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A Comparison of Motor Abilities of Normal and Mentally Retarded Children

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A COMPARISON OF MOTOR ABILITIES OF NORMAL AND MENTALLY RETARDED CHILDREN

BY

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A COMPARISON OF MOTOR ABILITIES OF NORMAL

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This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Adviser

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CHAPTER I

INTRODUCTION

Background for Study

The problem of education for the mentally retarded is fast becoming a major problem in the field of education. According to the United States Department of Health, Education, and Welfare, 126,000, or 3 out of every 100 children born in the United States each year, are mentally retarded (1).

Proper education for the mentally retarded child presents a problem. Presently, the retarded child is completely segregated from the normal child in the academic subjects; however, the mentally retarded child is integrated with the normal student in physical education classes. The theory behind this practice is that retarded students would be able to derive social benefit from association with normal students during physical education classes.

Many people in education assume that because the retarded child and the normal child have similarities in physical appearance, the retarded child has the same motor abilities as the normal child. Because of this assumption, educators believe that integrated physical education classes are not detrimental to the educational program (2).

Statement of the Problem

The purpose of this study is to ascertain what differences, if any, exist between the selected motor abilities of the normal child and the mentally retarded child.

The motor abilities considered were: (1) motor educability as measured by a modified Iowa Brace Test, (2) performance time as measured by a multiple choice response timer, and (3) accuracy throwing as measured by the throwing of darts at a target of concentric circles.

Limitations

The two major limitations of this study were:

1. The tests were limited to 74 normal and 73 mentally retarded students in public school systems of South Dakota.

2. The normal and mentally retarded students were compared only according to sex and chronological age.

Assumptions

In considering the results of this study, the following assumptions must be made:

1. The measuring devices used in this study gave valid indications of performance time, accuracy throwing, and motor educability.

2. The students found in the regular classrooms of the public school in Volga, South Dakota were representative of normal school children.

Definition of Terms

1. Retarded students--students who have been tested by an agent of the state of South Dakota and declared mentally retarded (having an intelligence quotient below 70).

2. Motor ability--a general term combining the concepts of motor educability and achievement in motor skills (3).

3. Performance time--the lapse of time between the application of a stimulus and the completion of a movement.

4. Accuracy--consistency of dart throwing relative to a designated central spot on a target of concentric circles.

5. Motor educability--ability to learn skills easily and well (4).

6. Chronological age--student's age at his last birthday.

CHAPTER II

REVIEW OF LITERATURE

While much research has been done in the area of motor abilities, the greater portion of this research deals with the abilities of the normal boys and girls.

Francis and Rarick reported,

> A considerable body of information is available concerning the physical and mental development of mentally retarded children, but only a limited number of investigators have made observations on the motor characteristics of the slow-learning child (5).

Stein (6) felt that there was very little literature dealing with the physical nature of the mentally retarded student and that most of the information available pertained only to retarded students in institutions.

As early as 1900, there was an interest in the possible correlation between mental and motor ability. Bagley (7) found that there was little relationship between mental ability, as measured by reaction time, and mental ability as represented by class standing, except that a superior performance in either of these areas was apt to be accompanied by a deficiency in motor ability. He also concluded that, under the conditions of his study, there was an inverse relationship between motor ability and mental ability.

Howe stated, "Later studies have refuted this early finding by Bagley because intelligence tests were available and used as measures of mental ability" (8).

In his book on the measuring of motor abilities, Brace (9) stated there was negative and practically negligible correlation between intelligence and motor abilities as measured by his motor abilities tests and a basketball skills test.

Farmer (10) conducted a study to find the correlation between reaction time and intelligence among a group of 978 subjects. Among the young children, there was a high correlation between intelligence and the results on the motor ability test, but this correlation became less with increasing age. He also found an average correlation of +.08 between intelligence and reaction time for the entire group.

Goodenough (11), in a study of the development of the process of reaction time from early childhood to maturity, found there was only slight relationship between scores on the intelligence tests and the speed of reaction time initiated by a simple stimulus. There were sex differences evident in favor of the male, even in the measurements taken during early childhood.

