeared to attempt to inhibit turning away behaviors by verbalizing out loud, "Look at the pictures" or "Don't do that," as they turned away from the screen. One subject even positioned her face to point to the screen with her hands, after turning away. The retarded subjects frequently showed stereotyped behaviors while looking away from the screen, such as repeatedly turning around to look at the projector, or at specific areas of the room, or repeatedly manipulating their clothing. The pre-school control subjects showed behaviors similar to the older retarded subjects regarding their behaviors while looking away from the screen. In contrast, the pre-adolescent control group, which showed a high rate of responding or fixating on the geometric designs, generally looked steadily at the designs for eight to twelve seconds before turning away, sometimes just anticipating the end of each slide exposure. The young adult control group showed consistent, high rates of attending to the designs.

All of the groups showed satiation to the <u>constant</u> design. However, the two retarded groups, and the pre-school control group did not show a corresponding increase in looking times on the varied designs, but instead showed increasingly longer times looking away from both designs.

How marked a deficit does the retarded have in comparison with normal subjects? The data indicate that the retardates have at least a Low MA-Low IQ deficit, i.e., they have a deficit in comparison with chronological age control subjects. Some aspects of the data suggest that the retardates also have a low IQ deficit, i.e., a deficit in comparison with mental age control subjects. This is indicated by the fact that the pre-adolescent control group consistently showed significantly faster indices of satiation than the young adult retarded sample. Similarly, the pre-school control group showed faster satiation than the pre-adolescent retarded group, although the obtained differences did not reach significance levels. Perhaps the strongest argument for a low IQ deficit for the retarded is that the young adult retarded group, with an MA of 10.3

years, had very similar looking behaviors on all the variables as the pre-school control group, which had a C.A. of only 4.8 years.

A word of caution regarding the interpretation of a low IQ deficit for the retarded from the data in this study is in order. The M.A. control groups used in this study represent subjects whose chronological ages are comparable with the mental ages of the retarded subjects. The mental ages of the control subjects are probably somewhat higher than the mental ages of the retarded samples. Therefore, we can state only that the data suggest a low IQ deficit for the retarded regarding stimulus satiation measures. We can not be more definitive as yet.

One hypothesis was not supported. This was the hypothesis that the control subjects would show avoidance learning mediated by stimulus satiation, whereas, the retarded samples would not. This was not supported because no group showed avoidance learning. Several factors may relate to this negative finding. First, the conditioning paradigm used in this study was a relatively weak, trace conditioning paradigm--the CS (color square) preceded the UCS (constant design)but did not overlap with it. A replication study with a stronger conditioning procedure may yield significant results. Another factor which may account for the negative finding is that the second phase of the experiment may have been sufficiently different from the first phase so that whatever avoidance learning may have occured in Phase 1 did not generalize to Phase 2. A second hypothesis relative to Phase 2, regarding response rates for pushing a button to see individual slides, was supported. Here the retarded samples far exceeded the control subjects by perseverating on the task with high response rates. In fact the young adult retarded group showed significantly slower satiation on that task than even the pre-school control group.

Can other interpretations account for the significant differences which were found regarding the looking behavior of control and retarded subjects (in Phase 1)? Zigler (1958) has stated that studies which report slow satiation among retardates are generally based on data which can be explained by the retardates high motivation to please the examiner. For example, he interpretes Kounin's study (1941) which demonstrated higher persistence among retardates than normals in a simple play activity to represent the retardates desire, based on social deprivation, to please the examiner by persisting in a play activity initiated by the examiner. In the present study Zigler's interpretation could account for the retardates excessive high response rates in Phase 2, for in this case the retardates consistent responding could be interpreted as the retardates attempt to prolong the relationship with the examiner. Zigler's interpretation; however, cannot account for the data in Phase 1 in which indices of consistent responding (looking at the designs) represent fast satiation. Here the alleged high motivation of the retardate should have continued to produce consistent responding, or attending to the designs. But true to form the retardate showed divergent aspects of slow satiation, i.e., perseverative and repetitive responding and distractibility to background stimuli.

