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DIFFERENTIAL TEST PERFORMANCES OF MENTALLY RETARDED AND NORMAL CHILDREN OF THE SAME MENTAL AGE

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DIFFERENTIAL TEST PERFORMANCES OF MENTALLY RETARDED AND NORMAL CHILDREN OF THE SAME MENTAL AGE

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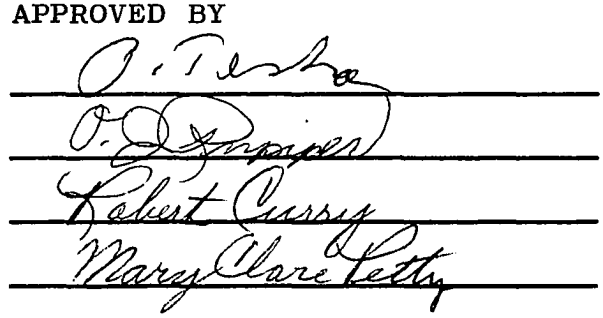

DISSERTATION COMMITTEE

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CHAPTER I

Historically, one of the most neglected areas of educational research has been in the area of comparing and contrasting the performances of normal and retarded children on standardized tests. The statements that have been made concerning the differences between normal and retarded children have essentially been based upon the personal philosophy held by the individual making the statement, with little foundation of scientific fact and information.

Although the concept of mental retardation is not new, professionals working in the field are still unable to agree on a definition. However, there appears to be general acceptance of the idea that mental retardation refers to both the quantitative and qualitative impairment of the functioning organism's overall efficiency which results in social incompetence (Doll, 1941); (Deacon, 1968). Since the competence of an organism depends heavily upon its learning capacity, it would seem that an understanding of the learning process would be a vital component of understanding mental retardation.

Publications in the field of mental retardation are replete with dogmatic statements concerning the psychological characteristics of the mentally handicapped with little or no supporting evidence. Baker (1953) states:

> Mental Characteristics show many features unique to the mentally retarded. In addition to the gross retardation in terms of mental age, there are many qualitative psychological ways in which they are backward, as follows: They show a tendency to stereotyped answers by repeating the same response to different questions; they lack power of self-criticism; their power of association is limited; they are unable to keep unusual instructions in mind, but return to traditional methods; they fail to detect error and absurdities in statements and in commonplace situations; they tend to have concrete abilities rather than abstract; and similar mental traits [p. 258].

Similar statements concerning interest, judgment, and learning ability can be found. Tredgold (1937) says:

> . . . the range of interests, and consequently the number of things they can attend to, is decidedly limited, and of aments in general, even the mildest, it may be said that their ability to attend much less than in the normal [p. 99].

Garrison (1950), in discussing learning ability, reports "The differences in the learning ability of those classed as mentally retarded and the average child is most pronounced in those activities that involve reasoning and problem solving in which symbols are used." Duncan (1943) reports along a somewhat similar line:

> Our investigations into the abilities of so-called mentally defective children reveal a deficiency of verbal ability much more marked than the deficiency in general ability. In general ability exercised through verbal channels and in abstract situations these children are of course among the poorest 3% or

> so of the population. In general ability exercised in real situations dealing with the relationships of things that can be seen or handled they are, on the average, approximately at the same level as children of middle ability [p. 15].

Many of these statements concerning the behavioral characteristics of retarded persons were made on the basis of subjective observations of individuals or selected groups. Little research was available or engaged in to further the development of a more scientific understanding of these children.

Ingram's (1953) statement concerning the learning potential of mentally retarded children reflects a more scientific approach although not all of his assumptions were supported by research.

> Mental age and I. Q. suggest the limitations of the retarded child's abilities of association, comparison, comprehension, generalization, and symbolization compare with those of other children. For example, in school tasks calling for association, comprehension, and judgment - such as getting meaning from the printed page, adding new words to his vocabulary, and solving problems in number - the mentally retarded child who is chronologically 12 years old and mentally eight and a half years, with an I. Q. of 70, will respond more as the average eight year old child rather than as the average child of his own chronological age would. This principle generally holds true at all ages. Among the higher age groups long life experience and other favorable conditions may aid some individuals in succeeding better than their mental ages would suggest [pp. 15-16].

Kirk (1940) states:

> All studies and observations show that the mentally deficient learn more slowly and retain less than normal children. There is no question on this point. A related question is: How do the mentally deficient compare in learning ability

> with normal children of the same mental age? That is, will a child of 12 whose mental age is six learn as rapidly as an average child of six years?

The statements of Baker, 1953; Duncan, 1943; Tredgold, 1937; and others similar to them, taken either in their entirety or out of their context, have been primarily responsible for the many cliches so glibly spoken when referring to the characteristics of mentally handicapped children. Few of these statements concerning the differences between the mentally retarded (MR) child and the normal (Nc) child have been submitted to empirical investigation.

Review of the Experimental Literature

Research in the field of mental retardation in the last two decades has been characterized by increased interest in experimental endeavors designed to provide further information regarding the learning characteristics of MR children. McPherson (1948) reviewed the published research in this area from 1907 to 1945. These 14 studies fell into three general classifications: (a) formation of conditioned responses; (b) learning simple tasks; (c) problem solving. McPherson (1948) wrote:

> The outstanding impression gained from this review of learning in the subnormal is one of lack of information. The actual experiments have been few, the number of subjects small, the tasks to be learned heterogeneous within a narrow range, and the motivational factors inadequately controlled. The results of this review serve not so much as an aid to the technician in meeting clinical problems but as a reminder to the experimentalist [p. 252].

In a similar review in 1958, McPherson examined the literature on learning in mental defectives covering the period from 1943 to 1957. This review also covered 14 studies. The tasks in four studies consisted of learning nonsense syllables or learning lists of common words. None of the studies used paired-associate learning tasks. In the introduction, McPherson (1958) states:

> The first survey indicated that the relationship between these two variables represented an area of limited information and that the learning of mental defectives is not consistently inferior to that of individuals who achieve normal intellectual ratings [p. 870].

In an attempt to summarize the studies reviewed, McPherson concluded:

> The review reveals a diversity of methodology and of results. Some papers highlight a slow, arduous learning process among mental defectives whereas others point to more skill in acquisition than is ordinarily assumed. There is evidence that intellectual level is not an adequate predictor of the learning of mental defectives and that their learning per se is variable [p. 877].

The following four studies used familiar objects or pictures in the pairs to be associated in comparing the learning rates of mentally retarded and normal children of the same mental age (M.A.). Ring and Palermo (1961) used eight pairs of highly familiar pictures and found no difference between retardates and equal M.A. normals. Cantor and Ryan (1962) used six pairs of photographs of common objects, and no differences emerged. Iscoe and Semler (1964) found that retardates did not differ from equal M.A. normals when the pairs to be associated were actual objects from a single

category such as "toothbrush-comb." However, normals were superior when pictures of these objects were used. When the pairs consisted of dissimilar objects (e.g., "doll-cigar") the normals displayed an even more pronounced learning superiority.

Ring and Palermo, as well as Cantor and Ryan, used high-grade retardates with mean I. Q.'s in the 70's. However, the mean I. Q. of the retardates used by Iscoe and Semler was in the 50's.

Table 1 presents summary data for the pair-associate experiments involving normal and mentally retarded children matched on M. A. Four of the seven studies cited found no differences between the normal and retarded samples in rate of learning, when the subjects were matched on M. A. whereas three studies report normal superiority.

The most frequently used intelligence test in determining the degree of mental retardation is the Stanford-Binet Intelligence Test Form L-M (1960). Thompson and Margaret (1947) present the most recent comparison of the performances of mentally retarded and normal children of the same M. A. They compared 441 retardates with 1326 normals on Form L to the 1937 Binet. The groups were arranged so that defectives of any given mental age could be compared to a normal group of similar level. Table 2 gives the Binet items on which defectives did significantly better than did the normals and vice versa.

