ALTERNATION BEHAVIOR IN MENTALLY RETARDED AND NORMAL CHILDREN

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ALTERNATION BEHAVIOR IN MENTALLY RETARDED AND NORMAL CHILDREN

By

ROBERT ARTHUR PIERSON

AN ABSTRACT

Submitted to the School for Advanced Graduate Studies
of Michigan State University of Agriculture and
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ABSTRACT

The present study was undertaken to explore the effects of stimulus satiation and related phenomena in mentally retarded and normal school age children. Three hundred sixty-five subjects of both sexes, ranging in age from 6-0 to 21-3 made up the mentally handicapped sample. There were 575 children in the normal sample. Mean IQ ratings for the mentally retarded sample were 67. 42 and 69. 40 on the Stanford-Binet and Wechsler Intelligence Scale for Children, respectively. In brief, all subjects were first presented with an open alley figure shaped like a T on a plain half sheet of paper. Subjects were then told to start at the bottom of the T and draw a line with a pencil anywhere they wanted to go, as long as the pencil was not lifted from the paper and the borders of the T were not crossed. The direction first turned was noted. Normal children of both sexes and at all age levels showed a definite preference for turning right. For mentally retarded, the right preference appeared to be a developmental phenomenon. That is, as age increased so did the right preference. A theoretical explanation to account for this finding was discussed.

After the T, all subjects were presented with an inverted L on a clean half sheet of paper. For half the subjects the L was pointing right and for the other half the L was pointing left. The subjects were then forced either right or left for ten trials, no delay,

then were presented with another T after a specified delay. Once again, the direction first turned was noted.

The following hypotheses were tested:

1. There is no difference in the alternation behavior (stimulus satiation effects) at different age levels.

2. There is no difference between sexes as regards alternation behavior (stimulus satiation effects).

3. There is no difference between normal and mentally retarded children in alternation behavior (stimulus satiation effects).

4. The introduction of delay after stimulus exposure will not result in less alternation behavior (dissipation of stimulus satiation effects).

On the basis of the data, the 1st hypothesis was rejected as there were significant differences from chance in the alternation behavior of younger and older mentally retarded females and in older normal males. The 2nd hypothesis was also rejected as younger mentally retarded females differed significantly from younger mentally retarded males and older mentally retarded males. For the normal sample, significant differences occurred between older males and older females. The 3rd hypothesis was accepted as the data when viewed in their totality showed no significant differences between normal and mentally retarded children with respect to the effects of stimulus satiation. The 4th hypothesis was rejected as dissipation

effects were evident whenever a significant amount of stimulus satiation occurred.

Subsidiary findings with respect to avoidance and perseveration were discussed as were the educational implications of this study.

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INTRODUCTION

Early Formulations

Ever since Tolman (25) in 1925 described the following phenomenon in the behavior of rats, investigators have been concerned with its explanation. "A simple T maze was used, and it was arranged so that the animal could get back to the food box in identical fashion, whether he chose the left or right angle of the T, either route met with success . . . . There was a very pronounced tendency towards continuous and regular alternation, left, right, left, right, or right, left, right, left, it appeared in short, that even where either side was equally satisfactory, there was in our rats a positive tendency left over toward variation of response . . . . A positive tendency in and of itself."

Notably, the Hullians (21) have attempted an explanation of this response variability (now termed spontaneous alternation) in terms of the response, only, employing reactive inhibition or work decrement as the explanatory concept.[1] Other investigators (8) have suggested a theory of spontaneous alternation in terms of the stimulus, using the

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[1] In a response-type theory of explanation, the animal is viewed as alternating responses instead of alleys, i. e. making a right rutn because a left turn has already been made. Reactive inhibition and work decrement when employed as explanatory concepts merely state that the occurrence of a response reduces temporarily the probability of its recurrence. The concept of reactive inhibition in addition assigns an explicit role to the number of times the response is made and the amount of work required by the response.

concept of stimulus satiation to account for a reduced tendency to respond toward or visit a recently exposed stimulus.

In contrast to a response type theory of explanation, a stimulus-theory explanation proposes that the animal alternates from one arm of the maze (a set of stimuli) to the other (a different set of stimuli) because the less recently visited is less satiated and thus has greater exploratory value. One of the first systematic studies designed to point out the inadequacies of a response-theory type of explanation was made by Glanzer (8) who incorporated the ideas of various investigators (Dennis, Heathers, Solomon) and formed the construct of stimulus satiation. Following Hull's procedure he formulated a theory to account for this and related phenomena in terms of a postulate. His intent was to circumvent the difficulties in the reactive inhibition explanation of spontaneous alternation and at the same time come up with a theory that would lend itself to a number of testable predictions.

His first postulate states: "Each moment an organism perceives a stimulus--object or stimulus--objects, **A**, there develops a quantity of stimulus satiation to **A**." Glanzer experimentally tested two deductions from the postulate and contrasted his results to those which would have been predicted from a response-type theory. The first hypothesis which he tested stated: "Exchanging the stimulus-object of a 2 alternative maze between trials would result in a repetition

rather than an alternation of turns." He found that the animals did alternate alleys (stimuli) rather than responses. A response-type theory would have predicted the opposite. The second hypothesis stated that an increase in the interval between trials would have differential effects on spontaneous alternation depending on the place of delay. Glanzer, for example, found that when animals were detained in the end box of the alternative chosen in the first run of a T maze, 96% of the group showed spontaneous alternation on the following trial. A response-type theory would have regarded the amount of alternation as a function of the time interval independent of the stimulus complex during the delay interval. The verification of the hypotheses was accepted by Glanzer as evidence for an explanation of spontaneous alternation in terms of the stimulus.

Berlyne (1), in a similar vein, has developed two postulates and three corollaries based primarily on Hull's postulate 8. Berlyne's postulate I states, "When a novel stimulus affects an organism's receptors, there will occur a drive-stimulus-producing response." Berlyne termed this response, "Curiosity." Postulate II states, "As a curiosity-arousing stimulus continues to affect an organism's receptors, curiosity will diminish." The corollaries present the following ideas: (1) "An organism will learn to respond to a curiosity arousing stimulus with activity which will increase stimulation by it," (2) after a time lapse, the activity, which Berlyne labels as exploration

will cease, and (3) "after a further lapse of time, if the curiosity-arousing stimulus is again affecting the organism's receptors, there will be a second spell of exploration, but this time there will be less exploration than during the first spell; such spells of exploration will reoccur at intervals, until exploration of the stimulus in question ceases altogether."

Berlyne's experimental results were in the same direction as the predictions following from his corollaries. That is, subjects spent more time exploring a novel stimulus than they did exploring stimuli previously explored and they spent less time exploring stimuli the second time the stimuli were encountered. In an attempt at an explanation of the alternation problem, Berlyne's results fit in nicely, as the stimuli of the most recently visited T maze arm will have less effect in arousing the drive-stimulus producing response, "curiosity," than the other arm. Hence, the animal alternates.

In an experiment designed to study the relationship between exploratory behavior and the general activity level, Montgomery (14, 15, 16) concluded that neither Hull's concepts nor any other fundamental theory could explain the phenomena of exploratory behavior and spontaneous alternation. Much the same as Berlyne, Montgomery decided the phenomenon could best be explained by introducing a unique drive which he termed "exploration." Although he regarded the drive as being primary, he felt it was relatively independent of the other primary

drives, even though it showed some tendency to decrease in strength when another primary drive was heightened, as in the case of food or water deprivation.

Stimulus Satiation and Related Studies

From the aforementioned investigations of stimulus satiation and spontaneous alternation one can easily get the idea that the only relevant issues with respect to this phenomena are those that deal solely with explanatory concepts. However, within the framework of stimulus satiation and spontaneous alternation, reference can also be made to investigations that bear directly to certain aspects of the learning process. Rothkopf and Zeaman, using rats (18), have empirically demonstrated an alternation learning effect; that is, an increase in alternation as a function of the opportunity to alternate. More recently Denny (5), has demonstrated that avoidance learning could be mediated by stimulus satiation effects. Learning via stimulus satiation is being defined in this case as a learned preference for the subject to visit the side that was less frequently visited in the past.

In a study designed to investigate the effect of new and familiar stimuli, Berlyne (2) reported on an experiment concerned with attention to change. In this experiment, human subjects were first habituated by key pressing responses, to a series of visual stimuli. In the experimental phase the subjects had a choice of responding to

stimuli encountered in the habituation phase or others of a different shape and color. Berlyne found that humans showed a tendency to respond more frequently to the novel rather than to the familiar stimuli.

The majority of studies investigating stimulus satiation and spontaneous alternation as well as related aspects of this phenomenon have been based upon the study of infra-humans. In an attempt to provide added insight into this phenomenon at the human level, Denny and Allen (4) developed a technique somewhat similar to that employed by Zeaman and House (27) in their study with rats. In brief they presented human subjects with an inverted L about a quarter inch in diameter on a clean, half sheet of paper for ten successive trials (no delay between trials). For any one subject, the L was always pointing in the same direction (right or left). The subject was instructed to start at a dot near the base of the L and do anything he wanted to do with a pencil, so long as the pencil was not lifted from the paper nor the solid line crossed. When subject had traversed the path, another was presented. Following the L's, either immediately or after a specified delay, S was presented with a T and the direction first turned was noted; same as L or opposite. Half of the subjects were given an inverted L pointing to the left and half given one pointing to the right. The results of the experiment showed a striking difference between male and female subjects all of whom were college students.

Male students at zero delay showed a substantial tendency to go the opposite way they were forced (67%). This opposite effect held up in the males for 48 hours (60%), then dissipated. That is, the responses at the 72 and 96 hour intervals were at the 50% level. In other words, the effect of being forced one way and responding by going the other held up for 48 hours or for three responses. On the other hand, females tended to show a perseveration effect at 0 delay, they responded by going the same way they were forced (65%). By 24 hours this effect was no longer present.

Wingfield (26) in 1938, made an attempt to investigate the alternation phenomena in human subjects by using a square plank maze with a perpendicular divider connected to one end. His subjects were eight boys and seven girls who ranged in age from 3-0 to 6-8. All subjects had average intelligence. In this experiment, subject would simply walk down the center of the plank, come to the choice point and either turn right or left and then continue to a goal, where he or she was rewarded with some candy. In all there were six blocks of trials (two a day with about an hour's spacing). Since Wingfield reported only 30% alternation with his subjects, he concluded that "it is evident that alternation does not occur in children as it does in the rat." It is interesting to note that seven of his subjects perseverated for all trials, five of whom were females. This last finding is not inconsistent with the results of Denny and Allen.

Relation to Mental Retardation

Just as psychoanalytic theory has been advanced by the study of the abnormal, it would appear that we might better understand certain facets of behavior, particularly those dealing with learning in youngsters of average intelligence by studying those who are intellectually inferior. Since one of the problems the present research is designed to investigate makes a comparison of mentally handicapped and normal children on a similar task, we might look at some relevant studies. That research on learning has been sorely neglected in this area of mentally retarded is attested to by McPherson's (13) survey of learning studies up to 1948. Her survey indicated only 14 published papers concerned with experimental studies of learning in mental defectives to that time. The implications for such research have been aptly stated by her, in that she emphasizes the need for extensive laboratory work in learning and other aspects of behavior.

One of the first systematic studies in this area was published by McCulloch, et al. (12) and dealt with work learning in the mental defective. These experimentors analyzed the performance of mental defectives on a word learning task presented by a tape recorder. They compared a group with a mean MA of 9-0 with another whose mean MA was 6-0. In brief, they found that the group with the mean MA of 9-0 excelled on total score, grasp score (equated with one trial learning), and gain score (repetitive learning). However when the two groups

were compared with respect to a ratio of grasp to gain, there were no significant differences between them.

Sloan and Berg (20) replicated the study of McCollough et al. (12) and came up with essentially the same results. However, they also included an investigation of maze learning (standard stylus maze) and reported no significant relationship between maze learning and MA. The subjects in this experiment were 17 males and 15 males between 10 and 30 years of age. The mean MA and IQ ratings for the group were 8-2 and 57. 0 respectively.

In a study comparing the performance of mentally retarded and normal children, Bernice Eisman (7) compared superior, average and mentally retarded adolescents with respect to learning on a seven card paired associate problem. She also tested for stimulus generalization, and retention over a one week and one month period of time. Her results indicated that there were no significant differences among the three intelligence levels with respect to any of the afore-mentioned measures of performance. As a possible explanation of the fact that no differences occurred, she posited that the task was relatively simple. This type of explanation holds up when viewing the results of other investigators (17). It should also be noted that her groups were formed on the basis of group intelligence tests which tend to penalize those youngsters with poor reading ability. Hence some of her subjects may have been educationally rather than mentally retarded. All in all

from Eisman's study we get the idea that mentally handicapped children compare favorably in pictorial paired association learning tasks with youngsters of average and superior intelligence.

Operating from a physiological frame of reference, Spitz and Blackman (22) recently investigated the role of neural satiation in mental defectives. They compared high grade adolescent mental defectives with a group of normal adolescents and found that the mentally defectives were significantly more limited in their capacity to satiate. Satiation being defined as an electro-chemical process occurring the the brain that tends to come to a state of equilibrium. Mention was also made that the retardates showed greater perceptual rigidity as measured by the modified Rubin-Vase-Profile reversible figures test. The authors suggested that a common factor, possibly "brain modifiability" underlay both production of visual figure after effects and facility in reversing the figure and ground of a nonfixated reversible figure.