Spitz (1963) has reported low generality of findings pertaining to his studies of visual satiation in the Kohler-Wallach sense. He has found wide overlap between retarded and control subjects. This was not the case in this study, particularly regarding retarded and C.A. control subjects, among whom there was only a minimum of individual overlap among the groups. The differences reported by Spitz and the data of this study may pertain to the kinds of behaviors investigated. The behaviors investigated in this study are more molar in comparison with the figural-after effects behaviors investigated by Spitz.

The data have implications for training retardates. The fact that retardates of two age groups, Young-Adult and Pre-adolescent, could not attend to a given set of stimuli consistently for relatively short periods of time (12.30 seconds) reflects the retardates' need for structure in learning situations. It would be expected, for example, that the retardate is handicapped in learning situations to the extent that time intervals between materials to be associated are long and prevailing stimulus conditions are distracting for them. This goes along with the idea that the retardate is not a "self starter" and must be directed in every phase of learning situations (Denny, 1964). This study also indicates a comparable situation for young normals.

Further research is indicated in several areas regarding the role of stimulus satiation in learning, in performance and in intelligence. Of interest would be studies to determine if individuals of superior intelligence differ from those of average intelligence to the same degree that individuals of average or near average intelligence differ from the retarded. Also, the technique employed in this study of recording looking behavior would make it possible to simulate the learning conditions of retardates for normals; e.g., stimulus input could be monitored for normals by flashing on and off stimulus material to simulate the retardates' transient attending to and away from stimulus material. This could be accompanied by measures of incidental and/or intentional learning regarding aspects of the stimulus material. Such an approach would make it possible to specify the attending behavior that prevailed during learning trials so that performance on learning tasks for both retardates and normals could be related to the specific behaviors that were elicited during learning trials.

CHAPTER V

SUMMARY

This study compared both retarded and normal subjects on measures of stimulus satiation in an experiment in which one geometric design was repeated for twenty-seven consecutive trials and paired with a varied design. In all 115 subjects were tested. These included twenty control subjects in each of the following age groups: Young adult, Pre-adolescent, and Pre-school; twenty each of Young adult and Pre-adolescent institutionalized retardates, and fifteen non-institutionalized Pre-adolescent retardates. The groups were arranged to provide approximate CA and MA controls for two age levels of retarded subjects, as well as to provide a control for effects of institutionalization.

Specifically, the hypotheses were that the retarded are slower satiators than normals, and that, within both normal and retarded groups, there is a developmental relationship with younger individuals being slower satiators than older individuals. In this study slow satiation was equated with relatively high responding to a constant design, and to background stimuli. Conversely, fast satiation was equated with increasingly higher rates of responding to novel stimuli— the varied design. The data consisted of looking times on a constant design, a varied design, and neither design, i.e., away from both designs. The results were analyzed by means of analysis of variance and the Duncan's multiple range test.

The results supported the hypotheses. Developmentally, the three control groups and two retarded samples were ordered with respect to age with the younger showing slower satiation than the older groups. The obtained difference was significant between the Pre-school control group and the two older control groups. Regarding the effect of retardation, both CA control groups showed significantly faster satiation than the corresponding retarded samples. Furthermore, the Pre-adolescent control group showed significantly faster satiation than the Young adult retarded group for whom it served as a MA control. The Pre-school control group also showed faster satiation than its MA counterpart, the Pre-adolescent retarded group, but the obtained difference was not significant.

One hypothesis was not supported; the hypothesis stated that normal subjects would show more avoidance learning to a constant stimulus than retarded subjects. The results showed than neither the control nor the retarded groups showed avoidance learning in the context of the present study. The negative finding was attributed to the particular conditioning paradigm (trace conditioning) that was used.

The effect of slow satiation on the behavior of retardates was discussed as being detrimental to learning in three ways: (1) it hinders adaptation to irrelevant cues--particularly in complex learning situations, (2) it impedes incidental learning, i.e., learning in which consistent pairing between stimulus and response depends on the maintenance of internal sets, and (3) it reduces contacts with new stimuli.

Some implications for future research and education were also discussed.

REFERENCES

Barnett, C.D. Learning in Familial and Brain-injured Defectives. Amer. J. Ment. Defic., 1960, 64, 894-901.

Berkson, G. and Mason, W. Stereotyped Movements of Mental Defectives. Amer. J. Ment. Defic., 1964, 68, 511-524.

Berlyne, D. E. Conflict and Information Theory Variables as Determinants of Human Perceptual Curiosity. Jour. of Exper. Psychol., 1956, 53, 399-404.