TABLE 1

SUMMARY DATA FOR PAIRED-ASSOCIATE EXPERIMENTS: MA MATCHED

Experiment	CA[a]	MA	IQ	Materials	Presentation rate (seconds)	Institutionalized	Result
Cantor & Ryan, 1962	9	6.6	72	6 picture pairs	6:5	No	N = R
Girardeau & Ellis, 1964	13	8.4	66	10 word pairs	3:3	No	N = R
Heckman, 1966	17	10.6	--	5 Japanese character-picture pairs	2:2 2:4 2:8 2:10	Yes	N = R
Iscoe & Semler, 1964	12	6.8	--	6 picture pairs	5 second	Yes	N > R
Jensen, 1965	24	9.3	58	8 picture pairs	Subject-paced	Yes	N > R
Rieber, 1964	12	8.3	70	3 picture color word pairs	2:2	No	N > R
Ring & Palermo, 1961	14	12.6	76	8 picture pairs	3:3	No	N = R

Note. - Reprinted from an article by Norman R. Ellis published in Vol. 3, 1968 International Review of Research in Mental Retardation. Copyrighted by the Academic Press, 1968.

[a]Rounded to nearest year.

TABLE 2

ITEMS ON STANFORD-BINET SCALE, FORM L, WHICH DIFFERENTIATE DEFECTIVES FROM NORMALS WITH A P OF .01 OR LESS

Location	Name	Ages
III, 1	Stringing beads	3
III, 5	Drawing a circle	3
V, 2	Folding a triangle	4-5
V, 4	Drawing a square	4-6
VI, 1	Vocabulary	5-6
VI, 2	Bead chain	4-7
VII, 1	Picture absurdities I	5-7
VIII, 2	Wet Fall	6-7
VIII, 5	Comprehension IV	6-9
X, 2	Picture absurdities II	7-10
XI, 1	Memory for designs	8-10
XIII, 4	Problems of fact	8-10

Items on Which Normals Surpass Defectives

Location	Name	Ages
II ½, A	Identification by name	3
III, 6	3 digits forward	3-4
III ½, 5	Identification by use	3-4
IV, A	Sentence Memory I	4-5
IV ½, 2	4 digits forward	4-6
VI, 5	Picture comparison	5-8
VII, 3	Drawing a diamond	6-9
VII, 5	Opposite analogies I	6-10
VII, 6	5 digits forward	6-10
VIII, 2	Wet Fall	8-10
VIII, 4	Similarities and differences	7-10
VIII, 6	Sentence Memory III	6-10
IX, 4	Rhymes	8-10
IX, 6	4 digits reversed	7-10
X, 4	Reasons I	8-10
X, 6	6 digits forward	8-10
XII, 2	Verbal absurdities II	9-10
XII, 6	Minkus completion	9-10
XIV, 5	Directions I	9-10

Note. - Seymour B. Sarason, Psychological Problems in Mental Deficiency, 1959.

Drawings of a man by children have been quantitatively scored according to the procedures enumerated by Goodenough (1926) and revised and extended by Harris (1963). McCarthy (1944) found the reliability of the scoring procedure to be .90 for Nc children. Tobias and Gorelick (1960) reported a .93 correlation for a two-year test-retest evaluation of adolescent retardates. Murphy (1956) found that the Draw-A-Man Test (DMT) intelligence quotients of retardates correlate .78 with the Revised Stanford-Binet I. Q. Birch (1949) reported correlation between the Revised Stanford-Binet and DMT mental ages was .69.

Harris (1962) summarizes the research studies comparing the DMT performances of Nc and MR children of the same mental age:

> Israelite (1936) compared the relative difficulty of the items on the Goodenough scale for normal and mentally defective children of the same mental age. In general, the defectives surpassed the normals in respect to the number of details shown, while the normal children excelled on items involving the correct organization and proportion of the parts. Earl (1933), who compared the drawings of adult defectives with those of normal children, found much the same thing to be true. Spoerl (1940) likewise, found that retarded children showed more details in their drawings than did normals who earned comparable scores, but their sense of proportion was very poor. McElwee (1934), who compared the profile drawings of normal and subnormal children, found that although the latter depicted more detail than the former, the number of incongruities resulting from confusion between the full-face and the profile position was much greater in the drawings made by the subnormal than those made by the normal children [p. 21].

Statement of the Problem

The problem of this study is to compare the differential test responses of normal (Nc) and mentally retarded (MR) children with the same mental age, who are reading at first grade level on the Wide Range Achievement Tests (WRAT, 1965), and who have perceptual quotients (Frostig, 1961) above 90, on the individual test items of the Stanford-Binet Intelligence Scale, Form L-M (1960), the Frostig Developmental Test of Visual Perception (1961), the Draw-A-Man Test (Goodenough- Harris, 1963) and the Paired-Associate Learning Task (Hiner, 1963). In order to determine the differences in the performances of the two groups the following general hypotheses will be tested:

1. There is no statistically significant difference in the number of passes on each Stanford-Binet item attempted after basal age is established between the mentally retarded group and the normal group of median M. A. six years, six months, who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90.

2. There is no statistically significant difference in the number of passes on each individual item on the Frostig Developmental Test of Visual Perception attempted by the mentally retarded group and the normal group of median M. A. six years, six months, who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90.

3. There is no statistically significant difference in the number of trials required to meet the criterion of

learning in a Paired-Associate Learning Task by the mentally retarded group and normal group of median M. A. six years, six months, who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90.

4. There is no statistically significant difference in the number of errors made in reaching the criterion of learning on the Paired-Associate Learning Task by the mentally retarded group and the normal group of median M. A. six years, six months, who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90.

5. There will be no statistically significant difference in the performance of the Draw-A-Man Test (Goodenough-Harris, 1963) by the mentally retarded group and the normal group of median M. A. six years, six months, who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90.

CHAPTER II

METHOD

Selection of Subjects

The normal group of 20 beginning first grade children were identified during the 1968 Fall semester from those enrolled in the Pauls Valley, Oklahoma, elementary schools. Only those first grade children were used whose mental age as derived from the Stanford-Binet Intelligence Scale were from six years to six years, eleven months; whose Stanford-Binet I. Q. scores were from 90-110, which is within the normal or average I. Q. range as described by Terman and Merrill (1960, p. 18); whose reading grade level score on the Wide Range Achievement Test (WRAT), reading sub-test, was from first grade, first month, to first grade, ninth month; and whose perceptual quotient (P. Q.) as obtained on the Frostig Developmental Test of Visual Perception was above 90.

The group of 20 retarded children were selected during the 1968 Fall semester from those enrolled at Hilltop School, Pauls Valley State School, Oklahoma. Only those retarded children were used whose mental ages as derived from the Stanford-Binet Intelligence Scale were from six

years to six years, eleven months; whose Stanford-Binet I. Q. scores were from 30 to 69, which is within the mentally defective I. Q. range as described by Terman and Merrill (1960, p. 18); whose reading grade level score on the WRAT, reading sub-test, was from first grade, first month, to first grade, ninth month; and whose perceptual quotient as obtained on the Frostig Developmental Test of Visual Perception was above 90.

The identified 20 members in each of the groups were administered the Paired-Associate Learning Task (Hiner, 1963) and the Draw-A-Man Test (DMT). The instruments were administered by trained personnel.

Test Instruments

Instrument I

The Stanford-Binet Intelligence Scale was used to determine the two groups used in the study. It was administered individually. Robinson (1965) believes that:

> With all its limitations, the Stanford-Binet is probably the best single test of mental ability yet devised for children. Compared with most of the other major intelligence tests currently available, it is especially useful with individuals of low mentality. Most psychologists tend particularly to prefer the Stanford-Binet with younger children (Weise, 1960), and with persons of lower mental age because it extends to very low levels of ability and because they have found the test to be appealing and satisfying to the individuals tested. The test covers a very wide range and is suitable for most children from the preschool years through adolescence [p. 416].