In still another study designed to ascertain the generality of the inferred satiation process, Spitz and Blackman (23) using the Mueller-Lyer Illusion found no differences between satiated retardates and normals on illusion scores. The investigators made mention of the fact that satiated retardates performed more like normals than they did like the nonsatiating retarded. On the basis of their results, the authors point out that mentally retarded children might well profit educationally by being separated into distinct groups on the basis of

performance in various perceptual tasks. This certainly points up the fact of individual differences and gives credence to the need for a careful evaluation of our present techniques with respect to teaching the mentally retarded.

In a similar vein, it has long been accepted that the mentally retarded youngster is more rigid than the normal. Stevenson and Zigler (24) have presented a succinct summarization for this generalization:

> Feebleminded individuals have been characterized as being rigid in numerous studies in which feebleminded children and adults and normal children have been compared. The tasks employed have been primarily of the "satiation" and "switching" types. In the former, S's are instructed to perform a task and are allowed to repeat the task until they become satiated and no longer want to continue it. They are then instructed to perform a highly similar task and again allowed to perform until satiated. Feebleminded S's have been found to spend significantly more time on each task than normal S's. This lack of influence of initial satiation on the performance of subsequent tasks has been interpreted as indicating a greater rigidity in the personality structure of feebleminded S's. In the "switching" tasks the S, after acquiring one response, is forced to switch from this response to a new response involving identical or highly similar stimuli. The smaller amount of transfer from the first to the second task shown by feebleminded S's has been interpreted as indicating greater rigidity.

Plenderleith (17) in a recent study designed to get at some of the salient aspects of "switching tasks," compared 30 normal with 30 feebleminded subjects in a discrimination learning situation. Her results indicated that there were no differences between the groups in learning the original discrimination problems, nor were there any

significant differences in remembering them. She did point out however, that feebleminded subjects who underwent discrimination reversal training six weeks after the original discrimination learning, learned the reversal problem less easily than did the others. However, both normal and feebleminded subjects showed a large degree of positive transfer from the discrimination problems to the discrimination reversal problems.

A series of systematic, experimental tasks carried out by Stevenson and Zigler (24) at the University of Texas, confirmed the findings of Plenderleith. Perhaps the results of these two investigations are at odds with the recent work of Zeaman and House (11) who found chimpanzees learned discrimination problems faster than human subjects whose intellect was in the imbecile range. However, Plenderleith and Stevenson were working with subjects whose IQ's were above 40 and for the most part somewhat "brighter" than the subjects used by Zeaman and House.

As there is a paucity of experimental knowledge of the behavior of mentally retarded children as compared with normals, the present investigation was undertaken to gain insight into the phenomenon of stimulus satiation and spontaneous alternation in mental defectives as well as in normals.

STATEMENT OF THE PROBLEM

Although it was expected on the basis of the perseverative character of much of the retarded childrens' behavior that they would be more resistant to the effects of satiation very little basis existed for making hypotheses about the developmental aspects of this problem and about the present experimental situation. Therefore, the following hypotheses are more in the nature of inquiries and have been stated in the null form.

1. There is no difference in the alternation behavior (stimulus satiation effects) at different age levels.

2. There is no difference between sexes as regards alternation behavior (stimulus satiation effects).

3. There is no difference between normal and mentally retarded children in alternation behavior (stimulus satiation effects).

4. The introduction of delay after stimulus exposure will not result in less alternation behavior (dissipation of stimulus satiation effects).

SUBJECTS

The subjects used in this experiment were 940 school children ranging in age from 6-0 to 21-3. Of the 940, 360 were enrolled in the Type A Program for the Mentally Handicapped in the Lansing, Michigan, Public Schools. Five other mentally handicapped youngsters were included in the sample but they were not yet in the Type A Program. The remaining 575 children were students in the Holt, Michigan, Public Schools.

Intellectual evaluations of the mentally handicapped children in the present sample were available in the form of the 1937 Revision of the Stanford-Binet Intelligence Test (Form L) and the Wechsler Intelligence Test for Children. The range of scores for the Stanford-Binet was from 51-82. The mean was 67.42 and the standard deviation 8.17. For the WISC, the range was from 49 to 81. The mean was 69.40 and the standard deviation was 7.95.

Reference to Table 1 shows the percentage of right handedness in the mentally handicapped ranges at various age levels from 75 to 91. Total per cent for the group was 84. When compared to the normal group the difference as measured by chi square is significant beyond the 5% level. However this great a difference with respect to left handedness is in line with the findings of Gordon (9) who found that of 729 mental defectives 18% or 131 were left handed.

Table 1

Mentally Handicapped Children with Respect to N, Sex, Handedness, Per Cent Handedness, CA, Mean IQ and Standard Deviation

N	Sex	R hand	% R hand	L hand	% L hand	CA	Mean IQ	Std. dev.
64	F	54	84	10	16	6-6 to 12-11	*67.66 **63.50	7.09 7.44
51	F	45	88	6	12	13-0 to 15-11	*64.86 **67.64	8.32 8.34
45	F	38	84	7	16	16-0 to 20-4	*68.56 **67.00	8.11 6.19
85	M	69	81	16	19	6-4 to 12-11	*68.22 **66.13	7.72 8.26
65	M	59	91	6	9	13-0 to 15-11	*70.31 **70.52	7.69 8.67
55	M	41	75	14	25	16-0 to 21-3	*71.58 **72.00	7.30 8.72
160	F	137	86	23	14		*67.18 **65.30	7.80 7.51
205	M	169	82	36	18		*70.02 **68.63	7.57 7.53
365	M&F	306	84	59	16		*69.40 **67.42	7.95 8.17

*WISC

**S-B

For the normal sample it was impossible to determine the range and mean IQ ratings for the younger and older groups as there were a variety of intellectual measures, i. e. Kuhmann-Anderson, SRA Primary Mental Abilities and the California Short Form Test of Mental Maturity. The situation was further complicated by the fact that some of the younger children had only been tested with regard to reading readiness. However, the sample in the age range from 13-0 to 15-11 were all in junior high school and intellectual measures were available for them. These children were all tested with the SRA Primary Mental Abilities Group Intelligence Test. The mean for the group was 97. 85 and the standard deviation was 13. 58.

Due to the fact that intellectual measures were not available for the younger and older subjects, the experimenter excluded those children who were over age for grade placement and in the teacher's opinion, intellectually inferior. Since Holt has had a program for the educable mentally handicapped for three years, the classroom teachers are alert and refer for psychological testing those children that experience difficulty with the learning process. In view of the aforementioned, it was highly improbable that a youngster who was mentally retarded was included in the normal sample. A breakdown of the normal group follows in Table 2.

Table 2

Normal Children with Respect to N, Sex, Handedness,

Per Cent Handedness and CA

N	Sex	R hand	% R hand	L hand	% L hand	CA	Mean IQ	Std. dev.
138	F	115	82	23	17	6-0 to 12-11		
65	F	60	92	5	8	13-0 to 15-11	98.03	13.47
79	F	73	92	6	8	16-0 to 18-10		
125	M	105	84	20	16	6-0 to 12-11		
70	M	57	81	13	19	13-0 to 15-4	97.72	13.60
98	M	91	93	7	7	16-0 to 18-9		
282	F	248	88	34	12			
293	M	253	86	40	14			
575	M&F	501	87	74	13			

METHOD AND PROCEDURE

1. Each subject was first presented with a T on a clean half sheet of paper which met the following dimensions: 4 inches across the top, a 2 inch stem and 1/4 inch in diameter. There was a small dot at the base of the T and subject was given the instructions to start at the dot and draw a line anywhere he wanted to go as long as he didn't go outside the lines. The subjects were further instructed that they could not lift up their pencil and draw another line once they started. In some instances the above instructions were modified for the younger mentally handicapped and normal children. In this case the subjects were told to start at the dot and drive their car anywhere they wanted to go, so long as they did not go off the street. If subject stopped at the top of the L or T he was told to go all the way.

2. Subject was then presented an inverted L on a clean half sheet of paper (the dimensions of the L in this case were 2 1/8 inches across the top with a stem of 2 inches), for ten successive trials (no delay between trials). For any one subject, the L was always pointing in the same direction, i.e., right or left.

3. After subject had traversed the path, he immediately went on to another L.

4. Following the ten L's, immediately or after a specified delay, subject was presented with a T and the direction first turned was noted. Same as L or opposite.

5. Half the subjects in each group were given an inverted L pointing to the left and the other half to the right.

6. For all subjects the testing was done in a group situation. The number of children in each group varied from as few as ten in some mentally handicapped rooms to as many as 30 for normal children at the high school level. In no case were the sexes separated.

After experimenter was introduced to class by the teacher, he simply told the subjects that he wanted them to do something for him. As was previously stated, the instructions were altered whenever it was deemed necessary.

EXPERIMENTAL DESIGN

The study was set up in the following manner to insure an adequate number of subjects in each group and at the same time provide for a control within each group. Essentially, the design is as follows: The total number of mentally retarded (N 365) were divided into three different age groups on the basis of CA. This approximated the three divisions arbitrarily set up by the Lansing Public Schools. That is, the youngsters in the age range from 6-0 to 12-11 are in the elementary program. Those with CA's from 13-0 to 15-11 are in junior high school, while those with CA's above 16-0 are usually in the high school program.

Each group was further broken down into three subgroups on the basis of sex and experimental treatment. Males constituted one group, females the other. Each sex group was then broken down approximately in half. Half the subjects in one treatment being tested after a 0, 24, 48, and 72 hour delay. The other half were given four consecutive trials with no delay between trials.

The design for the mentally retarded is depicted graphically in Table 3.

Normal children were fitted into the same type design. The only difference is a greater number of subjects in each group. This design is depicted in Table 4.

Table 3

Mentally Retarded

0, 24, 48, 72 Hour Delay Group

Male		Female
Elementary CA range: 6-4 to 12-11 N 46	Total N 79	Elementary CA range: 6-6 to 12-11 N 33
Junior high school CA range: 13-0 to 15-11 N 27	Total N 44	Junior high school CA range: 13-0 to 15-11 N 17
Senior high school CA range: 16-0 to 21-3 N 26	Total N 51	Senior high school CA range: 16-0 to 20-4 N 25
Total N male: 99	Total N 0-72 hr. group: 174	Total N female: 75

4 Consecutive Trials, 0 Delay

Elementary CA range: 6-4 to 12-11 N 39	Total N 70	Elementary CA range: 6-6 to 12-11 N 31
Junior high school CA range: 13-0 to 15-11 N 38	Total N 72	Junior high school CA range: 13-0 to 15-11 N 34
Senior high school CA range: 16-0 to 20-1 N 29	Total N 49	Senior high school CA range: 16-0 to 19-11 N 20
Total N male: 106	Total N, 4 consecutive trials group: 191	Total N female: 85

Table 4

Normal

0, 24, 48, 72 Hour Delay Group

Male		Female
Elementary CA range: 6-0 to 12-11 N 68	Total N 142	Elementary CA range: 6-0 to 12-11 N 74
Junior high school CA range: 13-0 to 15-11 N 30	Total N 60	Junior high school CA range: 13-0 to 15-11 N 30
Senior high school CA range: 16-0 to 18-9 N 39	Total N 61	Senior high school CA range: 16-0 to 18-10 N 22
Total N male: 137	Total N 263	Total N female: 126
4 Consecutive Trials 0 Delay		
Elementary CA range: 6-0 to 12-11 N 57	Total N 121	Elementary CA range: 6-0 to 12-11 N 64
Junior high school CA range: 13-0 to 15-11 N 40	Total N 75	Junior high school CA range: 13-0 to 15-11 N 35
Senior high school CA range: 16-0 to 18-7 N 59	Total N 116	Senior high school CA range: 16-0 to 18-5 N 57
Total N male: 156	Total N 312	N 156

RESULTS AND DISCUSSION

The experimental results of this study have been analyzed in terms of the responses made during the various delay periods. In this study there were essentially two different experimental treatments, i. e., I (0, 24, 48 and 72 hour delay group) and II (4 consecutive trials group), hereafter referred to as Treatment I or II. Since the subjects in both treatments made a response at 0 delay, these responses were pooled and analyzed separately for the retarded and the normal.

A response made opposite to the way forced was termed an alternation response whereas a response in the same direction as forced was termed a perseveration response. The number of alternation responses made by each group was used as a basis for statistical comparison, first in comparing the response with chance and then as a basis for making a comparison between groups. A summary of the results at 0 delay can be found in Table 5. Before proceeding to analyze the results of the two treatments we should consider the first task all subjects were presented with. In this task all subjects were presented a T, no previous trials, and the per cent of turns (right or left) was noted.

Table 5

Summary of Results at 0 Delay, All Subjects

	6-12			13-15			16+			Total		
	N	% alt.	χ^2	N	% alt.	χ^2	N	% alt.	χ^2	N	% alt.	χ^2
Mentally Retarded:												
M	85	52	NS	65	52	NS	55	49	NS	205	52	NS
F	64	64	*5.062	51	55	NS	45	29	**8.022	160	51	NS
Total	149	57	NS	116	53	NS	100	40	NS	365	51	NS
Normal:												
M	125	48	NS	70	47	NS	98	66	*4.418	293	54	NS
F	138	49	NS	65	60	NS	79	48	NS	282	51	NS
Total	263	48	NS	135	53	NS	177	58	NS	575	52	NS

*Significant from chance--5% level.