Berlyne, D. E. Supplementary Report: Complexity and Orienting Responses with Longer Exposures. Jour. Exper. Psychol., 1958, 56, 183.

Berlyne, D.E. The Influence of Complexity and Novelty in Visual Figures on Orienting Responses. Jour. Exper. Psychol., 1958, 55, 289-296.

Berlyne, D. E. Conflict, Arousal, and Curiosity, 1960.

Bindra, D., Stimulus Change, Reaction to Novelty, and Response Decrement, Psychol. Rev., 1959, 66, 96-103.

Cassell, R. H. Serial Verbal Learning and Retroactive Inhibition in Aments and Children. Jour. Clin. Psychol., 1957, 13, 369-372

Davenport, R.K., Berkson, G. Stereotyped Movements of Mental Defectives: II Effects of Novel Objects. Amer. Jo. Ment. Defic., 1963, 67, 879-882.

Denny, M. R. and Adelman, H. M. Elicitation Theory: I: An Analysis of Two Typical Learning Situations. Psych. Rev. 1955, 62, 290-296.

Denny, M. R. Learning through Stimulus Satiation. Jour. Exper. Psychol., 1957, 54, 62-64.

Denny, M. R. Learning and Performance. in Stevens and Heber (EDS) Mental Retardation, a Research Review. Univ. of Chicago, 1964.

Feldman, I. S. Psychological Differences among Moron and Borderline Mental Defectives as a Function of Etiology. Amer. Jour. Ment. Defic., 1953, 57, 484-494.

Hoats, D.L., Miller, M.B., and Spitz, H.H. Experiments on Perceptual Curiosity in Mental Retardates and Normals. Amer. Jour. Ment. Defic., 1963, 68, 386-395

Fiske, D. W., Rice, L. Intra-Individual Response Variability. Psychol. Bull., 1955, 52, 217-250.

Glanzer, M. Stimulus Satiation: An Explanation of Spontaneous Alternation and Related Phenomena. Psychol. Rev., 1953, 60, 257-268.

Glanzer, M. Curiosity, Exploratory Drive, and Stimulus Satiation. Psychol. Bull., 1958, 55, 302-315.

Kounin, J. S. Experimental Studies of Rigidity I. Measurement of rigidity in normal and feeble-minded persons. Character and Personality 1941, 9, 251-272.

Kohler and Wallach Figural after-effects: An investigation of visual processes. Proc. Amer. Phil. Soc., 1944, 88, 269-357.

Leckart, Bruce Thomas Satiation Learning: One Trial Per Day. M. A. Thesis. Michigan State University, 1963.

Lewin, K. A. A Dynamic Theory of Personality. New York: McGraw-Hill, 1935.

Lipman, R.S., and Spitz, H. The Relationship Between Kinesthetic Satiation and Inhibition in Rotary Pursuit Performance. Jo. Exp. Psychol., 1961, 62, 468-475.

Pavlov, I. P., Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex. London. Oxford Univ. Press, 1927.

Sarason, S. Psychological Problems in Mental Deficiency. Ney York, Harper Brothers, 1953.

Singer, Ronald V. Incidental and Intentional Learning in Retarded and Normal Children. Ph.D. Dissertation, Michigan State University, 1963.

Spitz, H. H., Field Theory in Mental Deficiency. in (Ellis, Ed.) Handbook of Mental Deficiency. Mc Graw-Hill, New York, 1963.

Spitz, H. H., and Blackman, L. S. A comparison of Mental Retardates and Normals on Visual Figural Aftereffects and Reversible Figures. J. Abnorm. Soc. Psychol., 1959, 58, 105-110.

Stake, Robert E. Overestimation of Achievement with the California Achievement Test. Educational and Psychological Measurement. 1961, 21, 59-62

Thompson, W. and Kahn, A. Retroactive effects in the Exploratory activity of "Bright" and "Dull" Rats. Can. Jo. Psychol. 1955, 19, 173-182.

Thompson, W.R., and Woodburn, H.C. The effects of restricting early experience on the problem solving capacity of dogs. Canad. Jo. Psychol. 1954 a, 8, 17-31.