Johnson, in a study of the relationship between physical skills and general intelligence of college students, stated, "There is no significant relationship between physical skill as measured and mental power or general intelligence as measured" (12).

In a study by Sloan (13), 20 feeble-minded and 20 normal subjects were given the Lincoln Adaptation of the Oseretsky Test of Motor Proficiency. Subjects were matched according to age and sex, and the results of the six subjects were compared. It was found there was a statistically significant difference between the two

groups on all six subtests; however, there were no statistically significant differences between sexes. Sloan concluded that, within the limits of this study, intelligence was related to motor proficiency.

McCloy and Young, in their book of test and measurements, said, "Almost no relationship has been found between intelligence quotients and measurements of physical ability." They went on to say, "For an indication of ability in physical skills, intelligence quotients are useless scores, at least within the zone of intellectual normality that is maintained in the public schools" (14).

Ellis and Sloan (15) tested 79 male and female mental defectives by measuring their simple reaction time, which was initiated by an auditory stimulus. Each subject was given three practice trials and 12 test trials. It was found there was a correlation of -.54 between mental age and the mean of the 12 trials, and a correlation of -.48 between mental age and the three fastest reaction times. It was also found that the reaction times tended to be more variable for low mental ages than for the higher mental ages.

In an experiment by Francis and Rarick (16), each of 284 retarded students from Madison and Milwaukee, Wisconsin, was tested with a battery of 11 gross motor tests. These tests measured static strength, running speed, power or dynamic strength, balance and agility. Observations were made on a basis of age and sex, and the scores of the retarded students were compared with published norms on normal children. These authors found the retarded students were markedly inferior to normal children in all of the 11 motor performance tests.

They also stated that these differences seemed to increase with advancing age.

Howe (17) used two groups of 43 subjects each; one group normal, and the other mentally retarded. Each subject was given 11 tests of motor ability; they were the first three subtests of the MacQuarrie Test for Mechanical Ability, Sargent Jump, balancing, grip strength, zig-zag run, 50-yard dash, Burpee Squat-thrust, ball throw at a target, and maze tracing. Both groups were intially tested and then given two weeks of individual instruction in each of the 11 areas. After the two weeks of individual instruction, both groups were retested and compared with the scores obtained on the initial test.

The results showed that the normal students obtained statistically significantly higher scores on the first test and maintained about the same degree of superiority throughout the instructional period. These results seemed to indicate that both the normal and mentally retarded students showed similar growth patterns.

Berkson (18, 19, 20) conducted a series of three studies, all of which dealt with reaction time in mentally defective young men. He concluded that no information from this series of experiments substantiated the belief that intelligence is related to reaction time. The studies did, however, indicate that intelligence is related to functions involved in the speed of performance of response.

Simmers (21), in work done at the University of Maryland, tried to find the relationship between intelligence, a reading achievement

score, and the motor educability score of seventh grade boys. He administered the Metheny Revision of the Johnson Test for motor educability and compared these results with the student's reading achievement scores and intelligence quotient score. The correlation between motor educability and intelligence was found to be -.008, while the correlation between motor educability and reading achievement scores was +.074. It could, therefore, be stated that there was little or no relationship between motor educability, as measured by the Metheny Revision of the Johnson Test, and intelligence and reading achievement.

Cantor and Stacey (22) tested 175 male mental defectives by administering the Purdue Pegboard test for manipulative dexterity. This group ranged in age from 14 to 18 years and had intelligence quotient scores that ranged from 42 to 82. These defectives were compared with two groups of normal males; one group consisted of 865 industrial workers, and the second group consisted of 456 male veterans.

The 56 defectives with the highest intelligence quotients failed to compare favorably with either group of normal subjects on the Pegboard scores. The authors also found there were no statistically significant differences between the 14- through 18-age groups. This seemed to indicate that the defectives reached dexterity maturity by the age of 14.

The authors also felt that in those people, whose intelligence quotient scores were approximately 60 or below, it could be generally accepted there would be an inability to perform tasks involving manual dexterity.