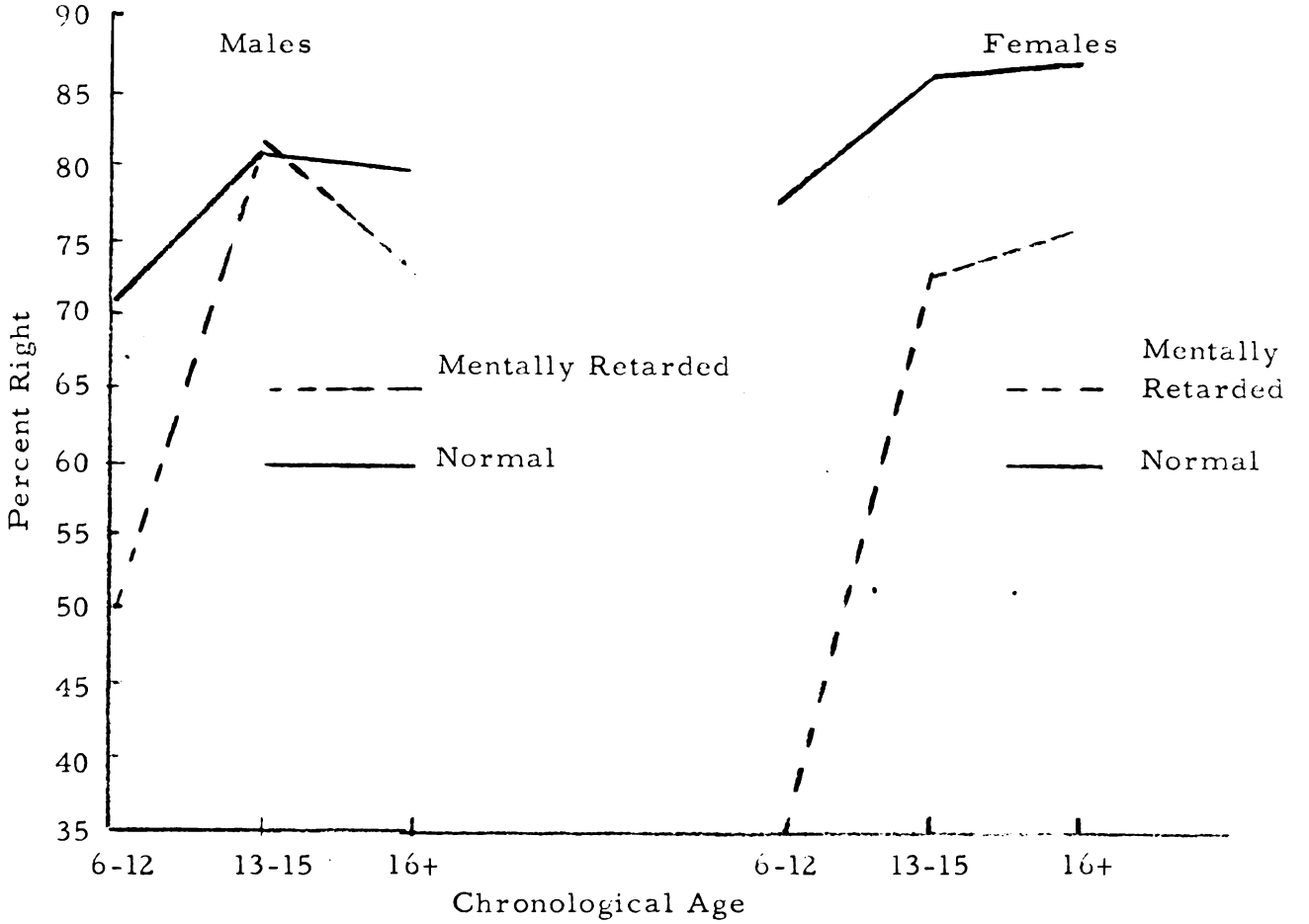
**Significant from chance--1% level.

Per Cent Turns Free Choice No Previous Trials

Figure 1A depicts the per cent of right turn responses on the T (no previous trials) for mentally retarded and normal subjects. There is no doubt that the trend with respect to both groups is clearly in the direction of turning right as chronological age increases. One could almost posit that for mentally retarded, the choice of going right is something that is learned slowly and apparently does not level off until they are of junior high school age. This particular finding may be an example of an incidental learning deficit in the mentally retarded as suggested by Denny (4). A comparison of mentally retarded with normal males in the age range from 6-0 to 12-11 regarding a right turn response gives a chi square value of 18.970. This is significant at the 1% level. For females in the same age range, the obtained chi square is 45.214 which is also significant at the 1% level. These are the only significant differences.

Alternation Data 0 Delay: Mentally Retarded Females and Males

Figure 1 shows the per cent of mentally retarded females who made an alternation response at 0 delay. Inspection of Figure 1 shows that the per cent of mentally retarded females making an



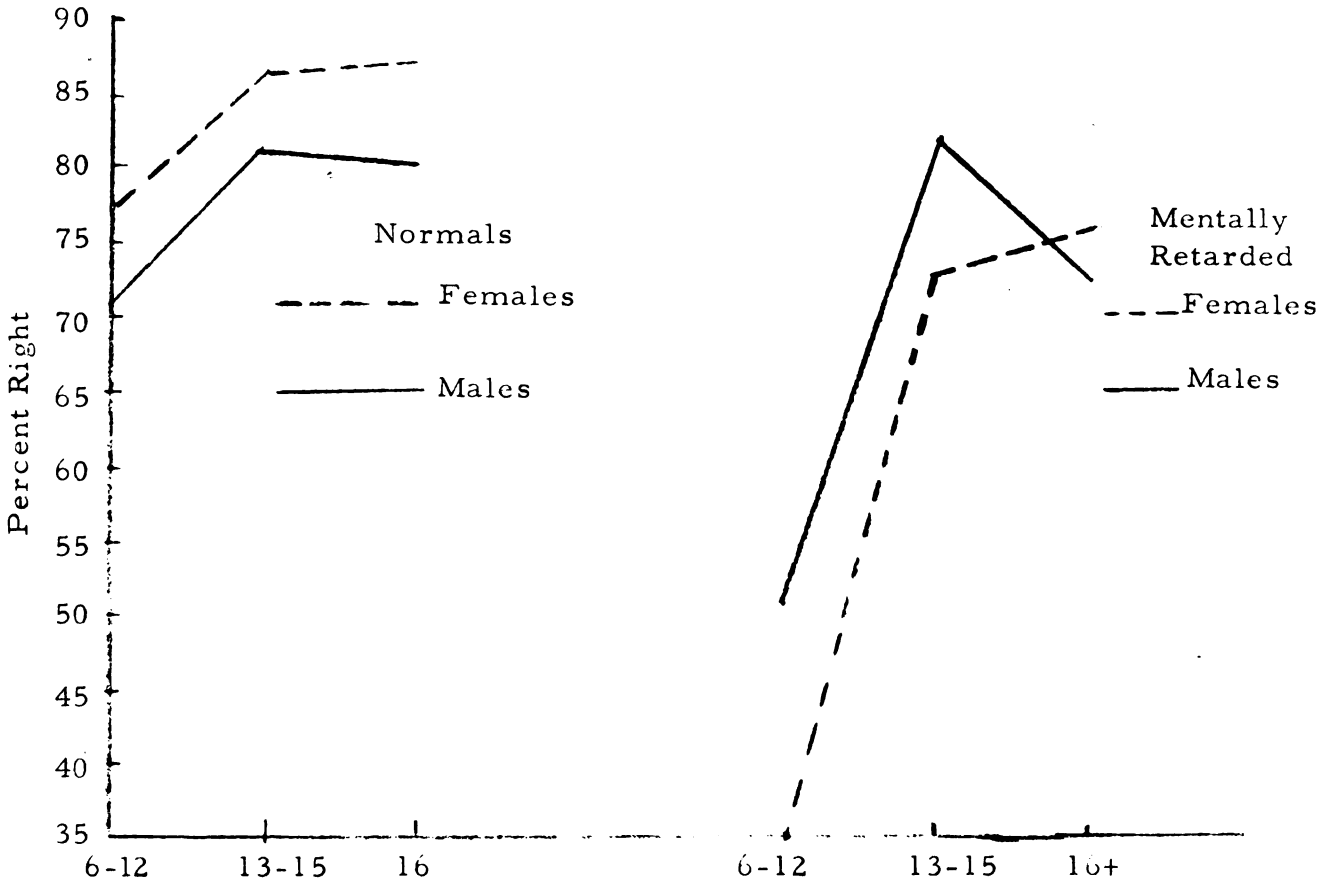
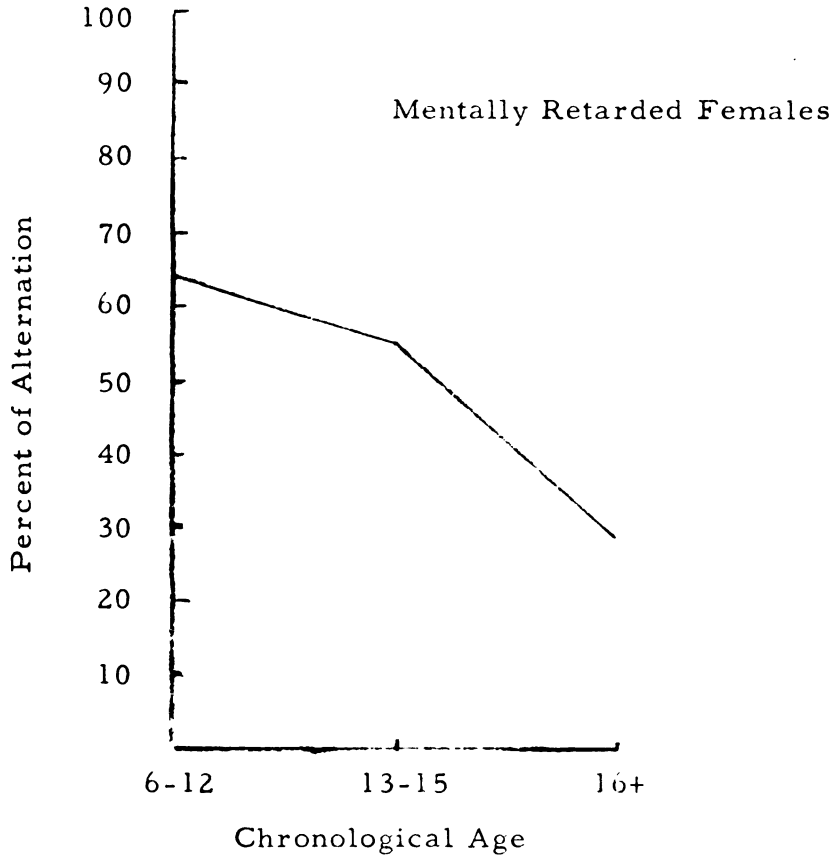


Figure 1A. Percent right turn responses. No previous trials



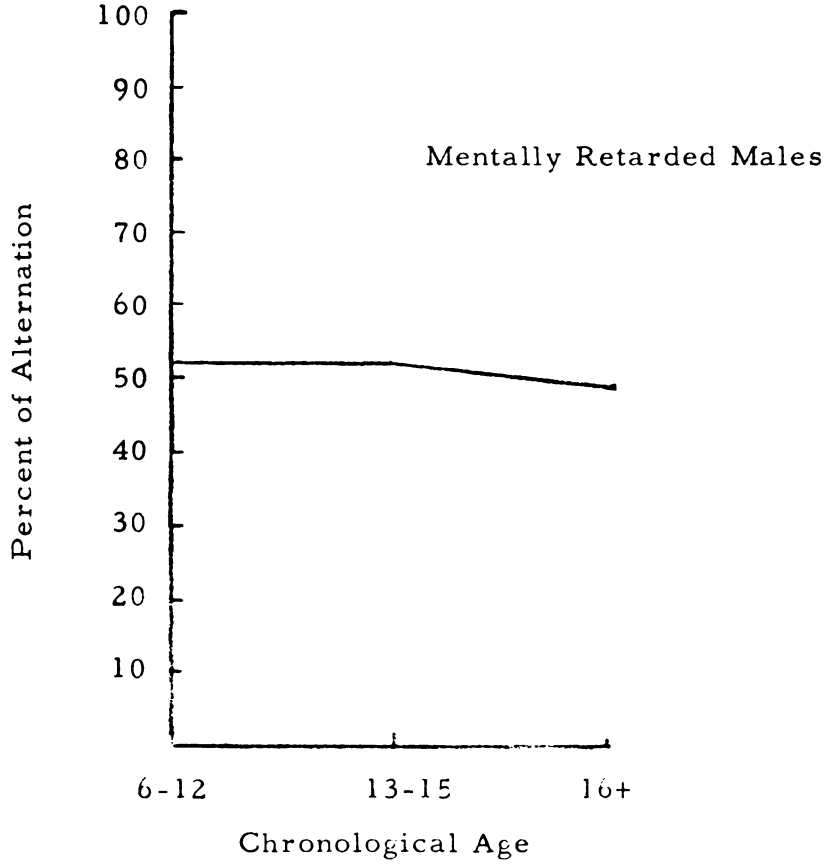


Figure 1. Percent of alternation 0 delay. Mentally retarded S's

alternation response at 0 delay decreases as chronological age increases. In other words, it appears that for this group there is a tendency to become more conforming or more resistant to the effects of satiation as age increases. The per cent of alternation in the elementary group (64%) when compared with chance performance gives a chi square value of 5.062 which approaches significance at the 2% level (5.412). The per cent of alternation for the junior high school group (55%) is only slightly above chance performance, consequently it is not significant. However, the marked tendency to perseverate (29% alternation) demonstrated by the senior high school group is significant beyond the 1% level (chi square 8.022). When the percentage of alternation for all mentally retarded females is combined and compared with chance we get a p value slightly larger than .50. This nonsignificance points up the need to consider age with respect to stimulus satiation behavior.

Figure 1 also shows the per cent of alternation responses made by mentally retarded males. Reference to Figure 1 shows that the per cent of alternation for mentally retarded males does not vary with respect to chronological age. Per cent of alternation at 0 delay is approximately the same for all three age groups (50%). Consequently there are no significant differences at the various age levels. This finding seems to indicate that mentally retarded males are not particularly satiable.