Thompson, W.R., and Woodburn, H.C. The effects of early restriction in activity in dogs. Jo. Comp. Physiol. Psychol. 1954 b, 47, 77-82.

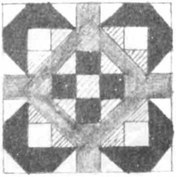
Walker, E. L. The Duration and Course of the Reaction Decrement and the Influence of Reward. Jo. Comp. Physiol. Psychol., 1956, 49, 167-176.

Welker, W. I. Some Determinants of Play and Exploration in Chimpanzees. Jo. Comp. Physiol Psychol., 1956, 49, 84-89.

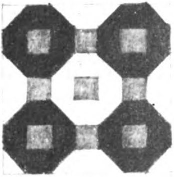
Zigler, E. F., Hodgen, L., and Stevenson, H. W. The effect of support and non-support on the performance of normal and feeble-minded children. Jo. Pers. 1958, 26, 106-122.

[illegible]

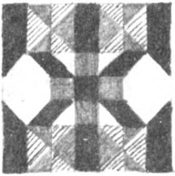
C[illegible]stant [illegible] 1



C[illegible] 2

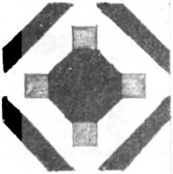


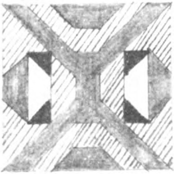
C[illegible] 3



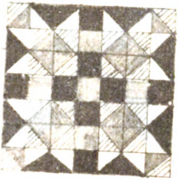
[illegible] 4

[illegible]



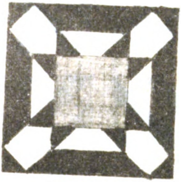


Varied 1



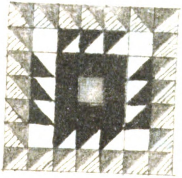
Varied 2

Varied 3



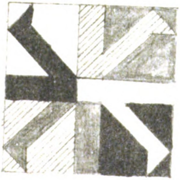
Varied 4

Varied 5



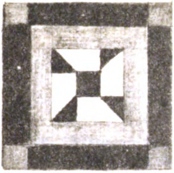
Varied [illegible]

Varied 7

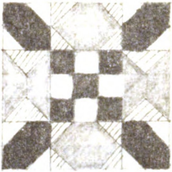


Varied [illegible]

Appendix A (continued)

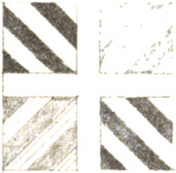


Varied [illegible]

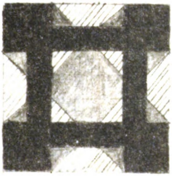


Varied [illegible]

Varied [illegible]



Varied [illegible]



[illegible]

[illegible]

Key

- White
- Red
- Blue
- Yellow

Appendix B

Sex, Chronological Age, IQ and Type of IQ Test or equivalence for Young adult and Pre-adolescent control groups

	Young adult				Pre-adolescent			
	Sex	CA in Years & Months	IQ	Type of Test	Sex	CA in Years & Months	IQ* Equiv	Type of Test
1	M	18-4	91	Otis G	M	10-9	43	IBST
2	M	18-3	102	Cal M M	M	11-2	81	IBST
3	M	19-4	112	Cal M M	M	11-1	81	IBST
4	M	20-9	91	Cal M M	M	10-4	51	IBST
5	M	24-0	97	Otis G	M	11-6	18	IBST
6	M	21-4	96	Cal M M	M	10-4	85	IBST
7	M	18-7	122	Cal M M	M	10-9	34	IBST
8	M	18-5	118	Cal M M	M	10-9	38	IBST
9	M	18-7	93	Cal M M	M	11-7	19	IBST
10	M	18-6	92	Cal M M	M	10-6	53	IBST
11	M	19-6	112	Cal M M	M	11-2	47	IBST
12	M	19-2	NA		F	10-7	80	IBST
13	M	18-4	95	Cal M M	F	11-5	86	IBST
14	F	19-2	109	Cal M M	F	10-8	42	IBST
15	F	20-0	111	Det Fm V	F	10-6	67	IBST
16	F	18-3	103	Cal M M	F	11-1	76	IBST
17	F	18-11	111	Cal M M	F	10-5	29	IBST
18	F	21-3	111	Cal M M	F	10-9	71	IBST
19	F	19-7	101	Det Fm V	F	10-7	19	IBST
20	F	19-1	NA		F	10-9	57	IBST