Instrument II

The Frostig Developmental Test of Visual Perception (1963) was also administered individually to each subject.

The subjects' perceptual quotient (P. Q.) and perceptual age (P. A.) equivalent were obtained from the child's test results in a manner similar to that used in determining mental ages and intelligence quotients. Since Frostig found the perceptual quotient to be a better indicator of overall visual perceptual ability than the perceptual age, the P. Q. score was used in determining the membership of the groups. The perceptual quotient is a deviation score determined from the sum of the sub-test scale scores after correction of age variation. For each age group, the median P. Q. is 100. A P. Q. score of 90 was chosen as the lower limits for the groups. Frostig (1964) believes that a P. Q. score of 90 or above is necessary for predicting success in beginning reading instruction.

The following is a summation of the five sub-test areas, (as published by Frostig, 1964):

> 1. Eye-hand Coordination: The child is to draw straight lines between increasingly narrow boundaries, curved and oblique lines, and straight lines from one point to another without guidance.
>
> 2. Figure-ground Perception: The child is to outline intersecting figures and to find and outline hidden, embedded figures.
>
> 3. Perception of Form Constancy: The child is asked to discriminate between similar shapes of different sizes, patterning, and position.
>
> 4. Perception of Position in Space: This is tested by requiring the child to detect a reversed or rotated figure in a sequence.
>
> 5. Perception of Spatial Relations: The task of this test is to copy patterns by linking dots [p. 14].

Frostig (1966) states:

> Several studies using the test are being conducted with small groups of mentally retarded children. . . Current evidence seems to indicate that scale scores and perceptual quotients computed on the basis of the mental age may be more helpful . . . [p. 7].

Instrument III

The Wide Range Achievement Test (WRAT) (Jastak and Jastak, 1965) was used to determine reading ability of the subjects. Jastak describes this sub-test in the Manual of Instructions as "1. Reading; recognizing and naming letters and pronouncing words. . . [p. 1]." He also states that the WRAT has been found of value in "the establishment of degrees of literacy of mentally retarded persons [p. 2]."

Instrument IV

The Draw-A-Man Test (Goodenough- Harris, 1963) is familiar and intrinsically pleasing to most children according to Robinson (1965, p. 423). The child's drawing is scored by adding points of credit for including various features of the body and clothing and for accuracy of perspective and proportion. The total point score is then converted to a deviation I. Q. with a mean of 100 and a standard deviation of 15 using the Harris tables (Harris, 1963, pp. 294-295).

Instrument V

The Paired-Associate Learning Task (PAT) utilized the 16 picture pairs developed by Hiner (1963). Hiner's criteria for selection of the pictures were:

(1) the pictures must be simple outline drawings of common objects;

(2) the words represented by the pictures must be one-syllable nouns;

(3) the pictures must be immediately recognizable;

(4) the pictures must be readily and consistently identifiable; that is, if a picture of a horse was sometimes called "pony" and sometimes "horse," the picture was eliminated; and

(5) pictures must not be obviously potentially affect arousing, for example, a picture of a gun or of a snake [pp. 11-12].

The test materials consist of two five-inch by eight-inch cardboard booklets. Each booklet contains 20 cards bound together by a flexible plastic spiral band. Booklet One contains 17 cards on each of which there is one pair of black line drawings and three blank cards serving as front, back, and blank page between sample card and stimuli cards. The first pair served as the sample card. The other 16 pairs are the stimuli cards. Booklet Two contains 20 cards on each of which appeared the first picture of the stimulus pair. The first picture card served as a sample card for instructional purposes and the other 16 pictures serve as test cards. Three blank cards were included in this booklet, also.

The examiner used individual record sheets for each subject. The numbers from one to 16 were printed down the left-hand margin which represented the 16 pairs of objects. The numbers from one to 23 were listed across the top of the

sheets which represented the number of trials. The intersection of the row and column lines formed squares in which the subjects responses were marked for each card and each trial.

The subjects were given these instructions as were Hiner's (1963) subjects:

> Here are a number of cards. Each card has two pictures on it. Look at both pictures on each card carefully. Then, I will show you a set of cards like this. (The Examiner shows the subject a sample card with only the first picture of the pair on it.) You are to tell me what was the other picture on each of these cards [p. 10]. The Examiner recorded each oral response made by the Subject. A second trial was then given following the same procedure . . . Between trials, the Examiner said; 'Now we shall look at the pictures again. Try to remember what two pictures were together.' If the Subject questioned the Examiner about the test, he added: 'Keep looking at the pairs of pictures until you remember all of them' [p. 17].

A series of paired pictures was presented at the rate of one every three seconds. Then the first picture of each pair was presented singly at the rate of one every five seconds. The inter-trial intervals were five seconds in length. This procedure was continued until each subject correctly associated the first and second pictures of each of the 16 pairs or until he failed to meet the criterion of learning which was set at 23 trials.

Data

Subjects for each of the two groups were identified by administering the Stanford-Binet Intelligence Scale, Form L-M, the Frostig Developmental Test of Visual Perception,

and the WRAT, reading sub-test. On the Stanford-Binet the M. A. was recorded and the I. Q. determined for each subject. On the Frostig Test, P. A., P. Q., and total raw scores on each sub-test were recorded for each subject. Raw score for the WRAT, reading sub-test, was recorded and converted to reading grade level scores for each subject.

To facilitate analysis of differences in test performances between the two groups, the number of passes by item on the Stanford-Binet and the number of points obtained on each item of the Frostig Test were recorded for each group, respectively. On the Paired-Associate Learning Task the number of trials with the number of errors required to meet the criterion of learning were recorded for each group, respectively. On the Draw-A-Man Test (DMT) items were credited and totaled for each subject.

CHAPTER III

RESULTS

This study was conducted to determine whether or not the MR and Nc groups perform with significant differences on four tests: (1) Stanford-Binet Intelligence Scale, Form L-M, (2) Frostig Developmental Test of Visual Perception, (3) Paired-Associate Learning Task (Hiner, 1963), and (4) Draw-A-Man Test (Goodenough-Harris, 1963). Twenty first-grade children and 20 MR children were identified from the test results and participated in this study. The institutionalized MR children had a median I. Q. of 54 with a range in I. Q. points from 37-64. The median M. A. was six years, six months. The M. A. range was from six years to six years, ten months. The median C. A. was 13.45 years. The C. A. range was from nine years, seven months, to 18 years, four months. The median reading grade level score (WRAT) was first grade, fifth month. The WRAT reading grade level scores ranged from first grade, first month, to first grade, eighth month. The median Frostig P. Q. was 102.5. The range was from 90-125. The Nc children had a median I. Q. of 101 with a range in I. Q. points from 92-110. The median M. A. was six years, six months. The M. A. range was from six years to six years, ten months. The median C. A. was six years, five months. The C. A. range

was from six years, one month, to six years, 11 months. The median reading grade level score (WRAT) was first grade, third month. The range in WRAT reading grade level scores was from first grade to first grade, ninth month. The median Frostig Perceptual Quotient was 106 with a range in P. Q. points from 92-124. Table 3 presents the medians and ranges by groups.

The statistical techniques chosen for the treatment of data in this study were as follows:

1. An item analysis was performed to test hypotheses 1 and 2 using the Chi-square test.
2. The Mann-Whitney U Test, $p < .05$, was performed to test hypotheses 3, 4, and 5.

An intercorrelational matrix table containing Kendall's Rank Correlation Coefficient Taus was constructed to show the relationships among the various variables.