Alternation Data 0 Delay Mentally Retarded Males vs. Females

Figure 2 compares the performance of mentally retarded males and females with respect to alternation at 0 delay. From Figure 2 it is evident that the per cent of alternation does not differ too much between the sexes until a chronological age of 16 is reached. At this point the girls show less effects of satiation. The difference between the two older groups is significant at the 5% level. Chi square 4.205.

Alternation Data 0 Delay: Normal Females and Males

Figure 3 depicts the per cent of alternation for normal males and females. With respect to the female elementary group it is obvious that the per cent of alternation (49%) does not differ significantly from chance. By the same token, even though 60% of the females in the junior high group make an alternation response, they too, do not as a group, differ significantly from chance. It appears that normal females as a group are much more homogeneous with respect to alternation behavior, that is to say, the tendency to alternate does not appear related in any way to chronological age up through the senior high school age range. However, in contrast to the junior high group the trend for the older females is somewhat in the direction of perseveration and/or conformity (47% alternation),

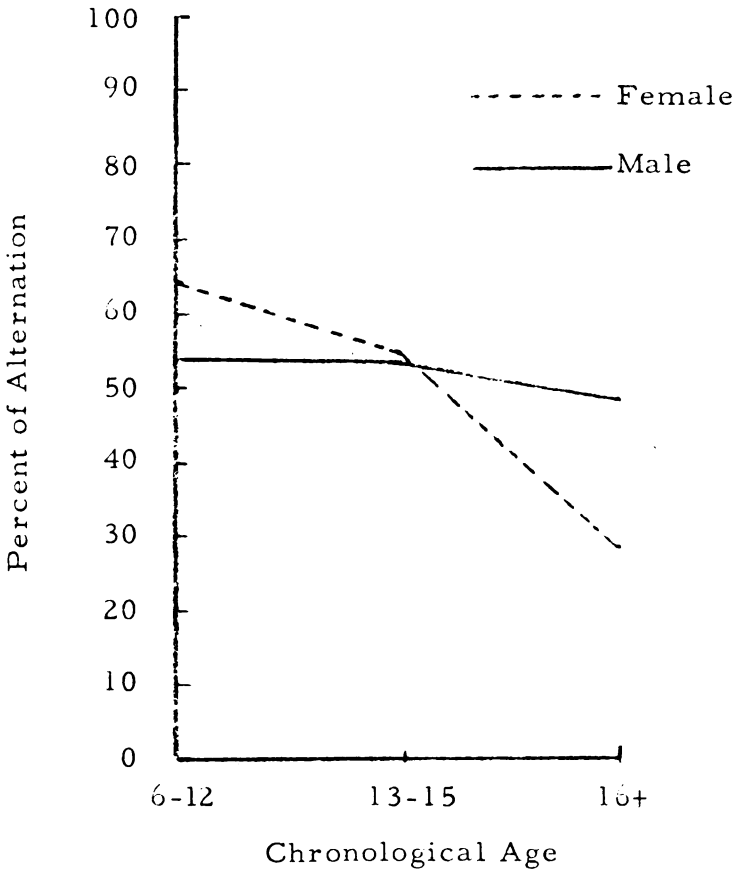


Figure 2. Percent of alternation 0 delay. Mentally retarded males and females.

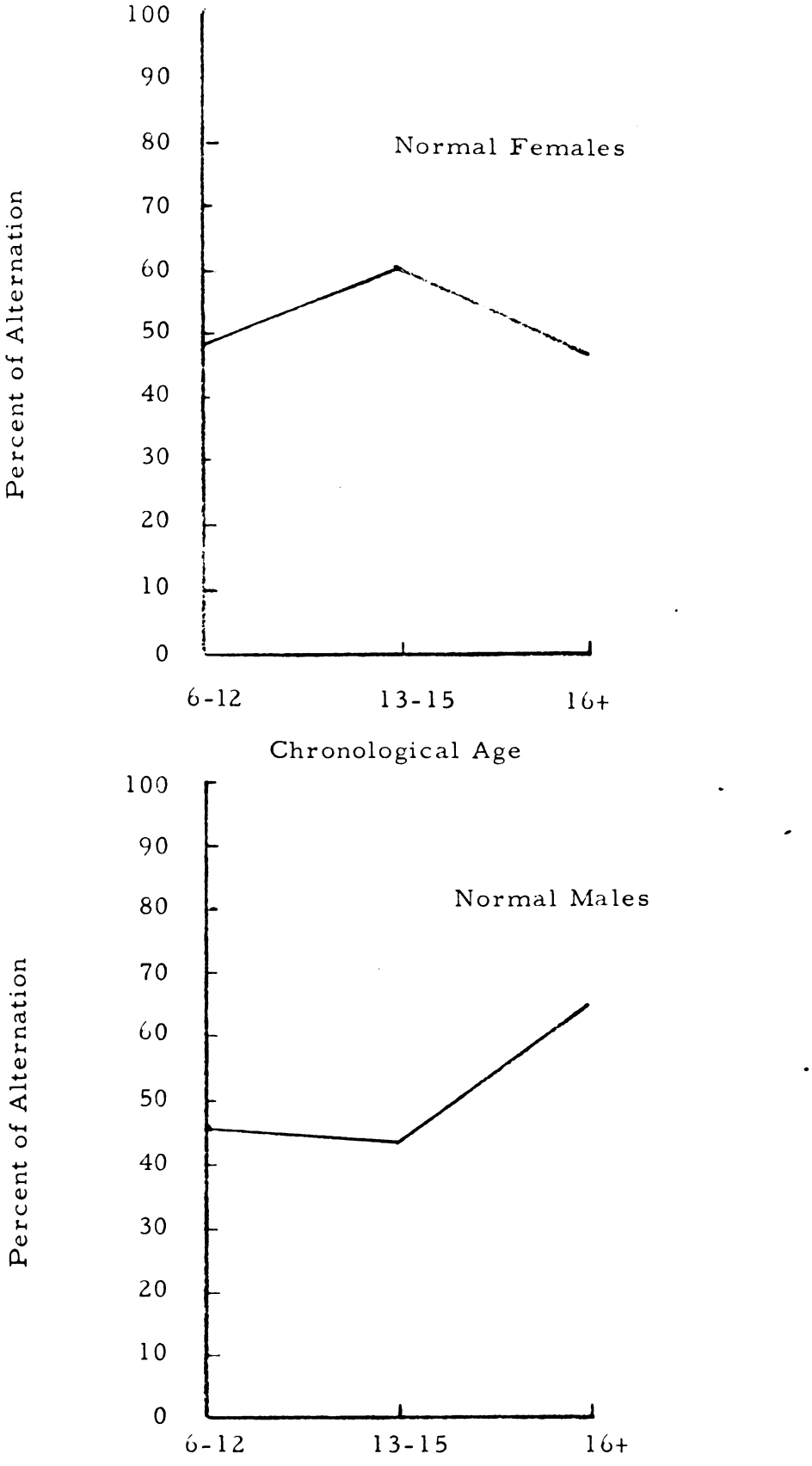


Figure 3. Percent of alternation 0 delay. Normal S's

if we consider the drop in per cent of alternation from the junior high to the senior high group.

The per cent of alternation for normal males as indicated by Figure 3 shows that with the exception of older males there are no significant differences from chance. The obtained chi square for older males in the high school group is 10.244. This is significant at the 1% level. It is interesting to note that this per cent of alternation (66%) is approximately the same as obtained by Denny with his male college students.

Alternation Data 0 Delay: Normal Males vs. Females

Figure 4 compares the performance of normal males and females with respect to per cent of alternation at 0 delay. Inspection of Figure 4 shows that boys and girls in the elementary group do not differ to speak of in alternation behavior. Males in the junior high group perform about the same as the younger males whereas junior high females tend in the direction of alternation. Even though there is an apparent difference between males and females at this age level it does not approach significance (chi square = 1.910, $p = .20$). Differences with respect to alternation behavior are most pronounced when comparing older males with older females. That is, the older males tend to alternate whereas females respond in the direction of perseveration. The difference between these two groups as tested by chi square is 6.000. This is significant at the 2% level.

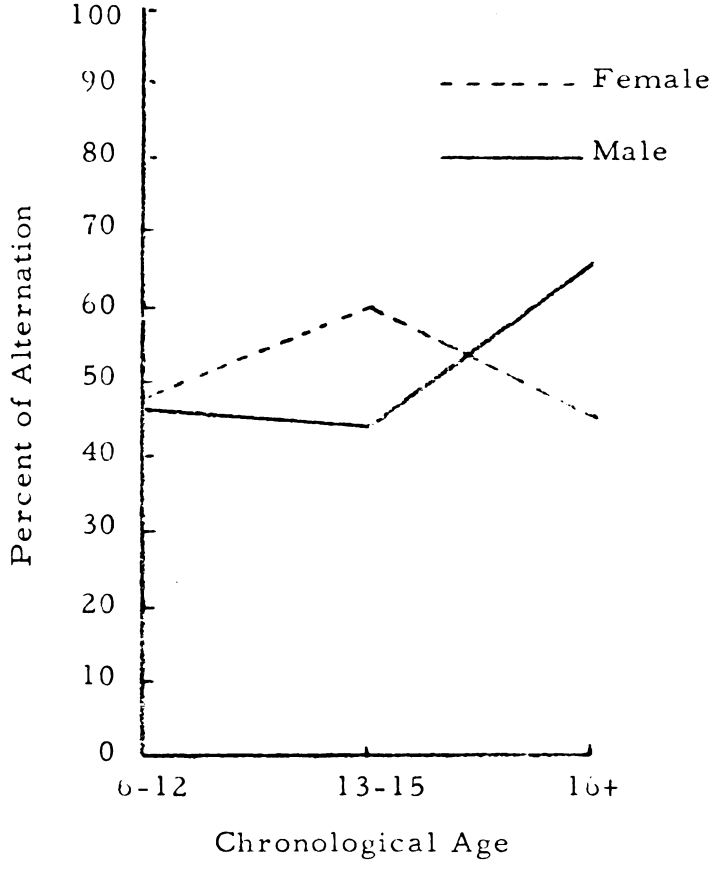


Figure 4. Percent of alternation, 0 delay. Normal males and females

Alternation Data 0 Delay: Mentally Retarded vs. Normal

Figure 5 compares mentally retarded females with normal females and mentally retarded males with normal males at 0 delay with respect to per cent of alternation. No difference between intelligence groups is obtained with respect to alternation when the data across all age levels are lumped together. Some significant differences, however are obtained between normals and retardates for both sexes when comparisons are made at each age level.

Regarding the females, significant differences are obtained between young mentally retarded and young normals and between older mentally retarded and older normals. The differences as expressed by chi square are 4.251 and 4.358 respectively. Both are significant at the 5% level.

The only significant difference obtained when comparing the performance of mentally retarded males with normal males is in the older age group. Reference to Figure 5 indicates that the older normals show a higher percent of alternation than do their mentally retarded counterparts. The difference as measured by chi square is 4.276, significant at the 5% level. Both normal and mentally retarded males in the elementary and junior high group hover near 50% with respect to alternation. Consequently, there are no significant differences at these age levels.

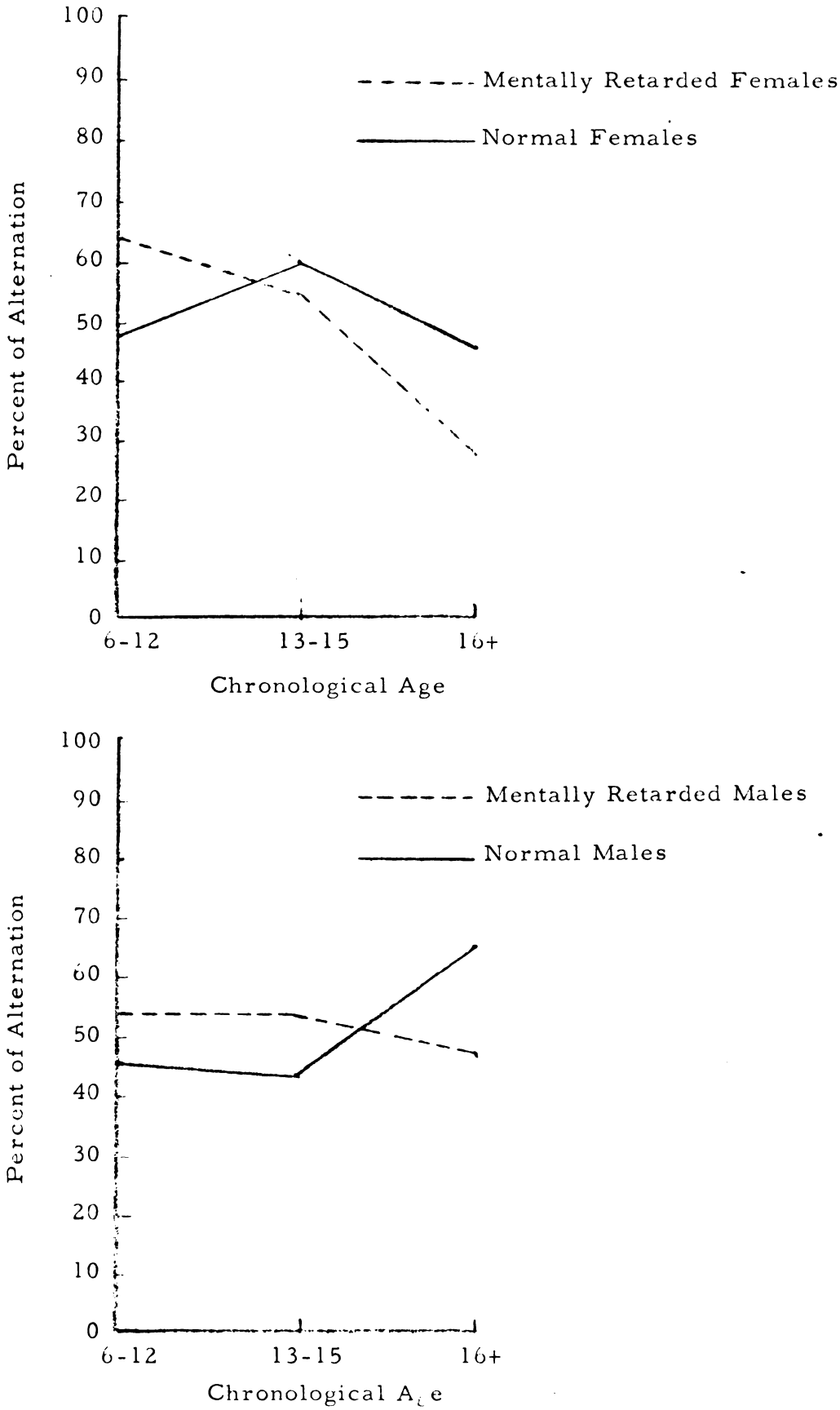


Figure 5. Percent alternation 0 delay. Mentally retarded and normal S's

From the evidence at hand, it appears that we have to reject the null hypothesis that there is no difference with respect to the alternation and stimulus satiation phenomena at different age levels. The results point up the fact that the tendency to alternate among normal males is more pronounced as they increase in chronological age. This tendency contrasted with chance yields a chi square of 10.244, significant at the 1% level. As a further check on this phenomenon, individual responses at this age level were analyzed to determine if a preference for going right was accounting for the difference. Although more male subjects turned right (70%) after being forced left, than turned left (62%) after being forced right the difference is not significant (chi square = .600, p = .55. Thus, a right preference is ruled out as an important variable.