In summary, it would appear from the literature cited that many opinions and theories exist concerning the motor abilities of both normal and mentally defective children. These studies seem to be divided into two camps; those who feel there is no correlation between motor ability and intelligence, and those who feel there is such a correlation.

CHAPTER III

PROCEDURE

Introduction

The general purpose of this study was to obtain data on selected motor abilities of mentally retarded and normal boys and girls, so that sex and chronological age comparisons could be made. The selected motor abilities consisted of three items: performance time, accuracy throwing, and motor educability.

Subjects

The retarded students (those with an intelligence quotient below 70) were from 8 to 15 years of age and were taken from special education classrooms of the public schools in Madison, Flandreau, Watertown, and Sioux Falls, South Dakota. Because of their limited number, the retarded students were tested first, and then normal students of corresponding ages were tested.

The normal students (those with an intelligence quotient above 70) were taken from the regular classrooms of the public schools in Volga, South Dakota, and ranged in age from 8 to 15. The only criterion for selection was that they were in age groups which corresponded with the retarded students.

Measurements

Selection of the Measures

Since little has been done to observe the motor abilities of the mentally retarded, the author used the following guides in selecting tests:

1. Tests had to be easy to administer and require a minimum of equipment. Since the testing was to take place in several different towns and schools, a large amount of equipment would have been a hindrance.

2. Tests must be easily understood by the retarded students.

3. Tests must lend themselves to easy and accurate scoring.

4. Because of the limited time available and the distances which had to be traveled, relatively short tests were necessary.

5. Since the author wished to measure only performance time, accuracy throwing, and motor educability, it was felt that items or tests which required strength for satisfactory completion should be overlooked.

With these criteria in mind, the following methods of measurement were selected:

1. A multiple choice response timer was used to measure performance time.

2. Accuracy throwing was measured by the throwing of darts at a target of concentric circles.

3. Motor educability was measured by a modified version of the Iowa Revision of the Brace test.

Pilot Study

Prior to the collection of data for this investigation, a pilot study involving four mentally retarded students was completed. The results of this study enabled the investigator to ascertain which items of the Iowa Revision of the Brace test were best suited for administration to retarded students. Results of the pilot study also revealed the number of trials and throws necessary to obtain a reliable measure of performance time and accuracy throwing.

Description of Tests and Testing Procedures

All of the students, retarded and normal, were tested individually, and each was given a standardized explanation of the tests and procedures.

Performance Time

Performance time was measured by a multiple choice response timer. (Figure 1) The subject stood facing the four stimulus lights on the back of the control box, inside a square, ten feet from the control box and centrally located with respect to the four target switches fastened to the chairs. (Figure 2) The investigator proceeded to turn on a red stimulus light that indicated to the subject which target switch needed to be depressed in order to break the circuit and stop the standard electric timer clock. The clock which had been started simultaneously with the red stimulus light recorded, in hundredths of a second, the time taken to complete the movement. Each one of the four stimulus lights had a corresponding switch placed on one of the four chairs.