Note: Otis G = Otis Gamma IQ test
Cal M M = California Mental Maturity Test
Det Fm V = Detroit Advanced Form V IQ Test
IBST = Iowa Basic Skills Test * Scores are expressed in Percentiles

Appendix B (Continued)

Sex, Chronological Age, IQ and Type of IQ Test for
Young Adult and Pre-adolescent Retarded Groups

Young Adult Retarded

	Sex	CA in Years & Months	IQ	Type of IQ Test
1-	M	18-10	47	WAIS
2	M	20-1	50	WAIS
3	M	22-11	62	WAIS
4	M	25-9	67	WAIS
5	M	22-8	66	WAIS
6	M	21-8	51	WAIS
7	M	24-3	70	WAIS
8	M	22-8	66	WAIS
9	M	20-8	67	WAIS
10	M	16-5	60	WISC
11	M	19-7	61	WAIS
12	M	17-11	66	WAIS
13	F	21-0	41	S-B-L
14	F	24-0	44	S-B-M
15	F	21-7	49	S-B-R
16	F	21-3	48	S-B-R
17	F	18-4	50	S-B-L
18	F	16-5	34	M P
19	F	16-5	49	S-B-L
20	F	15-5	49	S-B-L

Pre-adolescent Retarded

	Sex	CA in Years & Months	IQ	Type IQ Test
1-	M	10-1	35	G D S
2	M	12-3	40	S-B-R
3	M	10-9	45	S-B-R
4	M	11-11	42	C-I-I-T
5	M	8-0	32	S-B-L
6	M	13-4	44	WISC
7	M	12-10	45	S-B-L
8	M	12-1	46	WISC
9	M	9-0	72	WISC
10	M	11-5	57	C-M-M-T
11	M	12-11	48	S-B-L
12	F	11-3	44	C-M-M-T
13	F	13-8	47	WISC
14	F	11-1	30	K-A
15	F	13-3	24	S-B-R
16	F	13-5	27	S-B-R
17	F	10-5	42	G D S
18	F	9-0	55	S-B-R
19	F	12-0	46	S-B-R
20	F	10-0	52	S-B-R

Note: WISC = Wechsler Intelligence Scale for children
WAIS = Wechsler Adult Intelligence Scale
S-B-L = Stanford-Binet, Form L
S-B-M = Stanford-Binet, Form M
S-B-R = Revised Stanford-Binet
M P = Merrill Palmer
G D S = Gessel Developmental Schedule
C-I-I-T = Cattell Infant Intelligence Test (Scale)
K-A = Kuhlman-Anderson, Form K.
C-M-M-T = Columbia Mental Maturity Test

Appendix B (Continued)

Sex and Chronological Age for Pre-School Control group, and Sex, Chronological Age, IQ and Type of IQ Test for Pre-adolescent non-institutionalized retarded group.

Pre-School Control

	Sex	CA in Years & Months	IQ	T
1	M	5-1		
2	M	4-9		
3	M	5-0		
4	M	4-8		
5	M	5-2		
6	M	4-11		
7	M	5-3		
8	M	4-11		
9	M	5-2		
10	M	4-6		
11	M	5-3		
12	F	4-6		
13	F	4-8		
14	F	4-8		
15	F	4-5		
16	F	4-11		
17	F	4-11		
18	F	4-9		
19	E	4-3		
20	F	4-11		

Pre-Adoles. Non-Inst. Retarded

Sex	CA in Years & Months	IQ	Type of Test
M	11-1	59	S-B-L
M	10-1	40	S-B-L
M	15-9	46	WISC
M	15-8	44	S-B-L
M	8-9	56	WISC
M	7-10	55	WISC
M	7-10	50	S-B-L
M	10-6	40	S-B-L
M	7-10	26	S-B-L
M	13-5	45	S-B-L
F	10-1	43	S-B-L
F	10-1	45	S-B-L
F	9-1	30	S-B-L
F	9-1	67	WISC
F	12-11	64	S-B-L