The data with respect to the mentally retarded females lend further credence to the rejection of the aforementioned hypothesis. In this case the tendency for the younger females to alternate beyond chance performance is significant at the 5% level, chi square 5.062. Older retarded females indicated a perseveration tendency. This tendency is significant at the 1% level, chi square 8.022. It should be noted that the same analysis of right preference as performed with normal males was taken here and no significant differences were obtained. Chi square = .280 and .668 respectively for the younger and older group. In both cases p was near .5. Appendix I lists the percentages of responses for all subjects who were forced right and left.

Effects of Repeated Testing with Females

The data with respect to dissipation of satiation collected on successive days have been analyzed in terms of per cent responses. The response made at 0 delay was used as a base for comparing the response made at the other delay periods. The dissipation of satiation refers to the effects of the initial response (only if significantly different from chance in the direction of alternation) to tend in the opposite direction from which it was significant as time passes. Figure 6 compares the responses of mentally retarded and normal females in Treatments I and II. In Treatment I it is seen that younger mentally retarded females in the age group from 6-0 to 12-11 are alternating as much at the end of 24 hours as was true at 0 hours. But by 48 and 72 hours the tendency to alternate has largely dissipated. Comparing the per cent of alternation at 0 delay to that at the end of 72 hours gives a chi square value of 4.131, significant at the 5% level.

Although both normal and retarded females (age range 13-0 to 15-11) in Treatment I do not show a significant per cent of alternation at 0 hours they show the same trend over days as present in the mentally retarded 6-12 group.

In Treatment I, the tendency for the mentally handicapped females to perseverate persists over 24 hours but is dissipated by 48 hours. In other words, this age group shows a perseveration tendency at 0 hours and then responds in the direction of alternation. In contrast

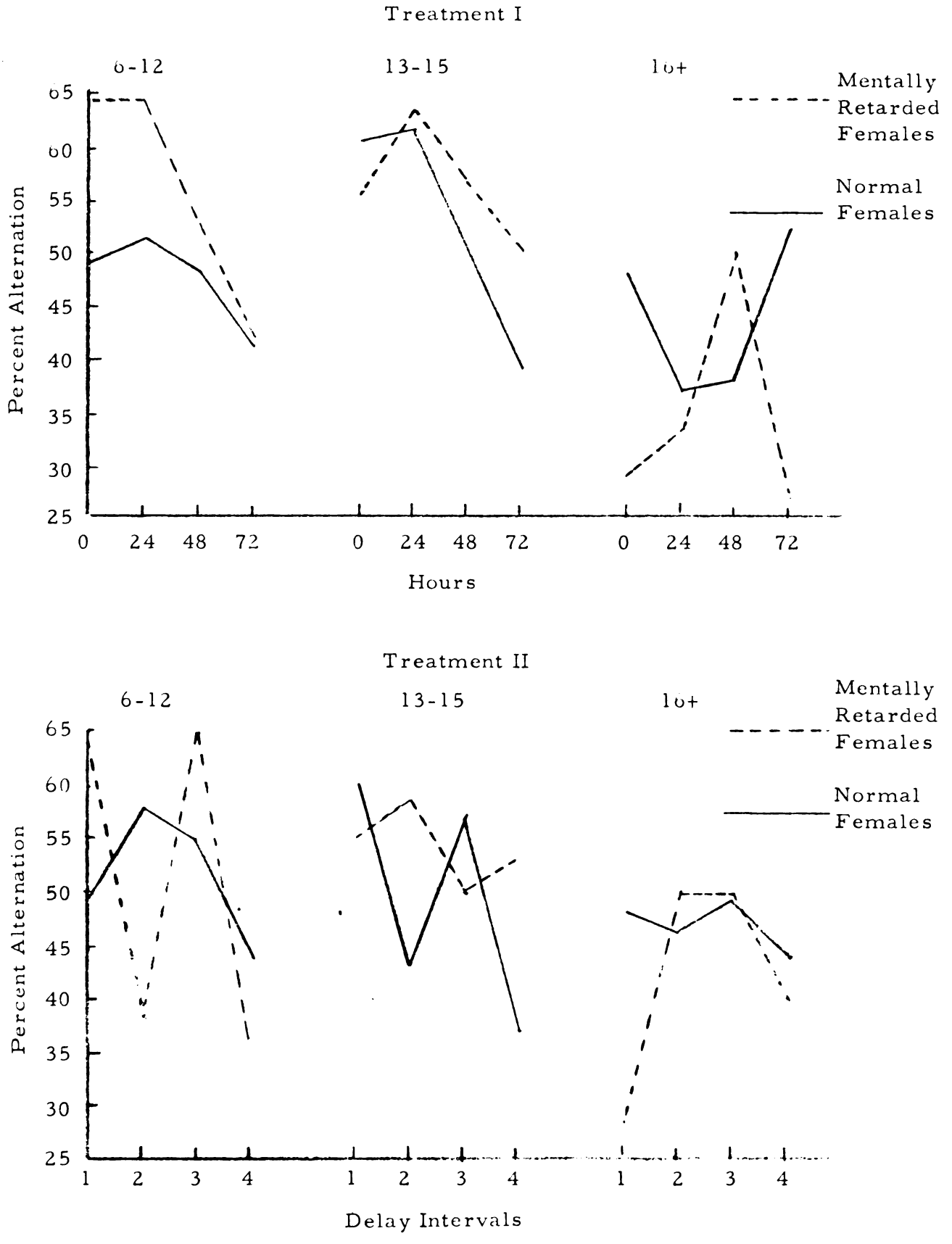


Figure 6. Percent alternation treatments I and II. Mentally retarded and normal females

normal females show a tendency to perseverate though this is not significant.

The results of Treatment II as depicted in Figure 6 are very interesting and show the phenomenon of spontaneous alternation on immediately successive trials in young female mentally retarded. Inspection of Figure 6 shows the per cent of alternation at 0 delay to be 64%, immediately thereafter on the second response it drops to 39%, then on the third response it goes up to 65% and finally on the fourth response drops to 36%, yielding a saw tooth effect which reflects satiation or alternation from the immediately preceding response. When the first and third responses are compared with the second and fourth, we get a chi square value of 4.845 and 5.220 respectively. Both are significant at the 5% level. This finding seems to refute the observations of Wingfield (26) who found no tendency for spontaneous alternation in human subjects.

Reference to Treatment II as depicted in Figure 6 shows that normal females in the age range (13-0 to 15-11) closely resemble young mentally retarded females with respect to alternation behavior. This seems to be correlated with the fact that both groups initially show an appreciable percentage of alternation. Older mentally handicapped females differ from both normal and other mentally retarded females in Treatment II not only with respect to percent of alternation at 0 hours, but also in that there is a tendency to alternate in Treatment II

on the second response and this holds up for two delays. Only on the fourth response does it tend in the direction of the original response. In other words, although these females tend to perseverate after making ten forced similar responses, the second free response tends to follow a stimulus satiation preference that is opposite to the previous free choice. This confirms the findings of Denny and Allen when they presented females with two successive free T's unpreceded by forced trials.

Effects of Repeated Testing with Males

Figure 7 compares the responses of mentally retarded and normal males in Treatments I and II. Reference to the results of Treatment I in Figure 7 shows that a dissipation tendency is evident in the older normal males. One point of interest is that this dissipation effect is somewhat cumulative. That is, the number of older males responding by going in the same direction as forced builds up over the delay periods. If the per cent of alternation at 0 delay is compared to that of 72 hours, we get a chi square value of 7.653. This is significant at the 1% level.

Effects of Repeated Testing: Mentally Retarded Males and Females and Normal Males and Females

Figure 8 compares mentally retarded males and females in Treatments I and II. Although there are no significant differences

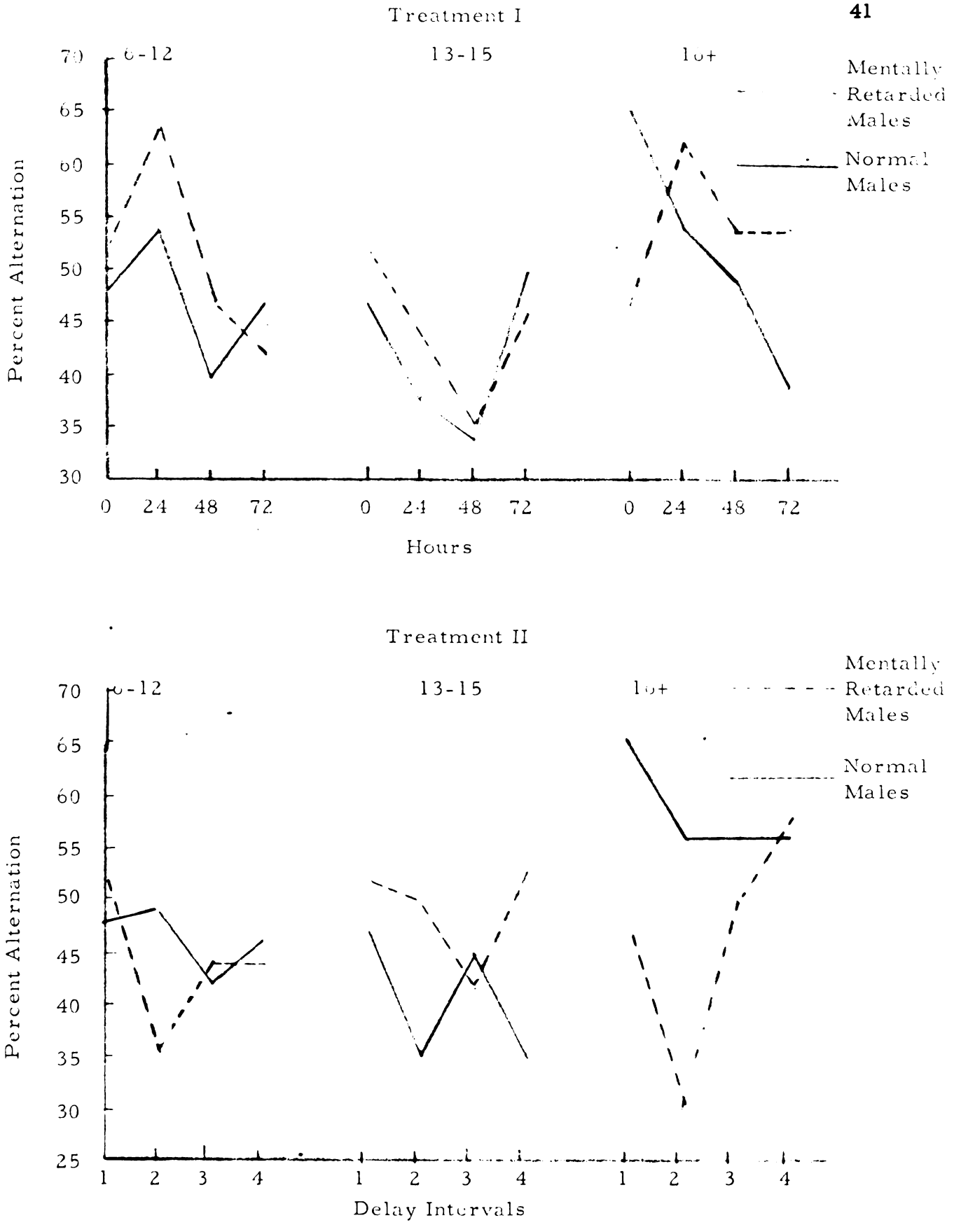
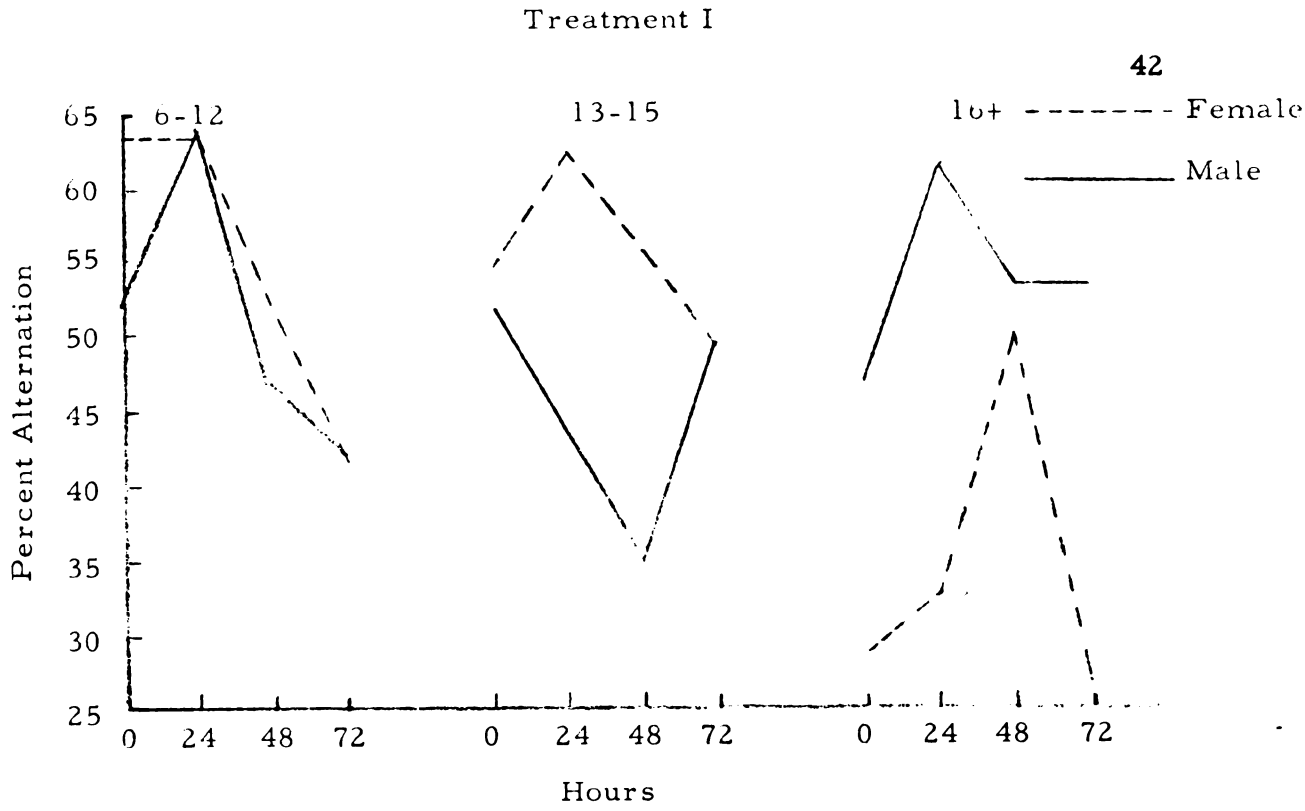