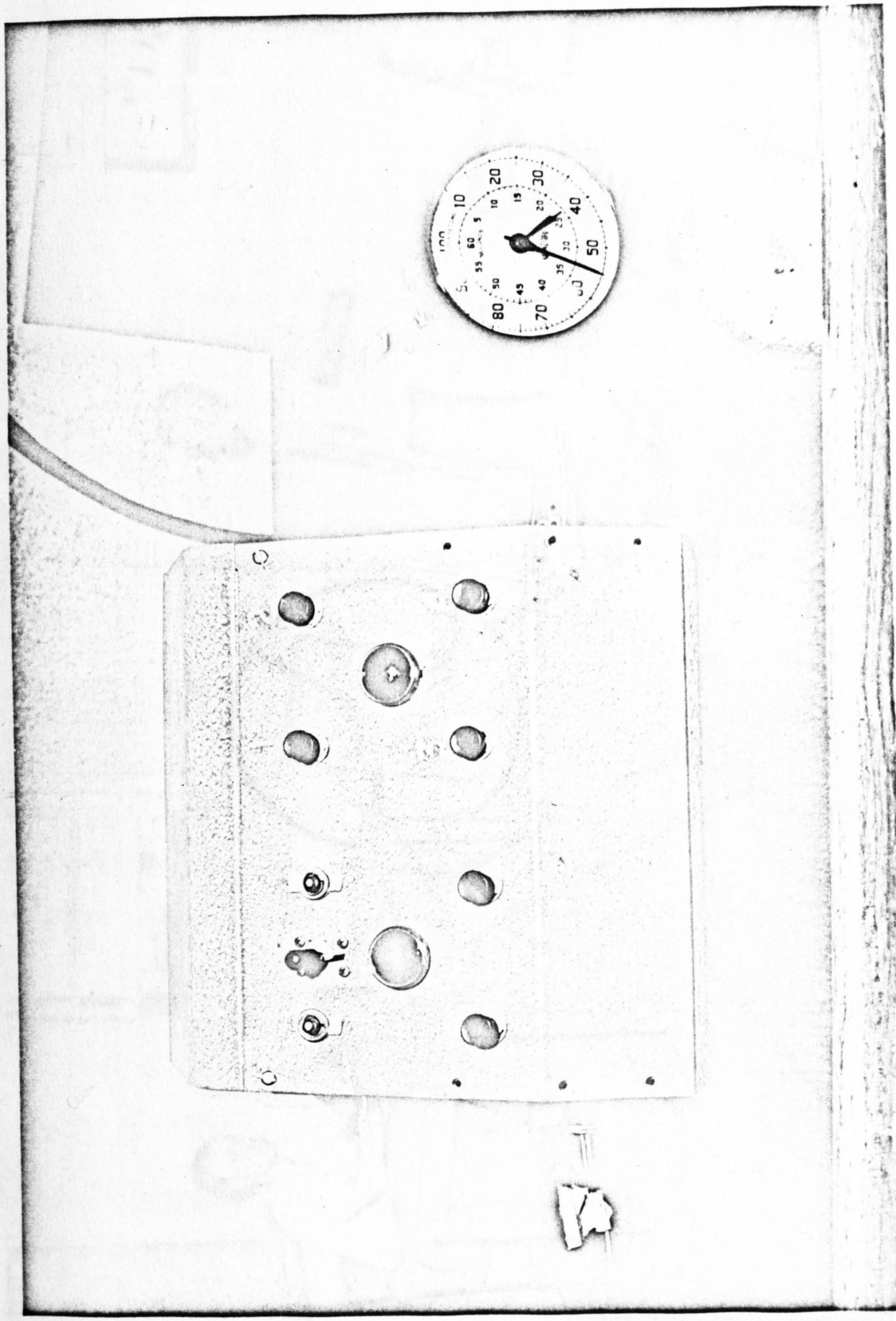

Figure 1. Multiple choice response timer

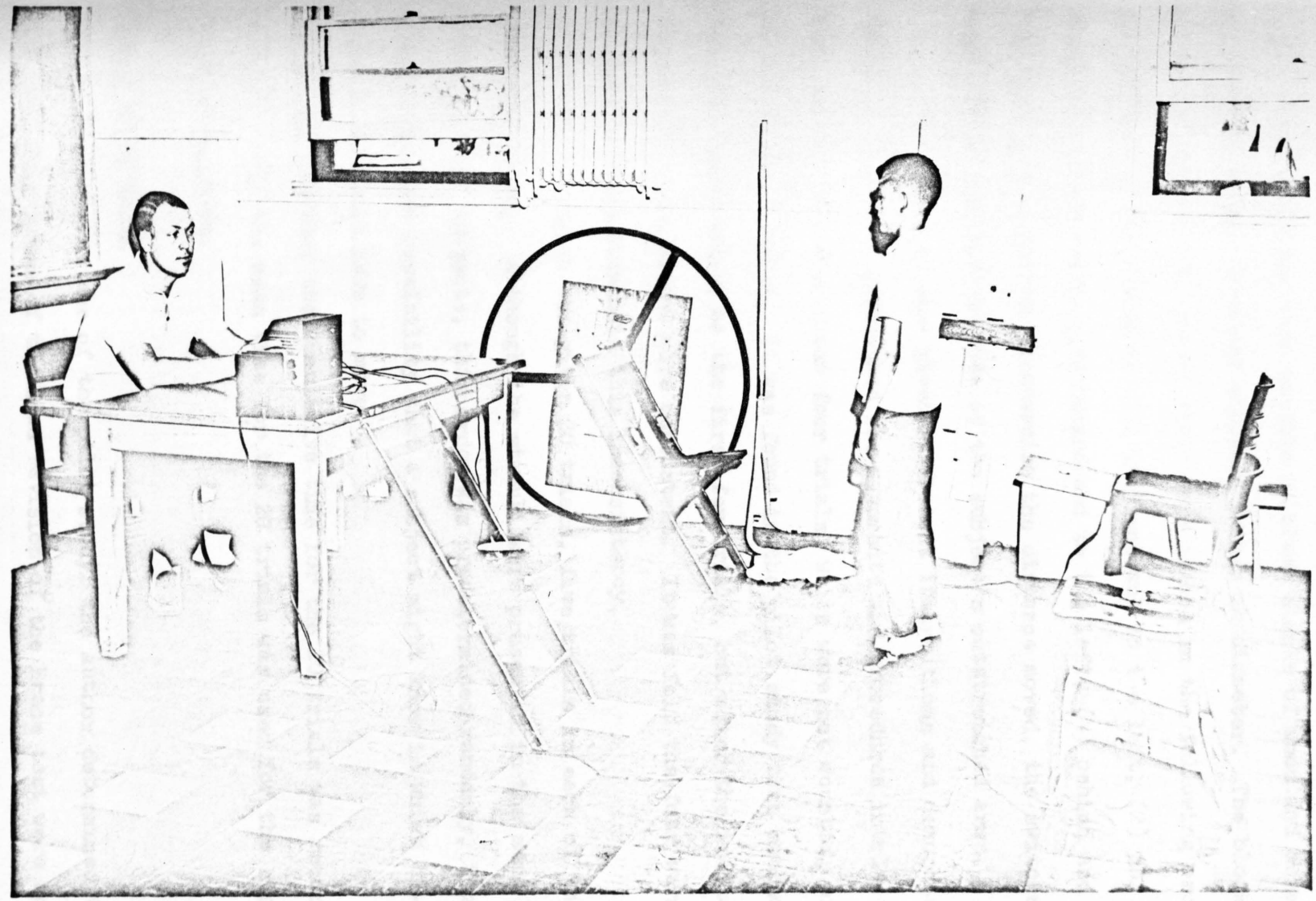

Figure 2. Subject taking performance time test

These switches were mounted on black blocks of wood and covered by a white target, five and one-half inches in diameter. The blocks were then attached to chairs which were placed in the following order in relation to the subject: (1) in front and to the left, (2) in front and to the right, (3) behind and to the left, (4) behind and to the right. In order to standardize the distance moved, the switches were placed one foot outside of the subject's outstretched arms.

All students were given sufficient instructions and demonstrations so that each understood the movements and procedures involved. Each subject was also given four trials, which were not counted, prior to the actual testing. It was found in the pilot study that subjects had poor performances on the first few trials, but after the initial trials the times became more consistent. It was felt the four warm-up trials would eliminate this inconsistency.

Each subject was given 20 trials, five trials in each of the four directions. Although the stimuli were presented in the same order for all subjects, this order was predetermined randomly, thus eliminating the possibility that a subject might know in which direction he would have to move.

In scoring, the cumulative time for the 20 trials was recorded; however, only the mean time for the 20 trials was used for the statistical evaluation.

Motor Educability

Through the use of the pilot study, the author determined that the following items of the Iowa Revision of the Brace test were most

applicable and most readily understood by the retarded students:

1. One foot-touch head (Iowa Brace Number 1)
2. Side leaning rest (Iowa Brace Number 2)
3. Stork stand (Iowa Brace Number 5)
4. Single heel click (Iowa Brace Number 6)
5. Full left turn (Iowa Brace Number 8)
6. Backward hop (Iowa Brace Number 10)
7. Full squat-arm circles (Iowa Brace Number 12)
8. Half turn jump-left foot (Iowa Brace Number 13)
9. Grapevine (Iowa Brace Number 3)
10. Cross leg-squat (Iowa Brace Number 7)

A complete description of the tests may be found in Appendix A.