Appendix C

Over all Analysis of Variance for <u>Varied</u> Design for five groups over four blocks of trials, Showing Degrees of Freedom, Degrees of Variation, Mean Squares and F-Ratios

Sources of Var.	Sum of Sq.	df	M.S.	F	P
Groups	789.556	4	197.389	23.373	.001
Pooled SS bet.	802.280	95	8.445		
Trial blocks	10.740	3	3.580	3.489	.05
Groups X Trials	13.793	12	1.149	1.120	NS
Pooled subjects X trials int.	292.406	285	1.026		

Analysis of Variance for <u>Constant</u> Design

Sources of Var.	Sum of Sq.	df	M.S.	F	P
Groups	258.465	4	64.616	13.202	.001
Pooled SS bet.	464.9405	95	4.894		
Trial blocks	71.728	3	23.909	28.218	.001
Groups X Trials	10.167	12	.847	1.126	NS
Pooled subjects X trials int.	214.4375	285	.7524		

Analysis of Variance for <u>Neither</u> Design

Sources of Var.	Sum of Sq.	df	M.S.	F=	P.
Groups	1865.334	4	466.334	27.671	.001
Pooled SS bet.	1601.037	95	16.853		
Trial blocks	33.539	3	11.180	10.483	.001
Groups X Trials	16.216	12	1.351	1.267	NS
Pooled subjects X trials int.	303.074	285	1.067		

Appendix D

Mean looking times on the *Varied* design for six groups on each of 27 trials

	Control Groups			Retarded Groups		
	Young adult	Pre-adol	Pre-school	Young adult	Pre-adol inst.	Pre-adol non-inst.
1	6.30	5.51	4.89	5.47	4.50	5.22
2	6.38	6.72	5.31	4.34	3.49	4.89
3	6.79	6.69	5.08	5.36	2.89	4.52
4	6.77	4.88	3.51	3.18	2.24	1.92
5	6.96	6.39	3.78	4.61	2.92	3.23
6	7.16	6.09	4.17	4.29	2.30	2.45
7	6.74	6.13	5.11	5.28	3.92	4.32
8	6.23	6.61	6.18	5.59	3.67	3.30
9	7.14	6.46	5.39	5.71	4.08	4.98
10	7.20	5.92	3.04	3.75	3.28	2.58
11	6.82	6.12	3.80	4.63	1.87	2.37
12	7.57	6.40	5.10	4.67	2.33	3.40
13	7.80	6.63	5.23	4.86	3.66	5.52
14	7.05	5.88	5.72	5.26	3.21	3.83
15	6.42	5.93	4.62	5.17	3.50	3.49
16	7.43	6.04	3.67	3.89	2.80	2.54
17	7.68	6.61	3.81	3.88	2.99	3.20
18	7.48	6.05	4.51	4.25	2.81	3.34
19	7.96	6.68	4.68	5.23	3.93	4.82
20	7.54	7.27	5.77	4.68	3.51	3.66
21	7.23	5.97	5.25	4.15	3.94	4.17
22	8.38	6.87	3.69	4.09	3.80	2.82
23	8.24	6.99	4.52	4.51	3.08	2.24
24	7.50	6.97	4.33	3.86	2.24	2.33
25	8.29	5.67	4.76	5.30	3.08	3.96
26	8.27	7.64	4.58	5.24	4.51	3.70
27	8.66	7.01	5.13	5.94	2.60	4.25

Appendix D (continued)