Analysis of Data

The Chi-square test was used to test hypothesis 1 which states: There is no difference in number of passes on each Stanford-Binet item attempted after basal level was established between the MR group and the Nc group of median M. A. six years, six months, who are reading at first grade level (WRAT), and who possess Frostig P. Q. scores above 90. Stanford-Binet item analyses were performed only at Year VII since this was the only year level at which all children were performing. All children had reached basal level before Year VII and did not reach ceiling level until

TABLE 3

MEDIAN AND RANGE FOR MR AND Nc GROUP

	Source	MR		Nc	
		Median	Range	Median	Range
1.	Chronological Age	13.45	9.7-18.4	6.5	6.1-6.11
2.	WRAT, Reading Sub-Test Grade Level	1.5	1.1-1.8	1.3	1.0-1.9
3.	Stanford-Binet I.Q.	54	37-64	101	92-110
4.	Stanford-Binet M.A.	6.6	6.0-6.10	6.6	6.0-6.10
5.	Frostig Perceptual Age	6.6	5.4-8.9	6.6	6.1-8.5
6.	Frostig Test I, Eye Motor	16	11-23	16	9-25
7.	Frostig Test II, Figure Ground	16	7-20	17	7-20
8.	Frostig Test III, Form Constancy	6	1-16	7	3-11
9.	Frostig Test IV, Position in Space	6	4-8	6	2-8
10.	Frostig Test V, Spatial Relations	5	1-8	6	4-7
11.	Draw-A-Man Test (Harris) Raw Score	18	9-34	16.5	10-30
12.	Paired-Associate Learning Task, Trials	8	4-17	11	6-21
13.	Paired-Associate Learning Task, Errors	42	10-110	68.5	15-157
14.	Frostig Perceptual Quotient	102.5	90-125	106	92-124
15.	Length of Institutionalization	3.1	.2-12.7	0	0

after Year VII. Using the Chi-square test for significance, it was found that only one item at Year VII discriminated between the two groups. The Nc group performed Stanford-Binet item VII-3, copying a diamond, significantly better than did the MR group. The Chi-square value was 5.23 which was significant at the .05 level. Therefore, hypothesis 1 is rejected. (See Tables 4, 5, and 6.)

The Chi-square test was used to test null hypothesis 2 which states: There is no statistically significant difference in the number of passes on each individual item on the Frostig Developmental Test of Visual Perception attempted by MR group and Nc group of median M. A. six years, six months, who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90. Table 7 reveals that a significant difference in the performance of MR and Nc children was found on three Frostig sub-test items. The MR group performed significantly better ($p < .05$) on Frostig test IIIa, items 10 and 11, than did the Nc group. The Nc group performed significantly ($p < .01$) better on Frostig test Vc, item 6, than did the MR group. Therefore, hypothesis 2 is rejected.

The Mann-Whitney U test was used to test null hypothesis 3 which states: There is no statistically significant difference in number of trials required to meet the criterion of learning on the Paired-Associate Learning Task by MR group and Nc group of median M. A. six years, six months, who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90. Examination of Table 8 reveals

TABLE 4

NUMBER OF PASSES ON YEAR VII ON STANFORD-BINET INTELLIGENCE SCALE, FORM L. M. (1960) BY GROUPS

Stanford-Binet Item	Location	Passes MR	Passes Nc	χ^2	P
Picture Absurdities	VII,1	9	5	1.76	*
Similarities: Two Things	VII,2	5	3	.62	*
Copying a Diamond	VII,3	9	16	5.23	.05
Comprehension IV	VII,4	10	9	.10	*
Opposite Analogies III	VII,5	8	8	.00	*
Repeating 5 Digits	VII,6	2	7	3.58	*

*Indicates not significant

TABLE 5

STANFORD-BINET BASAL AND CEILING LEVELS FOR MR AND Nc GROUPS

Subject	MR (n=20) Basal	MR (n=20) Ceiling	Subject	Nc (n=20) Basal	Nc (n=20) Ceiling
S_1	V	IX	S_1	VI	VIII
S_2	V	X	S_2	VI	IX
S_3	V	X	S_3	VI	IX
S_4	V	X	S_4	VI	IX
S_5	V	IX	S_5	VI	VIII
S_6	V	IX	S_6	IV-6	X
S_7	IV-6	IX	S_7	VI	X
S_8	IV-6	IX	S_8	VI	IX
S_9	VI	IX	S_9	IV-6	X
S_{10}	V	VIII	S_{10}	V	IX
S_{11}	V	X	S_{11}	VI	VIII
S_{12}	V	IX	S_{12}	VI	X
S_{13}	V	VIII	S_{13}	V	VIII
S_{14}	IV-6	IX	S_{14}	V	VIII
S_{15}	V	IX	S_{15}	VI	VIII
S_{16}	V	VIII	S_{16}	V	VIII
S_{17}	V	X	S_{17}	IV-6	IX
S_{18}	VI	IX	S_{18}	VI	X
S_{19}	VI	XI	S_{19}	IV-6	VIII
S_{20}	VI	X	S_{20}	VI	IX
Median	V	IX		VI	IX
Range	IV-6-VI	VIII-XI		IV-6-VI	VIII-X

TABLE 6

STANFORD-BINET BASAL AND CEILING LEVELS BY NUMBER OF INDIVIDUALS IN MR AND Nc GROUPS

Basal Age	MR (n=20)	Nc (n=20)
IV-6	3	4
V	13	4
VI	4	12
Ceiling Age		
VIII	3	8
IX	10	7
X	6	5
XI	1	

TABLE 7

NUMBER OF PASSES ON ITEMS ON FROSTIG DEVELOPMENTAL TEST OF VISUAL PERCEPTION BY GROUPS

Test	Location	Passes		Chi-Square	p
		MR	Nc		
IIIa	10	6	1	4.32	.05
IIIa	11	11	4	5.22	.05
Vc	6	8	16	6.66	.01

TABLE 8

MANN-WHITNEY U TEST FOR DIFFERENCES IN NUMBER OF TRIALS REQUIRED TO MEET CRITERION OF LEARNING ON PAIRED-ASSOCIATIVE LEARNING TASK FOR MR CHILDREN AND Nc CHILDREN

MR Subjects	Trials	Nc Subjects	Trials
S_1	17	S_1	21
S_2	16	S_2	19
S_3	16	S_3	19
S_4	13	S_4	19
S_5	12	S_5	17
S_6	11	S_6	15
S_7	9	S_7	13
S_8	8	S_8	12
S_9	8	S_9	11
S_{10}	7	S_{10}	11
S_{11}	7	S_{11}	11
S_{12}	7	S_{12}	10
S_{13}	6	S_{13}	9
S_{14}	5	S_{14}	8
S_{15}	4	S_{15}	8
S_{16}	DNF	S_{16}	7
S_{17}	DNF	S_{17}	7
S_{18}	DNF	S_{18}	7
S_{19}	DNF	S_{19}	6
S_{20}	DNF	S_{20}	6

DNF = Did not finish task to criterion of learning.
U value = 113
z = 1.23, not significant

a U value of 113 and a z value of 1.23, which is not significant. Therefore, the null hypothesis 3 was accepted.

The Mann-Whitney U test was used to test null hypothesis 4 which states: There is no statistically significant difference in the number of errors made in reaching the criterion of learning on the Paired-Associate Learning Task by MR children and Nc children of equal M. A. who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90. Examination of Table 9 reveals a U value of 82.5 and a z score of 2.25, which is significant at the .05 level of confidence. The MR group did make significantly fewer errors in achieving the criterion of learning on the PAT than did the Nc group. Therefore, null hypothesis 4 was rejected.

The Mann-Whitney U test was used to test null hypothesis 5 which states: There will be no statistically significant difference in the performance of the Draw-A-Man Test (Goodenough-Harris, 1963) by MR children and Nc children of equal median M. A. who are reading at first grade level (WRAT) and who possess Frostig P. Q. scores above 90. Examination of Table 10 reveals a U value of 189 and a z value of .59, which is not significant. No statistically significant difference was noted in the performance of the DMT (Goodenough-Harris, 1963) by the two groups. Therefore, null hypothesis 5 is accepted.