The tests were administered to all students in the same order, with each student receiving similar instructions and demonstrations by the author. Each student was allowed two attempts to complete the stunt correctly. These trials were scored on a pass or fail basis; however, if the subject completed the stunt correctly on the first trial, no subsequent trials were given.

In scoring, the children received two points if the stunts were completed correctly on the first trial, one point for correct execution on the second trial, and no points if the student failed on both trials.

Each student received a motor educability score by simply totaling the number of points scored on each of the ten test items. For example, if a child correctly executed each stunt on the first

trial, he would have received a perfect motor educability score of 20.

Accuracy Throwing

In measuring the ability to throw accurately, the students threw darts at a target of concentric circles. (Figure 3) Darts were chosen because they lent themselves to very accurate scoring.

During the pilot study, throws were made from distances of 6, 8, 10, and 12 feet. It was decided that the distance of 10 feet gave the optimum discrimination; hence, this distance was used throughout the study. The pilot study also revealed that 20 throws gave a sufficiently reliable measure.

Each student threw 20 darts, four 5-dart bouts, at a target 18 inches in diameter. For all students tested, the target was placed so that the uppermost edge was 5 feet above the floor. The target was divided into seven, one and one-half inch sections. Darts landing outside of the target area received no points. A dart landing in the section farthest from the center scored one point, a dart landing in the next section scored two points, and so on in increasing order. A dart landing in the center, or "bull's-eye," scored seven points.

Each subject received an accuracy score determined by the total number of points scored on all 20 accuracy throws.