Mean looking times on the Constant design for six groups on each of 27 trials

	Control Groups					
	Young adult	Pre-adol	Pre-school	Young adult	Pre-adol inst.	Pre-adol non-inst.
1	5.82	5.30	3.65	4.42	3.22	2.71
2	5.60	4.54	3.36	4.66	2.06	2.33
3	5.01	4.22	3.22	3.16	2.25	1.81
4	5.21	5.79	4.75	4.67	3.71	4.31
5	4.72	4.61	4.30	4.30	3.14	3.14
6	4.71	4.82	3.78	3.87	3.10	3.58
7	5.01	4.25	3.32	3.32	1.58	1.36
8	4.93	4.09	1.83	2.86	2.36	2.15
9	4.80	4.64	2.82	2.43	2.44	.94
10	4.69	4.46	3.86	3.83	2.69	3.82
11	5.21	4.78	3.54	3.85	3.29	3.29
12	4.33	4.25	3.34	3.87	3.26	3.70
13	4.04	3.78	2.15	3.18	1.88	1.68
14	4.65	4.68	2.41	2.61	2.45	2.10
15	5.25	4.55	2.35	2.29	1.65	1.56
16	4.30	4.50	2.70	2.94	3.46	3.65
17	4.29	4.16	2.94	3.49	2.40	3.00
18	4.39	4.36	2.66	3.44	3.03	3.32
19	3.93	3.48	1.93	2.38	2.42	2.28
20	4.45	3.70	1.92	3.16	2.01	1.89
21	4.57	3.65	1.91	2.74	1.75	2.39
22	3.47	3.32	2.86	2.85	1.60	3.50
23	3.31	3.13	3.35	3.71	1.74	2.59
24	2.95	3.80	2.67	3.99	2.39	3.24
25	3.53	3.52	1.56	2.17	1.69	1.78
26	3.63	2.30	1.90	1.95	1.30	1.33
27	3.24	2.39	1.40	1.50	1.60	1.54

Appendix D (continued)

Mean looking times on the Neither design for six groups on each of 27 trials

	Control Groups			Retarded Groups		
	Young adult	Pre-school	Pre-school	Young adult	Pre-school inst	Pre-school non-inst
1	.18	1.49	3.76	2.41	4.48	4.27
2	.32	1.04	3.63	3.30	6.74	5.03
3	.50	1.39	4.00	3.78	7.16	5.97
4	.32	1.63	4.04	4.45	6.35	6.07
5	.62	1.30	4.22	3.39	6.24	5.93
6	.43	1.39	4.35	4.14	6.90	6.27
7	.55	1.93	3.37	3.70	6.80	6.71
8	.49	1.60	3.99	3.85	6.27	6.55
9	.36	1.20	4.09	4.16	5.78	6.38
10	.41	1.92	5.40	4.72	6.33	5.90
11	.27	1.40	4.96	3.82	7.14	6.54
12	.40	1.66	3.86	3.76	6.16	5.34
13	.46	1.89	4.92	4.26	6.76	5.10
14	.60	1.74	4.17	4.43	6.64	6.36
15	.63	1.82	5.33	4.84	7.15	7.35
16	.57	1.76	5.93	5.57	6.04	6.11
17	.33	1.53	5.55	4.93	6.91	6.10
18	.43	1.89	5.13	4.61	6.46	5.64
19	.41	2.14	5.69	4.69	5.95	5.20
20	.21	1.33	4.61	4.36	6.78	6.75
21	.50	2.68	5.14	5.41	6.61	5.74
22	.45	2.11	5.75	5.36	6.90	5.90
23	.75	2.18	4.43	4.09	7.48	7.47
24	.85	1.54	5.30	4.45	7.67	6.73
25	.48	3.11	5.98	4.53	7.53	6.56
26	.40	2.36	5.82	5.21	6.49	7.27
27	.40	1.90	5.68	4.86	8.10	6.51

Appendix E

Analysis of Variance for comparisons between institutionalized and non-institutionalized Pre-adolescent Retarded groups, showing sources of variance, degrees of freedom, Mean Squares and F ratios

Constant design

Source of var	S S	df	M S	F	P
Groups	1.8048	1	1.8048	.273	NS
Pooled SS bet.	184.8890	28	6.6032		
Trial Blocks	4.5109	3	1.5036	1.861	NS
Groups X Trials	1.7896	3	.5965	.740	NS
Pooled Ss X Trials int.	67.8600	84	.8079		

Varied design

Source of var	S S	df	M S	F	P
Groups	1.1933	1	1.1933	.065	NS
Pooled SS bet.	513.7022	28	18.3465		
Trial Blocks	.4492	3	.1497	.1313	NS
Groups X Trials	1.4317	3	.4772	.4187	NS
Pooled Ss X Trials int.	95.7340	84	1.1397		

Neither design

Source of var	S S	df	M S	F	P
Groups	5.9185	1	5.9185	.1422	NS
Pooled SS bet.	1165.9743	28	41.6420		
Trial Blocks	6.3581	3	2.1194	1.1194	NS
Groups X Trials	.8102	3	.2701	.1389	NS
Pooled Ss X Trials int.	163.3158	84	1.9442		