Figure 7. Percent alternation Treatments I and II. Mentally retarded and normal males



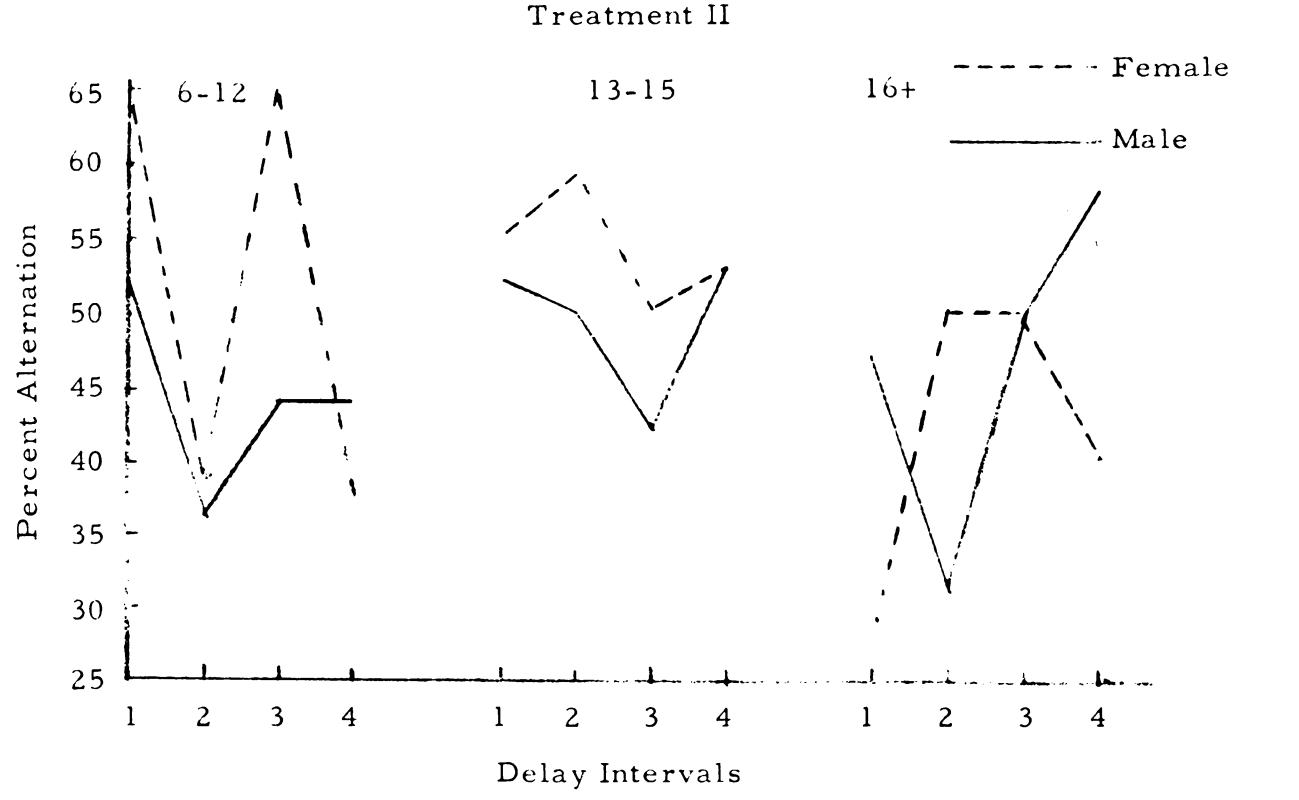


Figure 8. Percent alternation Treatments I and II. Mentally retarded males and females.

between male and female mentally retarded in either Treatment I or II, certain similarities in trends between the two groups are evident.

Figure 9 compares normal males and females in Treatments I and II. Again there are no significant differences between males and females when treated separately for Treatment I and Treatment II. The reader may find it of interest to scan the comparisons in Figures 8 and 9.

Comparison of Treatments I and II: Mentally Retarded

Figure 10 contrasts the performance of mentally retarded males and females in Treatments I and II. In young mentally retarded females it appears that the largest discrepancy occurs when comparing the response at 24 hours to its equivalent (second delay) in Treatment II. This difference as measured by chi square is 3.810 which approaches significance at the 5% level (3.841). But since the whole stimulus effect at 0 delay is in itself significant, this trail 2 comparison appears stable. The point to be made is that the 24 hour delay eliminates a satiation effect from a single previous trial. The same sort of trend with respect to a perseveration tendency is also present in the 16+ mentally retarded females in trials 2. In light of the deviant pattern of the 13 to 15-11 age group, the interpretation of these results is indeed complicated.

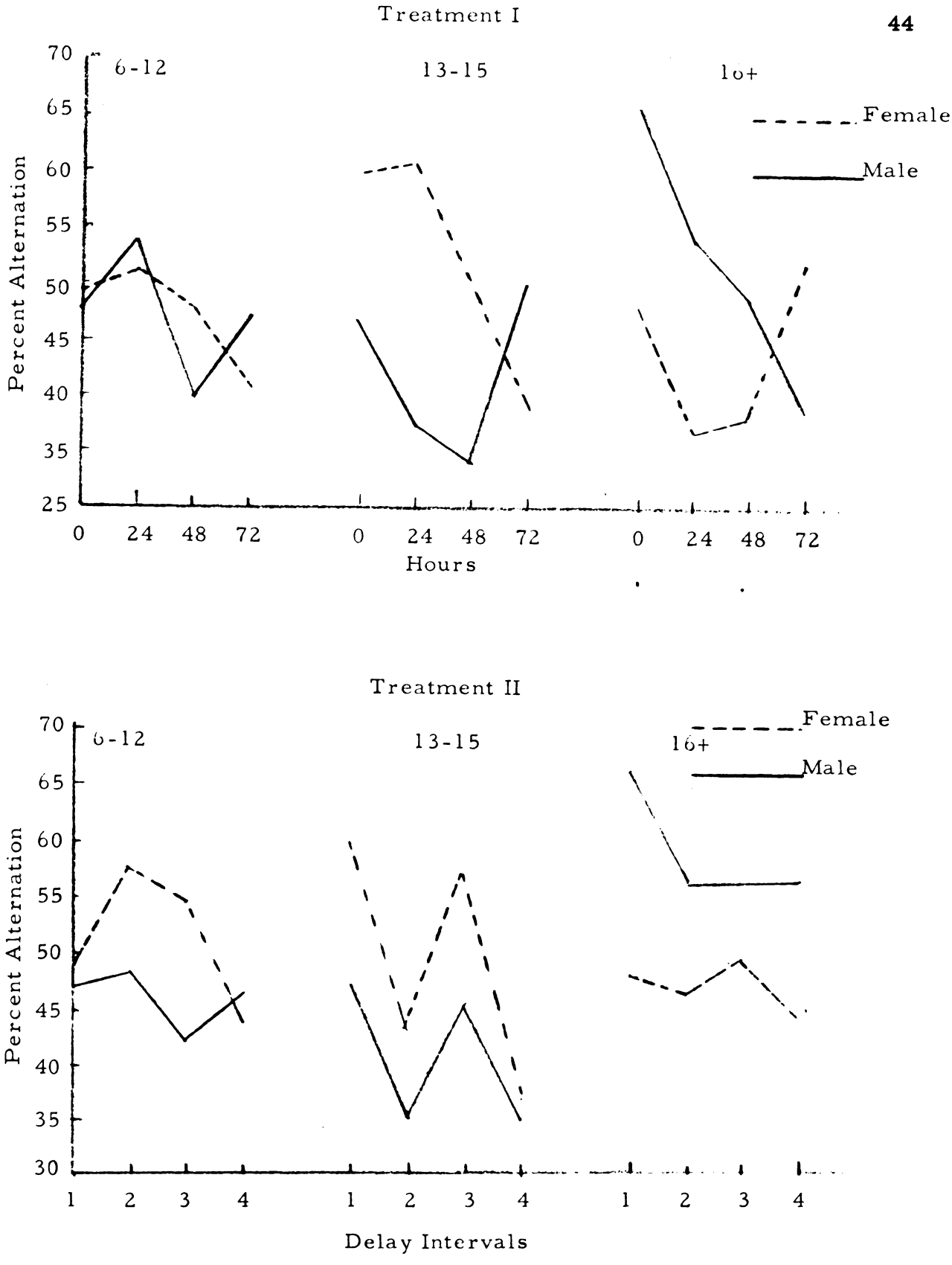


Figure 9. Percent alternation Treatments I and II. Normal males and females

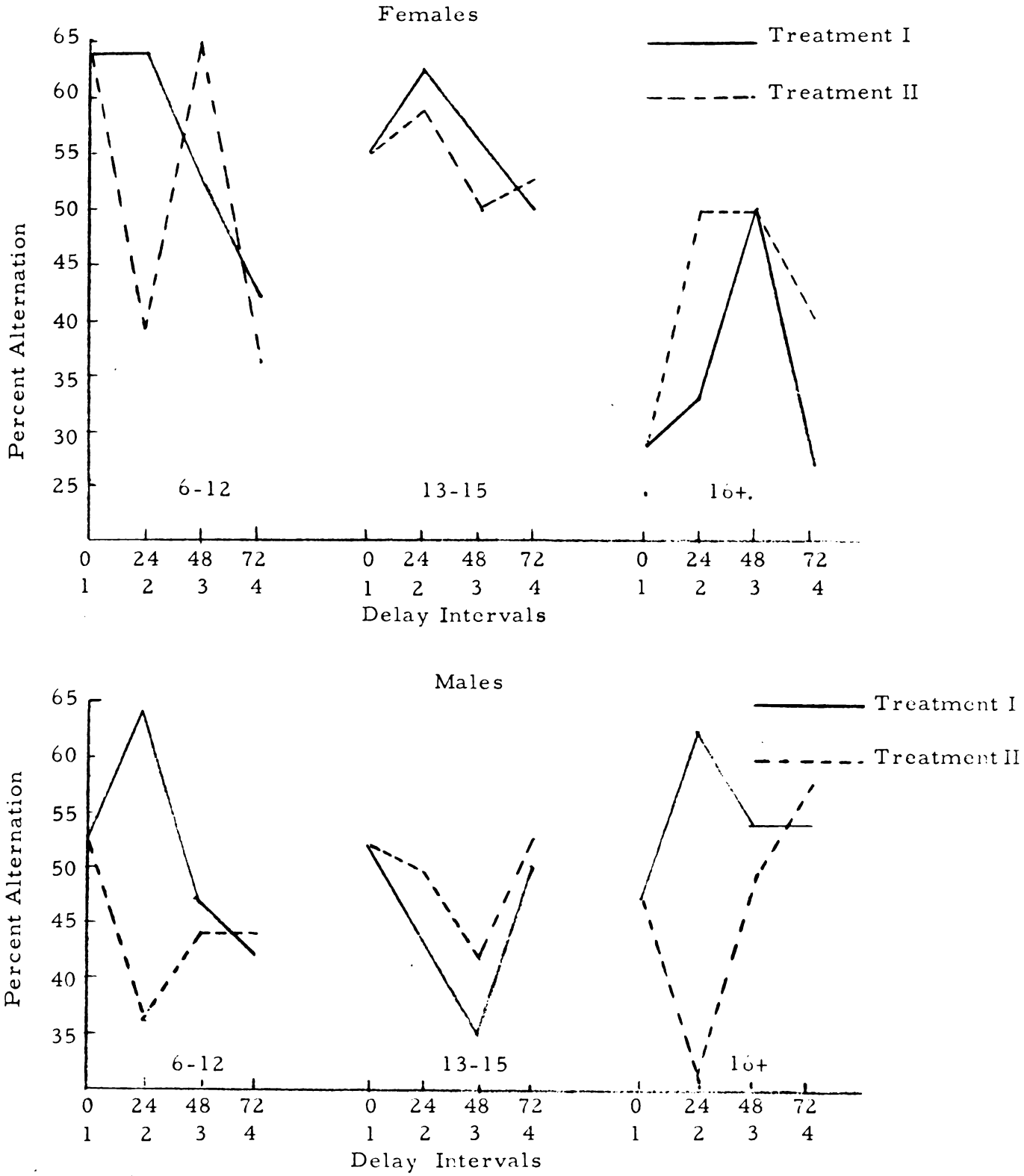


Figure 10. Percent alternation Treatments I and II compared. Mentally retarded S's

Because mentally retarded males don't show any tendency to alternate or perseverate, they don't show any clear cut alternation tendency from successive trials.