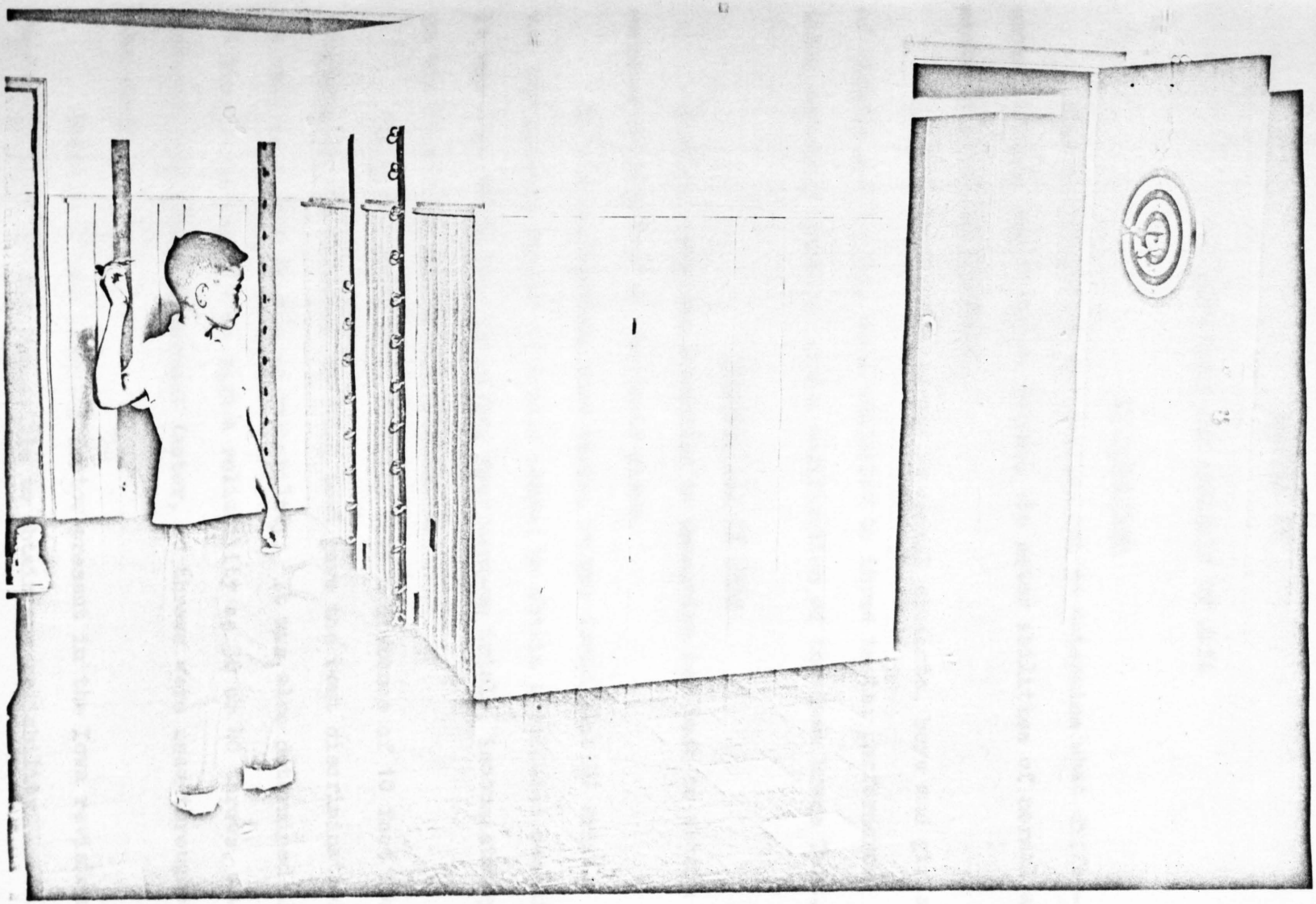

Figure 3. Subject performing accuracy throwing test

CHAPTER IV

TREATMENT AND ANALYSIS OF DATA

Introduction

This investigation was carried out to determine what differences, if any, were present between the motor abilities of normal and mentally retarded children.

Seventy-four retarded and 73 normal students, boys and girls of various age levels, were subjected to three tests: performance time, accuracy throwing, and a modification of the Iowa Brace Test.

Reliability of Data

A pilot study was conducted to determine how best to obtain maximum reliability in the tests given.

In the performance time tests, it was found that 20 trials was the minimum number of trials needed to obtain a reliable measure. It was also found that by giving four warm-up trials, inconsistency on the first few trials was eliminated.

The pilot study also revealed that a distance of 10 feet for throwing in the accuracy throwing test gave the best discrimination, as well as a high degree of reliability. It was also determined that 20 throws gave nearly as high a reliability as 30 or 40 throws, and because time was an important factor, 20 throws were used throughout the study.

Because of the learning factor present in the Iowa revision of the Brace Test, it was impossible to obtain any reliability

information by the test-retest method. The pilot study did reveal, however, which items were best suited for administration to retarded students. The author administered and scored each test item for all subjects in an attempt to make the measurements more reliable.

Statistical Procedure

Mean scores were computed for mentally retarded and normal boys and girls at four different age levels for each of the three tests. The means were derived from the raw scores by using the following formula (23):

$$M = \frac{\Sigma X}{N}$$

The standard error of the difference between the means of the same test given to different groups was derived from the following formula (24):

$$S.E._{Dif._{Mns.}} = \sqrt{\frac{\Sigma d_1^2 + \Sigma d_2^2}{(N_1 - 1) + (N_2 - 1)}} \cdot \sqrt{\frac{N_1 + N_2}{N_1 N_2}}$$

The following formula was used to obtain the critical ratios (t ratio) (25):

$$t = \frac{M_1 - M_2}{S.E._{Dif._{Mns.}}}$$

In addition, the mean for all mentally retarded students was compared with the mean for all normal students for each of the three

tests. A t ratio was computed in a manner similar to the previously mentioned pattern.

The five per cent level of confidence was chosen to denote statistically significant differences of the t ratios obtained. If the t ratios were statistically significant at, or beyond, the five per cent level of confidence, the null hypothesis (no difference between mentally retarded and normal children) was rejected.