Table 11 presents Kendall Tau values for MR groups and Nc groups. Significant Tau values (.05 level) obtained

TABLE 9

MANN-WHITNEY U TEST FOR DIFFERENCES IN NUMBER OF ERRORS REQUIRED TO MEET CRITERION OF LEARNING ON PAIRED-ASSOCIATIVE LEARNING TASK FOR MR CHILDREN AND Nc CHILDREN

MR Subjects	Errors	Nc Subjects	Errors
S_1	110	S_1	157
S_2	80	S_2	130
S_3	74	S_3	124
S_4	72	S_4	116
S_5	64	S_5	96
S_6	54	S_6	92
S_7	45	S_7	79
S_8	42	S_8	72
S_9	37	S_9	71
S_{10}	36	S_{10}	70
S_{11}	34	S_{11}	67
S_{12}	34	S_{12}	63
S_{13}	33	S_{13}	63
S_{14}	30	S_{14}	59
S_{15}	10	S_{15}	53
S_{16}	DNF	S_{16}	50
S_{17}	DNF	S_{17}	47
S_{18}	DNF	S_{18}	41
S_{19}	DNF	S_{19}	38
S_{20}	DNF	S_{20}	15

DNF = Did not finish task to criterion of learning.
U value = 82.5
z = 2.25, significant, $p < .05$

TABLE 10

MANN-WHITNEY U TEST FOR DIFFERENCES IN DRAW-A-MAN TEST (HARRIS) RAW SCORES MADE BY MR CHILDREN AND Nc CHILDREN OF THE SAME MA

MR Subjects	Errors	Nc Subjects	Errors
S_1	34	S_1	30
S_2	29	S_2	30
S_3	26	S_3	25
S_4	25	S_4	24
S_5	25	S_5	23
S_6	24	S_6	21
S_7	23	S_7	20
S_8	21	S_8	19
S_9	19	S_9	19
S_{10}	18	S_{10}	17
S_{11}	18	S_{11}	16
S_{12}	18	S_{12}	16
S_{13}	17	S_{13}	16
S_{14}	16	S_{14}	16
S_{15}	15	S_{15}	15
S_{16}	15	S_{16}	13
S_{17}	12	S_{17}	13
S_{18}	11	S_{18}	13
S_{19}	10	S_{19}	11
S_{20}	9	S_{20}	10

U value = 189
z = .59, not significant

TABLE 11

KENDALL'S TAU VALUES FOR MR GROUP AND Nc GROUP

MR					Nc				
Frostig					Frostig				
1	2	3	4	5	1	2	3	4	5
0.40					0.35				
0.37	0.60*				-0.06	0.01			
0.24	0.27	0.35			0.03	0.02	0.28		
0.58*	0.47*	0.59*	0.50*		0.19	-0.19	0.47*	0.33	

*Indicates $r > .4438$, $p < .05$

by the MR group on the Frostig sub-tests were between test V and tests I, II, III, and IV; and between tests II and III. The Nc group obtained a Tau value of .47, which is significant at the .05 level, between Frostig tests III and IV.

Discussion of Data

The author predicted that there would be no significant differences in the Stanford-Binet test performances by MR groups and Nc groups of the same median mental age who were reading at first grade level (WRAT) and who possessed P. Q. scores above 90. The Chi-square test was used to test the overall differences in the Stanford-Binet performances by the two groups of children. This test revealed an .05 level of significance for Stanford-Binet item, VII-3, copying a diamond, in favor of the Nc group. This indicated that Nc children were more adept at the complex task of copying a diamond than were the MR children. Stanford-Binet item analysis was performed only at Year VII since Year VII was the only year level at which all children were performing. All children had reached basal level before Year VII and did not reach the ceiling level until after Year VII.

It was also hypothesized that no statistically significant differences between the performances of the MR group and the Nc group on the individual items of the Frostig test would be found. The Chi-square test was used to test differences in the number of subjects passing individual Frostig items. This test revealed that three Frostig items did serve to differentiate between the two groups. Frostig test

IIIa, items 10 and 11, received Chi-square values that were significant at the .05 level. MR children received more passes on these two items than did Nc children. Frostig test III is a test of form constancy. Item 10 is a square standing on its corner embedded within a trapezoid. The rotated square, which looks like a diamond, is white but the ground surrounding the square is distorted with straight lines. The MR children were apparently more adept at visually rotating the "diamond" shape until it became a square than were the Nc children. Item 11 contains a circle embedded within an oval shape with curving lines drawn from the circumference of the circle to the outside of the oval. The increased cognitive and affective experience gained through the additional years of chronological age may have provided the MR child with increased ability to look within these two distorted shapes and to correctly outline the inner circle and square. Frostig test Vc is a test of spatial relationships. Item 6 requires the subject to draw two straight lines and two diagonal lines between five dots in order to reproduce a dot and line figure. The Nc group were better at reproducing this drawing than were the MR group. It would appear that the additional years of cognitive and affective experiences have given the MR child increased ability in rotating figures and discovering visual likenesses but have not aided him in locating himself in space to the extent that he is able to reproduce a line drawing.

A third hypothesis was that there would be no significant difference in the number of trials required to meet

the criterion of learning on the PAT between the MR group and the Nc group. The Mann-Whitney U value was 113. The corresponding z value was 1.23 which was not significant. No significant difference in the number of trials required to meet the criterion of learning the PAT was found between the two groups even though the median number of trials for the MR group was eight and the median number of trials for the Nc group was 11. Five MR children did not achieve the criterion of learning for the PAT. All of the Nc children achieved the criterion of learning for the PAT. However, the 15 MR children who achieved the criterion of learning did so in fewer number of trials than did the 20 Nc children, but the difference was not significant.

It was also hypothesized that there would be no significant difference in the number of errors made in reaching the criterion of learning on the PAT by MR children and Nc children. The Mann-Whitney *U* test yielded results significant at the .05 level. The MR group, consisting of 15 subjects who successfully achieved the criterion of learning for this task, made significantly fewer errors than did the 20 subjects in the Nc group.

Another hypothesis was that there would be no significant differences in the performances of the DMT (Goodenough-Harris, 1963) by the MR group and the Nc group. The Mann-Whitney U test resulted in a z value of .59 which was not significant. Therefore, the performance of the MR group on the DMT was similar to that of the Nc group.

Another hypothesis tested the relationships among the dependent variables for the two groups of children. These relationships were tested using Kendall's Rank Correlation Coefficient Tau. Because of less sophisticated overall visual-perceptual ability, the MR subjects were not able to discriminate among the specific tasks required on the Frostig. The significant correlations among the Frostig sub-tests as shown in Table 11 are indicative of the generalized skills with which the MR subjects approached the tasks. The lack of number of significant correlations among the Frostig variable for the Nc group suggests the possession of greater visual perceptual abilities which enabled the Nc subjects to discriminate or indicates greater ability in spatial organization. Significant correlations of .90 and .93 between number of trials and number of errors on the PAT were obtained for both the MR and Nc groups, respectively. Perhaps this could be expected since it was inherent in the test that with fewer trials there would be less opportunity to make errors. There were no significant correlations for DMT (Goodenough-Harris, 1963) scores for either group.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study was designed to determine differential test responses of the MR group of children and Nc group of children with median M. A. of six years, six months, whose WRAT reading grade level scores were from first grade to first grade, ninth month and Frostig P. Q. scores above 90. Four instruments were administered individually in order to analyze differences in test performances for the two groups: the Stanford-Binet Intelligence Scale, Form L-M, the Frostig Developmental Test of Visual Perception, the Paired-Associate Learning Task (Hiner, 1963), and the Draw-A-Man Test (Goodenough-Harris, 1963). Twenty subjects were selected for each group. The Nc first grade children were selected from those enrolled in the Pauls Valley, Oklahoma, elementary schools. The MR children were selected from those institutionalized pupils of Hilltop School, Pauls Valley State School, Oklahoma.