Comparison of Treatments I and II: Normals

Figure 11 contrasts the performance of normal males and females in Treatments I and II. None of the differences among these comparisons is significant.

Avoidance

Figure 12 depicts the per cent of avoidance in the normal and mentally retarded children with respect to age. Avoidance in this case is defined as going the opposite way as forced for all four trials for both treatments combined. Although there are no significant differences when making comparisons between groups, the 13 to 15 age group seems to contain some individuals who have a strong tendency to alternate and this is particularly interesting when contrasted with the group a few years older who seem to show an opposite effect. One further point of interest is the trend shown by mentally retarded and normal males. It appears that per cent of avoidance decreases with age in normal males whereas in the mentally retarded it seems to increase.

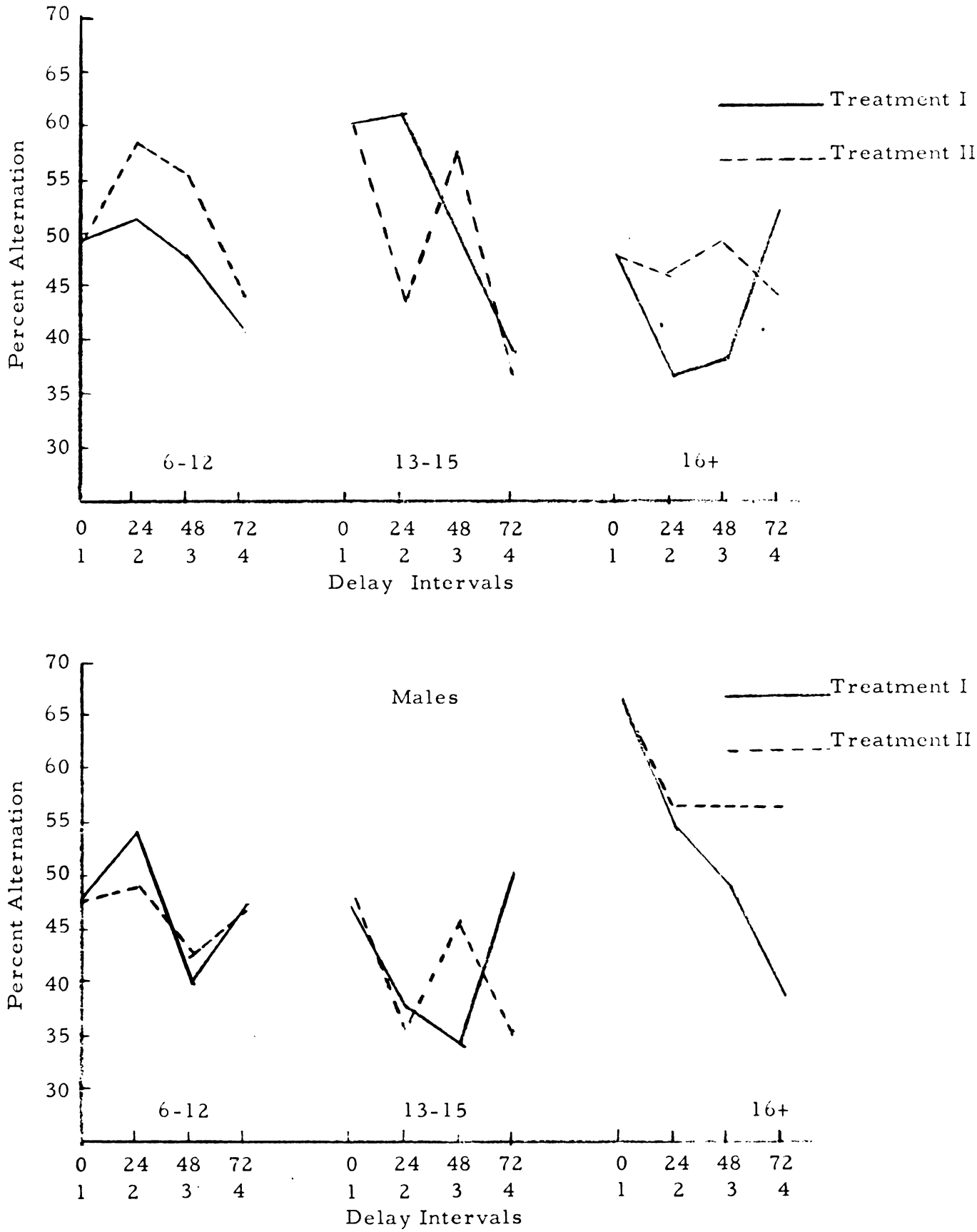


Figure 11. Percent alternation Treatments I and II compared. Normal S's

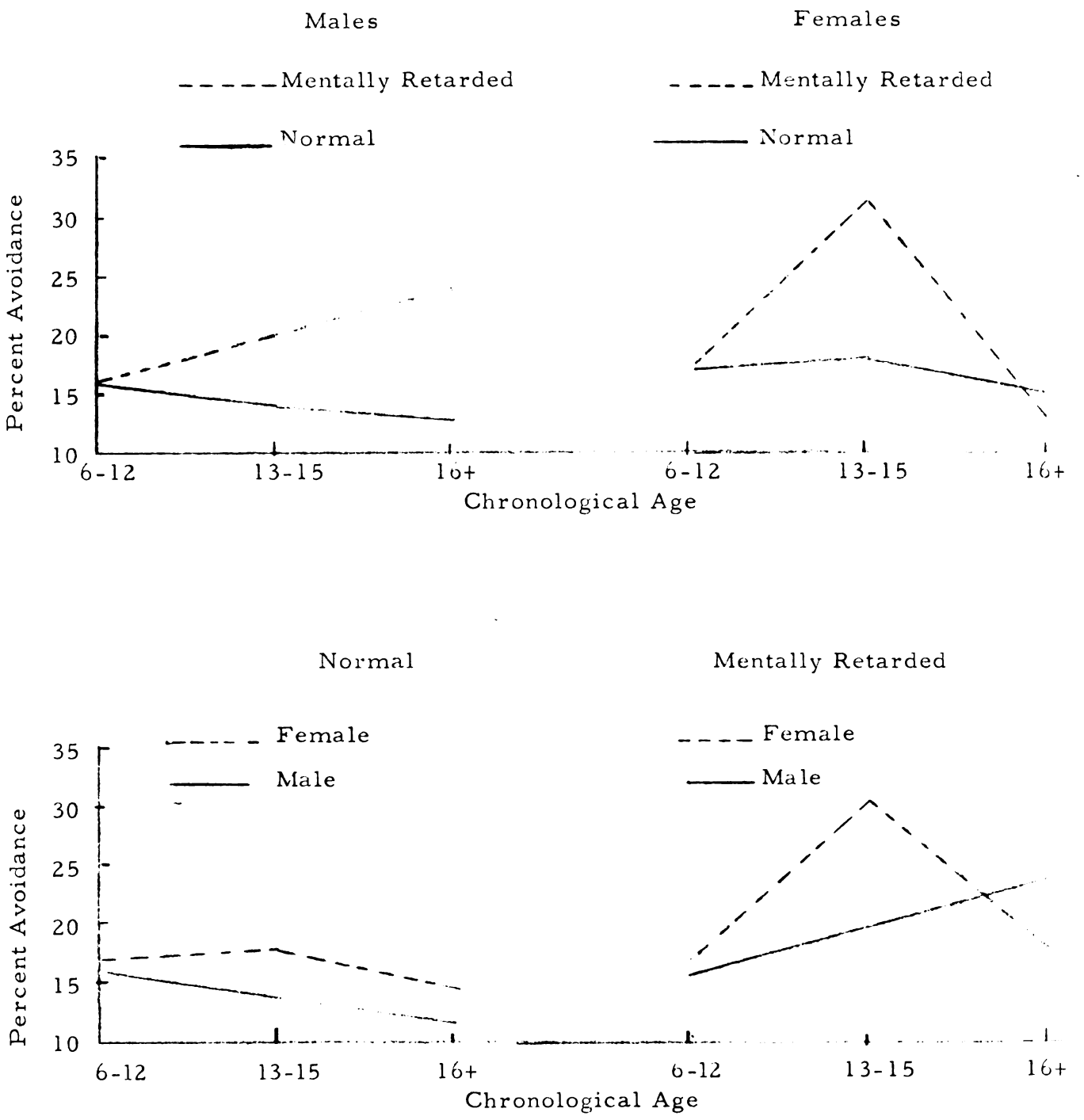


Figure 12. Percent avoidance. All trials

Perseveration

A comparison of mentally retarded and normal subjects with respect to percentage of perseveration (making a response in the same direction as forced throughout all four delay periods in Treatments I and II) is depicted in Figure 13. It can be seen that the per cent of perseveration in normal and mentally retarded males is not too different at the three age levels. The whole difference in Figure 13 is in the behavior of the mentally retarded females. The trend to perseverate as chronological age increases for mentally retarded females is such that significant differences are obtained when comparisons are made between younger mentally retarded and younger normal females and older mentally retarded and older normal females. Chi square = 7.006 (1% level) and 3.829 (5% level) respectively for the two groups). These findings are congruent with percentage data of alternation at 0 delay.

Because of the large number of statistical comparisons made in this study, the probability of obtaining 16 significant differences at the 5% level if 63 comparisons were made was taken into consideration. According to tables prepared by Sakoda, Cohen & Beall (19), one would not expect to find by chance, 16 significant differences at the 5% level if 63 comparisons were made. One would only expect three.

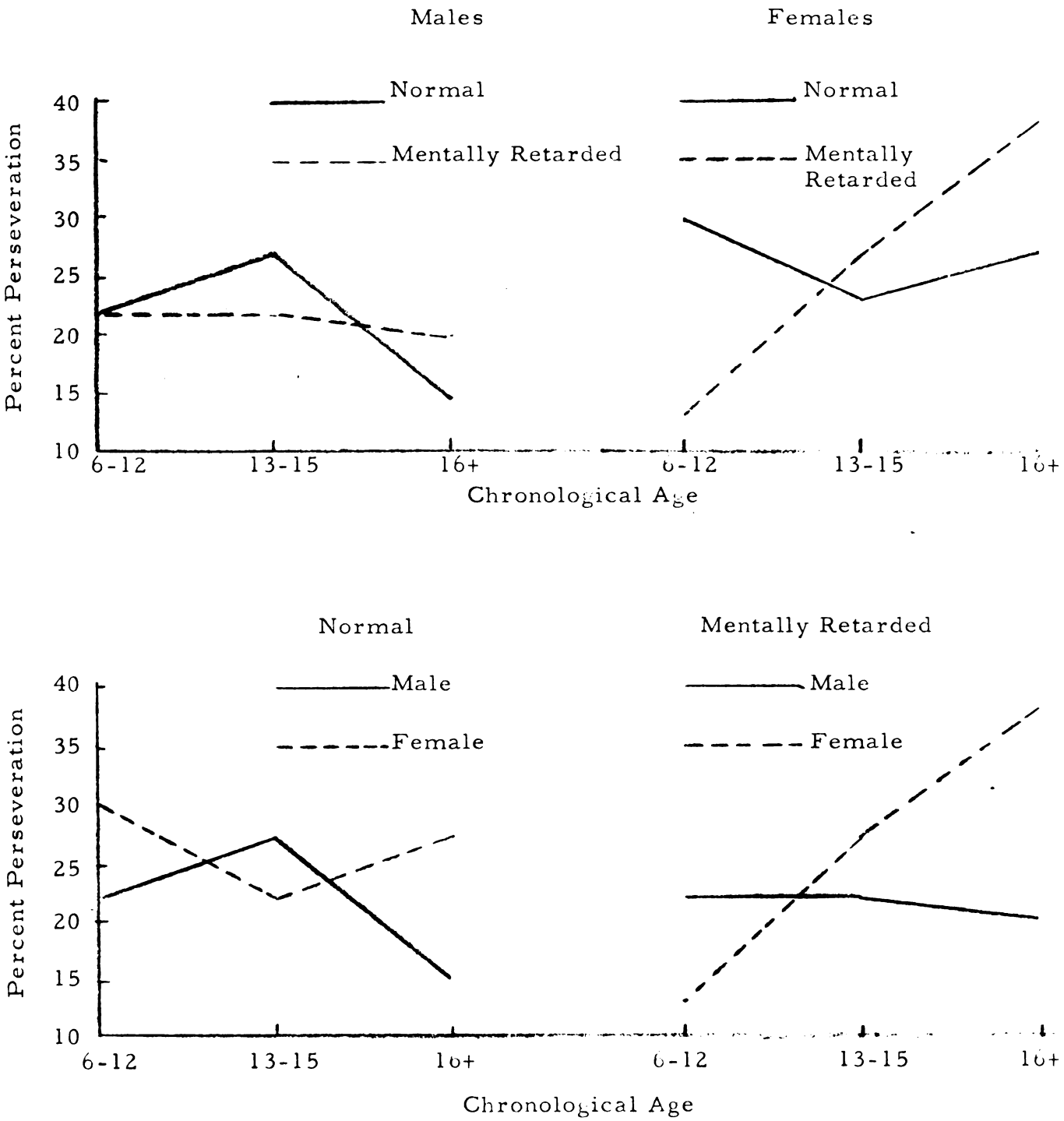


Figure 13. Percent perseveration. All trials

CONCLUSIONS

The results of the present study would seem to suggest differences between mentally retarded and normal children in alternation behavior. The youngest mentally retarded females showed the highest per cent of alternation at 0 delay. This finding may be related to the recent work of Zeaman and House (11) where it was found that younger mentally handicapped tended to select novel stimuli in a discrimination experiment. However the younger males in the present study responded more or less in chance fashion showing no particular trend. The youngest mentally retarded males responded in the same manner as did younger males and females in the normal group. Thus, the only deviate in both of the youngest groups was the mentally retarded females. Since older mentally retarded females showed a pronounced tendency to perseverate, it may well be that this perseverative tendency is a learned phenomenon. Possibly this perseveration tendency is reinforced as a result of an interaction with normal children. In other words, as a mode of adjustment, older mentally retarded females may find that by conforming to the standards of the normal group one can avoid painful embarrassments and frustrations in contacts with their peers. We need look no further than classrooms for the mentally retarded to find support for this explanation. Almost without exception, males outnumber females with respect to special room placement. Fortunately or unfortunately,

this is probably due to the fact that most teachers are less prone to refer young girls for individual intelligence testing as long as they can keep up with the group with respect to social poise, etc. Consequently, when retarded females are placed in a special room they are usually older than males when first placed in a special class and have learned that the best way to "get along" is to conform. This tendency for older females to show perseveration behavior is in accord with the data on normal college women as reported by Denny and Allen (4).

The present data indicate that retarded males as a group do not vary with age in alternation behavior. But more importantly it could be that they are less satiable than the normal males at the oldest age level.

The data when viewed in their totality seem to fit the findings of Stevenson, Zigler (24) and Plenderleith (17) in that there is little evidence of rigidity in the mentally handicapped. This is especially true when viewing the performance of the males. The only marked indication of "rigidity" and/or resistance to satiation was found in the older females as they showed a perseveration tendency at 0 delay. However, if this group was absolutely "rigid," this perseveration tendency would hold up throughout the various delay periods. Such was not the case, as there was a definite trend in Treatments I and II towards making an opposite response after the first delay period.

The data with respect to normal subjects also point up the fact of individual differences in alternation behavior at various age levels and between males and females. If we compare the percentage of alternation for all males against that of the females, there are no significant differences. However, when we explore the percentage of alternation between sexes with respect to age levels, significant differences occur. This is especially evident when making a comparison at the older age level.

In the same vein, when the percentage of alternation for all retarded females is compared to that for all normal females there are no significant differences. The same holds for males. However, significant differences are evident if we compare groups on the basis of chronological age and sex.

IMPLICATIONS FOR EDUCATION

Since this study was more in the nature of an exploratory investigation into one facet of behavior in mentally retarded and normal children, generalizations emanating from this investigation should not be considered as being directly applicable at this time to classroom situations. Rather, the data should be considered as being basic and should be extended further or coupled with parallel research that more closely follows the conditions one finds in the average classroom. In this respect, current research dealing with learning in the area of mental retardation points up the fact that much more research is needed in this area before sound educational procedures can be formulated and applied to this group.

That the concept of satiation is of importance can be seen if we ask the question as to why the relationship between grades and IQ is so variable; are boredom and need for a change the important factors? Do brighter youngsters become bored more easily with some of the repetitious drill they have to face? In a purely theoretical vein, we well know that learning theory has made significant contributions to the counseling process. Even though the concept of stimulus satiation is but one factor contributing to the learning process, its import becomes evident. Thus, it is considered that the present investigation makes a contribution in the direction of providing information in an incomplete and fragmentary area. Should the results

of this study be substantiated by further research, it would appear that retarded as well as normal children could benefit from being placed into distinct groups on the basis of their performance in a series of perceptual and motor tasks. The important thing is that particularly among mentally retarded females there seems to be sufficient differences to suggest the use of different educational techniques.

SUMMARY

The present study was undertaken to explore the effects of stimulus satiation and related phenomena in mentally retarded and normal school age children. Three hundred sixty-five subjects of both sexes, ranging in age from 6-0 to 21-3 made up the mentally handicapped sample. There were 575 children in the normal sample. Mean IQ ratings for the mentally retarded sample were 67.42 and 69.40 on the Stanford-Binet and Wechsler Intelligence Scale for Children, respectively. In brief, all subjects were first presented with an open alley figure shaped like a T on a plain half sheet of paper. Subjects were then told to start at the bottom of the T and draw a line with a pencil anywhere they wanted to go, as long as the pencil was not lifted from the paper and the borders of the T were not crossed. The direction first turned was noted. Normal children of both sexes and at all age levels showed a definite preference for turning right. For mentally retarded, the right preference appeared to be a developmental phenomenon. That is, as age increased so did the right preference. A theoretical explanation to account for this finding was discussed.

After the T, all subjects were presented with an inverted L on a clean half sheet of paper. For half the subjects the L was pointing right and for the other half the L was pointing left. The subjects were then forced either right or left for ten trials, no delay,

then were presented with another T after a specified delay. Once again, the direction first turned was noted.

The following hypotheses were tested:

1. There is no difference in the alternation behavior (stimulus satiation effects) at different age levels.

2. There is no difference between sexes as regards alternation behavior (stimulus satiation effects).

3. There is no difference between normal and mentally retarded children in alternation behavior (stimulus satiation effects).

4. The introduction of delay after stimulus exposure will not result in less alternation behavior (dissipation of stimulus satiation effects).

On the basis of the data, the 1st hypothesis was rejected as there were significant differences from chance in the alternation behavior of younger and older mentally retarded females and in older normal males. The 2nd hypothesis was also rejected as younger mentally retarded females differed significantly from younger mentally retarded males and older mentally retarded males. For the normal sample, significant differences occurred between older males and older females. The 3rd hypothesis was accepted as the data when viewed in their totality showed no significant differences between normal and mentally retarded children with respect to the effects of stimulus satiation. The 4th hypothesis was rejected as dissipation

effects were evident whenever a significant amount of stimulus satiation occurred.

Subsidiary findings with respect to avoidance and perseveration were discussed as were the educational implications of this study.

Appendix I

Per Cent Subjects Responding with a Left or Right Turn After Being Forced Right or Left at 0 Delay

Age	Number forced right	% L	% R	Number forced left	% L	% R
			Mentally Retarded Females			
6-12	31	68	32	33	40	60
13-15	16	54	46	25	44	56
16+	24	28	72	21	65	35
			Mentally Retarded Males			
6-12	43	59	41	42	55	45
13-15	32	47	53	33	43	57
16+	28	39	61	27	78	22
			Normal Females			
6-12	69	54	46	69	57	43
13-15	33	55	45	32	54	66
16+	39	54	46	40	57	43
			Normal Males			
6-12	63	43	57	62	47	51
13-15	35	43	57	35	49	51
16+	48	62	38	50	30	70

Appendix II

Number of Subjects in Respective Groups Alternating at the Various Delay Periods

	Hand R	Hand L	1st choice R	1st choice L		0	24	48	72	O2	O3	O4	Av.	Per
						Mentally Retarded								
M 16+	41	14	40	15		27/55	18/29	15/28	15/28	8/26	13/26	15/26	13	6
M 13-15	59	6	53	11	*1N	34/65	12/27	9/26	12/26	19/38	16/38	20/38	13	14
M 6-12	69	16	43	31	*11N	44/85	25/44	21/45	19/45	14/39	17/39	17/39	14	19
F 16+	38	7	34	11		13/45	9/21	11/22	6/22	10/20	10/20	8/20	6	17
F 13-15	45	6	37	14		28/51	10/16	9/16	8/16	20/34	17/34	18/34	16	14
F 6-12	54	10	24	29	*11N	41/64	21/33	17/33	14/33	12/31	20/31	11/31	11	8
						Normal								
M 16+	91	7	78	20		65/98	21/39	17/35	14/36	33/59	33/59	33/59	13	15
M 13-15	57	13	57	13		33/70	9/24	10/29	14/28	14/40	18/40	14/40	10	19
M 6-12	105	20	89	36		60/128	36/65	26/66	28/60	28/57	24/57	26/57	20	27
F 16+	73	6	69	10		38/79	7/19	8/21	11/21	26/57	28/57	25/57	12	21
F 13-15	60	5	56	9		39/65	17/28	14/28	11/28	15/35	20/35	13/35	12	12
F 6-12	115	23	106	32		67/138	37/73	32/67	26/64	37/64	35/64	25/64	24	41

*Neutral--Did not go right or left.

BIBLIOGRAPHY

1. Berlyne, D. E. Novelty and curiosity as determinants of exploratory behavior. Brit. J. Psychol., 1950, 41, 68-80.

2. Berlyne, D. E. Attention to change, conditioned inhibition (sI_R) and stimulus satiation. British J. Psychol., 1957, 48, 138.

3. Dannis, W. Spontaneous alternation in rats as an indicator of the persistence of stimulus effects. J. comp. Psychol., 1939, 28, 305-312.

4. Denny, M. R. and Allen, J. N. Alternation benavior in humans. Amer. Psychologist, 1959, 14, 405.

5. Denny, M. R. Learning through stimulus satiation. J. Exp. Psych., 1957, 54, 62-64.

6. Denny, M. R. Learning, Motivation and Performance. Unpub. 157 draft Handbook of Mental Deficiency, 1960.

7. Eisman, Bernice S. Lott. Paired associate learning, generalization and retention as a function of intelligence. Amer. J. Ment. Deficiency, 1958, 63, 481.

8. Glanzer, M. Stimulus satiation: An explanation of spontaneous alternation and related phenomena. Psych. Rev., 1953, 45, 387-393.

9. Gordon, Brian H. Left handedness and mirror writing, especially among defective children. Brain, 1920, 43, 313.

10. Heathers, G. L. The avoidance of repetition of a maze reaction in the cat as a function of the time interval between trials. J. Psychol., 1940, 10, 359.

11. House, Betty J. and Zeaman, D. Position discrimination and reversals in low-grade retardates. J. comp. physiol. Psychol.,

12. McCulloch, Thomas, L. Reswick, J. and Roy, I. Studies of word learning in mental defectives. I. Effects of mental level and age. Amer. J. Ment. Defic., 1955, 60, 133.

14. Montgomery, K. C. The effect of the hunger and thirst drives upon exploratory behavior. J. comp. physiol. Psychol. 1953, 44, 315-319.

15. Montgomery, K. C. A test of two explanations of spontaneous alternation. J. comp. physiol. Psychol., 1952, 45, 287-294.

16. Montgomery, K. C. The effect of activity deprivation upon exploratory behavior. J. comp. physiol. Psychol., 1953, 45, 438-441.

17. Plenderleith, Mavis. Discrimination learning and discrimination reversal learning in normal and feebleminded children. J. Genet. Psychol., 1956, 88, 107.

18. Rothkopf, E. Z. and Zeaman, D. Some stimulus controls of alternation behavior. J. Psychol., 1952, 34, 235-255.

19. Sakoda, J. M., Cohen, B. H. and Beall, G. Test of significance for a series of statistical tests. Psychol. Bull., 1954, 51, 112.

20. Sloan, W. and Berg, I. A comparison of two types of learning in mental defectives. Amer. J. ment. Defic., 1957, 61, 556.

21. Solomon, R. L. The influence of work upon behavior. Psychol. Bull., 1948. 45, 1-40.

22. Spitz, H. H. and Blackman, L. S. Figural after effects and reversible figures in retardates. J. abnorm. soc. Psychol., 1959, 58, 105.

23. Spitz, H. H. and Blackman, L. S. The Mueller-Lyer illusion on retardates and normals. Perceptual Motor Skills, 1958, 8, 219.

24. Stevenson, H. W., and Zigler, E. F. Discrimination learning and discrimination reversal in normal and feebleminded individuals. J. Personality, 1957, 25, 699.

25. Tolman, E. C. Purpose and cognition: The determiners of animal learning. Psychol. Review, 1925, 32, 285-297.

26. Wingfield, R. C. A study in alternations using children in a two-way maze. J. Comp. Psychol., 1938, 28, 439.

27. Zeaman, D. and House, B. J. The growth and decay of reactive inhibition as measured by alternation behavior. J. exp. Psychol., 1951, 41, 177-186.