The primary statistical treatments employed to evaluate the data obtained for this study were a Chi-square test and the Mann-Whitney U test. The findings which resulted from the evaluation of the obtained data were:

1. The Nc group performed significantly better on Stanford-Binet item, VII-3, copying a diamond, than did the MR group.

2. There were statistically significant differences in the number of passes on individual items on the Frostig Developmental Test of Visual Perception by the MR group and the Nc group. The Nc group performed significantly better on Frostig test Vc, item 6. The MR group performed significantly better on Frostig test IIIa, items 10 and 11.

3. There was no statistically significant difference in the number of trials required to meet the criterion of learning on the Paired-Associate Learning Task by the MR group and the Nc group.

4. There was a statistically significant difference in the number of errors made in reaching the criterion of learning on the Paired-Associate Learning Task by the MR group and the Nc group. The 15 MR subjects who achieved the criterion of learning for the PAT did so with significantly fewer errors than did the 20 Nc subjects who achieved the criterion of learning for the PAT.

5. There was no statistically significant difference in the performance of the Draw-A-Man Test (Goodenough-Harris, 1963) by the MR group and the Nc group.

These findings appear to have implications for educators concerned with the development of instructional materials and teaching methods for MR pupils. Too many special education curriculums consist primarily of "watered-down" versions of regular class curriculums. This practice

reflects the belief of many educators that the primary difference between Nc children and MR children of the same M. A. is that the MR children learn less and at a slower rate than do the Nc children. The findings of this study indicate that the majority of the MR group learned the PAT as rapidly as did the Nc group. This suggests that there may be learning tasks which the MR child can master at the same rate as the Nc child of the same M. A.

Educators have long accepted the M. A. concept as a test score and have tended to equate pupils with the same mental ages regardless of their chronological age. The I. Q. score has been considered by psychologists and educators as an index of brightness. The corresponding M. A. score has been considered a power score which reveals an exact level of mental power an individual possesses. The findings of this study support the belief that the M. A. cannot be thought of in terms of a test score alone. The factor of chronological age must also be considered in equating groups because of increased cognitive and affective experiences which older chronologically aged children may have encountered. The M. A. can indicate varying levels of ability.

Because of the very few statistically significant differences in the test performances of MR and Nc groups, it is suggested that more research needs to be done in this area. Perhaps a more exploratory type of research which would be concerned with qualitative as well as quantitative differences is warranted. It is also suggested that this

same or a similar study be conducted at other institutions within and without the state of Oklahoma. Subsequent research should use larger groups and random sampling techniques if possible. The effects of sex and race might also be investigated.

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APPENDIX

TABLE 12

ITEM ANALYSIS OF STANFORD-BINET TEST PERFORMANCES
BY MR SUBJECTS

Subject	Binet CA	MA	IQ	Year IV,6 123456	Year V 123456	Year VI 123456	Year VII 123456	Year VIII 123456	Year IX 123456	Year X 123456	Year XI 123456
S_1	17.5	6.6	40		++++++	+++-++	+--++-	-+----	------		
S_2	13.4	6.6	54		++++++	+-++++	--+--+	-+----	--+---	------	
S_3	12.8	6.6	56			++++++	---+--	+-----	---+--	------	
S_4	13.5	6.6	54			++++++	--+---	-+----	+-----	------	
S_5	12.11	6.6	55			++++++	+-+---	-----+	------		
S_6	13.6	6.2	51		++++++	-++-++	-+--+-	-+----	------		
S_7	13.1	6.3	53	++++++	+++++-	-+++++	--+--+	-----+	------		
S_8	10.2	6.7	64	++++++	+++++-	++++++	---++-	-+---+	------		
S_9	14.9	6.8	50			++++++	++--+-	+-----	------		
S_{10}	12.1	6.0	54		++++++	+-++++	--+---	------			
S_{11}	12.0	6.10	61		++++++	-+++++	+-+++-	-----+	--+---	------	
S_{12}	12.0	6.4	57		++++++	+-++++	-+----	++----	------		
S_{13}	16.8	6.2	40		++++++	-++++-	-+-++-	------			
S_{14}	17.9	6.1	37	++++++	+++-++	-+++--	+--++-	-+----	------		
S_{15}	17.2	6.2	38		++++++	+++-++	--+---	+-----	------		
S_{16}	9.7	6.0	64		++++++	+++++-	---+--	------			
S_{17}	14.4	6.8	52		++++++	+++++-	+++-+-	------	--+---	------	
S_{18}	18.4	6.8	39			++++++	+-++--	-----+	------		
S_{19}	16.6	6.10	44			++++++	+--+--	+---+-	------	---+--	------
S_{20}	11.0	6.10	64			++++++	+--+--	-+--+-	+-----	------	

TABLE 13

ITEM ANALYSIS OF STANFORD-BINET TEST PERFORMANCES
BY Nc SUBJECTS

Subject	Binet CA	MA	IQ	Year IV,6 123456	Year V 123456	Year VI 123456	Year VII 123456	Year VIII 123456	Year IX 123456	Year X 123456	Year XI 123456
S_1	6.2	6.6	106			++++++	--++*-	------			
S_2	6.1	6.6	108			++++++	---+--	-+-+--	------		
S_3	6.8	6.6	97			++++++	--+-+-	+-----	------		
S_4	6.2	6.6	102			++++++	--++--	----+-	------		
S_5	6.7	6.6	98			++++++	-+++-+	------			
S_6	6.9	6.10	101			++++++	+-+--+	+-----	---+--	------	
S_7	6.10	6.9	98	++++++	+++++-	++++++	--+-+-	+-----	--+--+	------	
S_8	6.4	6.10	109			++++++	--++-+	++----	------		
S_9	6.4	6.5	101	++++++	+++++-	++++++	----+-	-+----	---+--	------	
S_{10}	6.6	6.4	97		++++++	+++++-	--++--	----+-	------		
S_{11}	6.8	6.8	100			++++++	+-+++-	------			
S_{12}	6.3	6.10	110			++++++	++----	+----+	---+--	------	
S_{13}	6.2	6.2	100		++++++	-+++++	+-+---	------			
S_{14}	6.5	6.0	93		++++++	++++-+	--+---	------			
S_{15}	6.3	6.10	110			++++++	+++-++	------			
S_{16}	6.5	6.6	101			++++++	--++--	----+-	------		
S_{17}	6.5	6.4	98		++++++	+++++-	--+-++	------			
S_{18}	6.11	6.5	92	++++++	+++++-	++++++	--+-+-	+-----	------		
S_{19}	6.7	6.10	104			++++++	--++-+	+-----	---+--	------	
S_{20}	6.4	6.3	98	++++++	+++++-	++++++	---+-+	------			

TABLE 14

ITEM ANALYSIS OF FROSTIG DEVELOPMENTAL TESTS OF VISUAL PERCEPTION FOR MR SUBJECTS (TESTS I AND II)

				Ia					Ib				Ic		Id		Ie			IIa				IIb			
Subject	CA	MA	IQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8
S_1	17.5	6.6	40	2	2	2	1	1	1	1	1	0	2	2	2	1	0	0	1	1	1	1	1	2	4	5	3
S_2	13.4	6.6	54	2	2	2	1	0	2	2	1	1	2	0	2	2	1	1	0	1	1	1	1	2	4	5	5
S_3	12.8	6.6	56	2	2	1	1	0	1	1	1	1	0	1	1	1	0	0	0	1	1	1	1	2	2	4	4
S_4	13.5	6.6	54	2	2	2	2	1	2	1	2	1	2	1	1	1	0	0	0	1	1	1	1	2	4	4	4
S_5	12.11	6.6	55	2	2	2	1	1	2	1	1	0	2	2	0	0	0	0	0	1	1	1	1	2	1	5	5
S_6	13.6	6.2	51	2	2	2	1	0	0	0	1	0	2	1	1	0	0	0	0	1	1	1	1	2	2	4	3
S_7	13.1	6.3	53	2	2	2	1	0	1	1	0	0	1	0	1	0	0	0	0	1	1	1	1	2	4	4	3
S_8	10.2	6.7	64	2	2	2	0	0	2	1	1	0	2	1	2	0	1	0	0	1	0	1	1	2	1	5	5
S_9	14.9	6.8	50	2	2	2	1	0	1	1	2	1	2	0	2	0	1	0	0	1	1	1	1	1	4	5	4
S_{10}	12.1	6.0	54	2	2	2	1	0	1	0	1	1	1	2	2	2	0	2	0	1	0	0	1	2	2	5	5
S_{11}	12.0	6.10	61	2	2	2	2	1	2	2	2	1	2	0	1	0	1	0	1	1	1	1	1	2	4	5	5
S_{12}	12.0	6.4	57	2	2	2	1	1	1	1	1	1	2	1	1	0	0	0	0	1	0	0	1	2	0	3	3
S_{13}	16.8	6.2	40	2	2	2	1	1	2	1	2	0	2	0	1	0	1	1	0	1	1	1	1	2	2	4	3
S_{14}	17.9	6.1	37	2	2	2	2	0	2	1	0	1	2	0	0	0	2	0	0	1	1	0	1	0	0	0	4
S_{15}	17.2	6.2	38	2	2	2	1	0	2	1	1	0	2	0	1	1	1	0	0	1	1	1	1	1	3	5	5
S_{16}	9.7	6.0	64	2	2	2	2	0	0	1	0	0	2	1	1	1	0	0	0	1	1	1	1	0	0	5	4
S_{17}	14.4	6.8	52	2	2	2	1	1	1	1	1	0	2	0	1	1	0	1	0	1	1	1	1	1	3	5	5
S_{18}	18.4	6.8	39	2	2	2	1	1	2	2	2	1	2	1	1	0	1	2	1	1	1	1	1	2	4	5	5
S_{19}	16.6	6.10	44	2	2	2	1	1	2	2	1	1	2	1	1	2	1	0	0	1	1	1	1	2	4	3	2
S_{20}	11.0	6.10	64	2	2	2	1	0	2	2	2	0	1	1	1	0	0	1	0	1	0	0	0	2	1	5	4

TABLE 15

ITEM ANALYSIS OF FROSTIG DEVELOPMENTAL TEST OF VISUAL PERCEPTION
FOR MR SUBJECTS (TESTS III, IV, V)

S's	CA	MA	IQ	IIIa														IIIb																	IVa				IVb		Va		Vb		Vc		Vd	Ve
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
S_1	17.5	6.6	40	1	1	0	1	1	0	0	0	0	1	1	1	0	1	0	1	0	0	1	0	1	0	0	0	1	1	0	1	0	0	0	1	1	1	0	0	1	1	0	0	1	1	1	1	0	0	0
S_2	13.4	6.6	54	1	1	1	1	1	0	0	0	0	1	1	0	1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
S_3	12.8	6.6	56	1	1	1	1	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
S_4	13.5	6.6	54	1	1	1	1	1	0	0	0	0	1	1	0	0	1	0	1	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1
S_5	12.11	6.6	55	1	1	1	1	1	0	0	0	0	1	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
S_6	13.6	6.2	51	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0
S_7	13.1	6.3	53	1	1	1	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	0	1	0	0
S_8	10.2	6.7	64	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0
S_9	14.9	6.8	50	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	0	1	1	1	1	0	1	0	1	0	1	1	0	1	1	0	0	0
S_{10}	12.1	6.0	54	1	1	1	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	1	1	0	0	1	0	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	0
S_{11}	12.0	6.10	61	1	1	1	1	1	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	1	0	1	0	1	1	0	1	1	0	0	1	1	1	1	1	0	1	1	0	1	1	0	1	1	1	0
S_{12}	12.0	6.4	57	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	1	1	1	0	1	0	0	0	1	1	0	1	1	0	0
S_{13}	16.8	6.2	40	1	1	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
S_{14}	17.9	6.1	37	0	0	0	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	1	1	0	0	1	1	0	0	1	1	0	0	0
S_{15}	17.2	6.2	38	1	1	1	0	0	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	1	1	0	0	1	1	0	0	1	1	0	0
S_{16}	9.7	6.0	64	1	1	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	1	1	0	0	0	0	0
S_{17}	14.4	6.8	52	1	1	1	0	1	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	1	1	1	1	0	0	1	1	0	0	1	1	0	0
S_{18}	18.4	6.8	39	1	1	1	0	1	0	0	1	1	1	1	0	1	1	0	1	0	1	1	0	1	1	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
S_{19}	16.6	6.10	44	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	1	1	0	0	1	1	0	0
S_{20}	11.0	6.10	64	1	1	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	1	1	1	1	0	0	1	1	0	0	1	1	0	0

TABLE 16

ITEM ANALYSIS OF FROSTIG DEVELOPMENTAL TESTS OF VISUAL PERCEPTION FOR Nc SUBJECTS (TESTS I AND II)

				Ia					Ib				Ic		Id		Ie			IIa				IIb			
Subject	CA	MA	IQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8
S_1	6.2	6.6	106	2	2	2	1	1	1	1	1	1	2	2	2	1	1	0	0	1	1	1	1	2	3	5	5
S_2	6.1	6.6	108	2	2	2	1	1	1	1	1	1	2	0	0	1	0	0	0	1	1	1	1	1	1	4	5
S_3	6.8	6.6	97	2	2	2	1	0	1	1	0	1	1	0	2	0	0	0	0	1	1	1	1	2	3	5	3
S_4	6.2	6.6	102	2	2	2	1	0	1	0	0	0	1	0	1	1	0	1	0	1	0	1	1	1	3	0	0
S_5	6.7	6.6	98	2	2	2	2	1	2	1	0	1	1	1	1	1	0	0	0	1	1	1	1	2	4	5	5
S_6	6.9	6.10	101	2	2	2	0	0	1	1	1	0	2	1	1	2	1	0	0	1	1	1	1	2	4	5	4
S_7	6.10	6.9	98	2	2	2	2	0	1	2	1	1	2	2	1	2	0	1	0	1	0	0	0	2	4	5	3
S_8	6.4	6.10	109	2	2	2	1	0	1	0	0	0	1	0	1	2	0	1	0	1	0	0	0	2	4	5	5
S_9	6.4	6.5	101	2	2	2	0	0	1	1	1	0	1	1	1	0	0	0	1	1	1	1	1	2	2	5	5
S_{10}	6.6	6.4	97	2	2	1	0	0	0	1	1	0	1	0	0	0	1	0	0	1	1	1	1	0	0	1	5
S_{11}	6.8	6.8	100	2	2	2	1	1	2	2	2	1	2	2	1	0	0	1	0	1	1	1	1	2	4	5	5
S_{12}	6.3	6.10	110	2	2	2	1	1	1	1	1	0	2	1	1	1	0	0	0	1	0	0	1	1	1	3	3
S_{13}	6.2	6.2	100	2	2	2	1	0	1	1	1	1	2	1	1	2	0	0	1	1	1	1	1	2	2	5	3
S_{14}	6.5	6.0	93	2	2	2	1	0	1	2	0	0	2	0	1	2	0	0	0	1	0	1	1	2	2	3	2
S_{15}	6.3	6.10	110	2	2	2	2	1	2	2	2	1	2	1	2	2	1	0	1	1	1	1	0	1	2	5	4
S_{16}	6.5	6.6	101	2	2	1	1	0	1	0	1	0	2	1	1	0	0	0	0	1	1	1	1	2	4	5	5
S_{17}	6.5	6.4	98	2	2	2	2	1	2	1	1	0	2	0	2	0	0	0	0	1	1	1	1	2	4	5	4
S_{18}	6.11	6.5	92	2	2	2	2	1	2	2	1	1	2	1	1	2	0	0	0	1	1	1	1	2	4	5	4
S_{19}	6.7	6.10	104	2	2	2	1	0	1	1	1	0	2	0	1	2	1	0	0	1	1	1	1	1	2	5	5
S_{20}	6.4	6.3	98	2	2	2	1	1	2	1	1	0	2	0	0	0	0	0	0	1	0	0	1	1	1	1	4

TABLE 17

ITEM ANALYSIS OF FROSTIG DEVELOPMENTAL TESTS OF VISUAL PERCEPTION
FOR Nc SUBJECTS (TESTS III, IV, V)

				IIIa														IIIb																	IVa		IVb		Va	Vb	Vc	Vd	Ve
S's	CA	MA	IQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
S_1	6.2	6.6	106	0	1	0	1	1	1	0	1	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0
S_2	6.1	6.6	108	1	1	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	1	1	0	0
S_3	6.8	6.6	97	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	1	1	0	1	1	1	1	1	0	1	1	0	1	1	1	1	0	1	0
S_4	6.2	6.6	102	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0
S_5	6.7	6.6	98	1	1	0	1	1	0	1	1	0	1	0	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1	0	0	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1	1	0	0
S_6	6.9	6.10	101	1	1	1	1	1	1	1	1	0	0	1	0	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	0	1	1	0
S_7	6.10	6.9	98	1	1	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	0	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
S_8	6.4	6.10	109	1	1	1	0	1	1	0	1	0	0	1	0	0	1	0	1	0	0	1	0	1	1	1	0	0	0	0	1	0	0	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0	1	0	0
S_9	6.4	6.5	101	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	1	1	1	0	1	1	0	0	1	1	0	0	0	1	1	0	1	1
S_{10}	6.6	6.4	97	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0
S_{11}	6.8	6.8	100	1	1	0	0	1	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
S_{12}	6.3	6.10	110	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	0	0
S_{13}	6.2	6.2	100	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1	0	0
S_{14}	6.5	6.0	93	1	1	1	1	1	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	1	0	0	0	1	0	1	1	1	1	0	0	1	0	1	1	1	1	1	1	1	0	0
S_{15}	6.3	6.10	110	1	1	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	0	1	0
S_{16}	6.5	6.6	101	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	1	1	1	0	1	1	0	1	1	1	0	1	1	0	1	1	0
S_{17}	6.5	6.4	98	0	1	0	0	0	1	0	1	1	0	0	0	0	1	0	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	0	0
S_{18}	6.11	6.5	92	1	1	1	1	1	0	0	0	0	1	0	0	1	1	0	1	0	0	0	1	0	1	0	1	0	1	0	0	0	0	1	0	0	1	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
S_{19}	6.7	6.10	104	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
S_{20}	6.4	6.3	98	1	1	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	1	1	0	0	1	1	1	1	0

TABLE 18

DESCRIPTIVE INFORMATION FOR MR SUBJECTS

Subjects	Binet CA	Binet MA	Binet IQ	Frostig PA	Frostig I	Frostig II	Frostig III	Frostig IV	Frostig V	Frostig PQ	WRAT Read.	DMT Raw Score	PAT T	PAT E	Res.
S_1	17.5	6.6	40	6.9	19	18	9	4	4	106	1.4	25	4	10	6.0
S_2	13.4	6.6	54	8.9	21	20	15	8	7	125	1.7	34	7	23	6.1
S_3	12.8	6.6	56	7.1	13	16	11	8	5	106	1.8	18	8	34	2.7
S_4	13.5	6.6	54	7.8	20	18	16	4	8	119+	1.8	29	9	54	3.3
S_5	12.11	6.6	55	8.0	16	17	14	8	7	119+	1.5	21	7	42	4.8
S_6	13.6	6.2	51	5.4	12	15	6	4	1	91	1.2	16	16	64	6.6
S_7	13.1	6.3	53	5.7	11	17	4	5	4	90	1.3	15	8	34	2.7
S_8	10.2	6.7	64	6.2	16	16	4	6	4	94	1.3	15	5	30	1.8
S_9	14.9	6.8	50	6.5	17	17	6	5	5	98	1.3	18	13	80	.8
S_{10}	12.1	6.0	54	7.4	19	16	8	7	7	116+	1.5	25	DNF*	DNF*	3.10
S_{11}	12.0	6.10	61	8.5	21	20	15	7	7	124+	1.5	19	7	37	4.8
S_{12}	12.0	6.4	57	5.8	16	10	5	4	5	92	1.6	12	DNF*	DNF*	1.4
S_{13}	16.8	6.2	40	6.0	18	15	6	4	1	98	1.1	9	16	110	.2
S_{14}	17.9	6.1	37	5.4	16	7	1	6	4	91	1.1	11	12	74	5.1
S_{15}	17.2	6.2	38	6.3	16	18	3	5	6	105	1.2	24	DNF*	DNF*	3.10
S_{16}	9.7	6.0	64	5.8	14	13	4	6	2	92	1.3	10	17	72	.7
S_{17}	14.4	6.8	52	7.4	16	18	13	6	6	116	1.5	18	11	45	1.9
S_{18}	18.4	6.8	39	8.2	23	20	6	8	7	119+	1.5	26	DNF*	DNF*	12.7
S_{19}	16.6	6.10	44	6.7	21	15	4	6	5	100	1.5	23	6	36	3.4
S_{20}	11.0	6.10	64	6.4	17	13	7	6	5	92	1.5	17	DNF*	DNF*	1.4

*DNF = did not finish

TABLE 19

DESCRIPTIVE INFORMATION FOR Nc SUBJECTS

Subjects	Binet			Frostig							WRAT	DMT	PAT	PAT
	CA	MA	IQ	PA	I	II	III	IV	V	PQ	Read.	Raw Score	T	E
S_1	6.2	6.6	106	6.7	20	19	4	5	5	107	1.2	20	11	70
S_2	6.1	6.6	108	6.2	15	15	6	6	6	107	1.2	15	12	92
S_3	6.8	6.6	97	6.6	13	17	6	7	6	96	1.2	21	11	72
S_4	6.2	6.6	102	6.1	12	7	7	6	6	100	1.3	25	19	157
S_5	6.7	6.6	98	7.8	17	20	11	7	7	119+	1.3	24	19	130
S_6	6.9	6.10	101	6.6	16	19	5	6	4	96	1.2	17	21	116
S_7	6.10	6.9	98	7.9	21	15	9	8	6	121	1.3	19	6	15
S_8	6.4	6.10	109	6.4	13	17	7	7	4	100	1.2	19	19	124
S_9	6.4	6.5	101	6.2	13	18	7	5	4	98	1.3	16	9	63
S_{10}	6.6	6.4	97	6.1	9	10	9	6	6	92	1.2	16	10	63
S_{11}	6.8	6.8	100	8.5	21	20	9	8	7	124+	1.3	30	6	38
S_{12}	6.3	6.10	110	6.6	16	10	8	7	6	104	1.4	13	8	53
S_{13}	6.2	6.2	100	6.3	18	16	3	6	5	100	1.2	16	13	71
S_{14}	6.5	6.0	93	6.8	15	12	11	5	7	104	1.0	16	7	50
S_{15}	6.3	6.10	110	7.0	25	15	5	6	6	108	1.4	13	7	47
S_{16}	6.5	6.6	101	6.9	12	20	8	6	6	106	1.9	10	17	96
S_{17}	6.5	6.4	98	7.0	17	19	3	7	6	106	1.2	13	15	79
S_{18}	6.11	6.5	92	8.1	21	19	11	6	7	124	1.9	23	8	59
S_{19}	6.7	6.10	104	7.5	16	17	8	8	7	114	1.4	30	7	41
S_{20}	6.4	6.3	98	6.2	14	9	4	6	7	98	1.4	11	11	67