Analysis of Data

In the four tables that follow, $Mean_N$ represents the mean recorded by the normal group; $Mean_R$ represents the mean scores recorded by the retarded group; and df indicates the degrees of freedom, $(N_1 - 1) + (N_2 - 1)$.

Referring to Table I, one can see that differences do exist in the mean performance times recorded for the normal and mentally retarded boys and girls. However, these differences were statistically significant at, or beyond, the five per cent level in only three cases; 8-9 year old boys, 12-13 year old boys, and 12-13 year old girls. In these cases the differences must be assumed to be real, and the null hypothesis must be rejected. Because of the insufficient number of girls in the 8-9 age group, no comparisons were made.

The t ratios were not statistically significant at the five per cent level for any of the other age groups in the performance time test. Because these differences were not statistically significant at the five per cent level, in each case the null hypothesis was accepted.

Table I. Mean Scores, Degrees of Freedom, t Ratios, and Levels of Significance in Performance Time

	$Mean_N$	$Mean_R$	df	t Ratio	Level
Boys 8-9 Year Old	34.48	48.46	18	2.167	.05
Girls	-	-	-	-	-
Boys 10-11 Year Old	35.58	64.63	16	2.096	.10
Girls	31.82	37.39	15	2.110	.10
Boys 12-13 Year Old	28.08	51.10	26	2.729	.02
Girls	28.56	65.91	23	3.700	.002
Boys 14-15 Year Old	26.85	45.64	15	1.817	.10
Girls	25.07	57.74	11	1.243	.40

In Table II, the results of the accuracy throwing test were recorded. Here the differences were statistically significant at the five per cent level in all age groups except the 10-11 year olds. In this age group, the critical ratios did not attain the values necessary to reject the null hypothesis at the five per cent level of significance.

In the remainder of the age groups for the accuracy throw test, the differences were regarded as being real and the null hypothesis was rejected.

Table II. Mean Scores, Degrees of Freedom, t Ratios, and Levels of Significance in Accuracy Throwing

	$Mean_N$	$Mean_R$	df	t Ratio	Level
Boys 8-9 Year Old	40.10	17.90	18	3.181	.01
Girls	-	-	-	-	-
Boys 10-11 Year Old	48.57	39.64	16	1.197	.40
Girls	25.82	22.00	15	0.545	none
Boys 12-13 Year Old	67.29	43.43	26	4.869	.001
Girls	42.98	21.31	23	3.969	.001
Boys 14-15 Year Old	88.71	53.20	15	4.072	.001
Girls	59.83	31.75	12	3.424	.01

The results of the Iowa Brace Test are shown in Table III. In the Iowa Brace Test, the only two age groups in which the differences were not statistically significant were 8-9 year old boys and 12-13 year old boys. These t ratios did not reach the values necessary for rejection of the null hypothesis at the five per cent level; however, they were significant at the 10 per cent and 20 per cent levels, respectively.

The remainder of the age groups all met the values necessary for rejection of the null hypothesis at the five per cent level; and two of the age groups, 10-11 year old boys and 12-13 year old girls, were statistically significant at the .001 per cent level.

Table III. Mean Scores, Degrees of Freedom, t Ratios, and Levels of Significance in the Iowa Brace Test

	$Mean_N$	$Mean_R$	df	t Ratio	Level
Boys	12.20	9.00	18	1.905	.10
8-9 Year Old Girls	-	-	-	-	-
Boys	12.14	7.55	16	4.173	.001
10-11 Year Old Girls	13.73	10.83	15	2.710	.02
Boys	13.93	9.14	26	1.618	.20
12-13 Year Old Girls	14.17	6.17	23	5.384	.001
Boys	15.71	11.00	15	3.463	.01
14-15 Year Old Girls	14.00	8.75	12	3.365	.01

For comparison of both the normal and mentally retarded groups, as well as comparisons by sex within each group, a graphical presentation was used. (Figures 4, 5, and 6) Because of an insufficient number of girls in the 8-9 year old age bracket, no comparisons were made for this group.

In Figure 4, it must be noted that a lower score indicates a higher degree of excellence, so that a group with a mean performance time of 20 seconds must be considered better than a group with a mean performance time of 40.

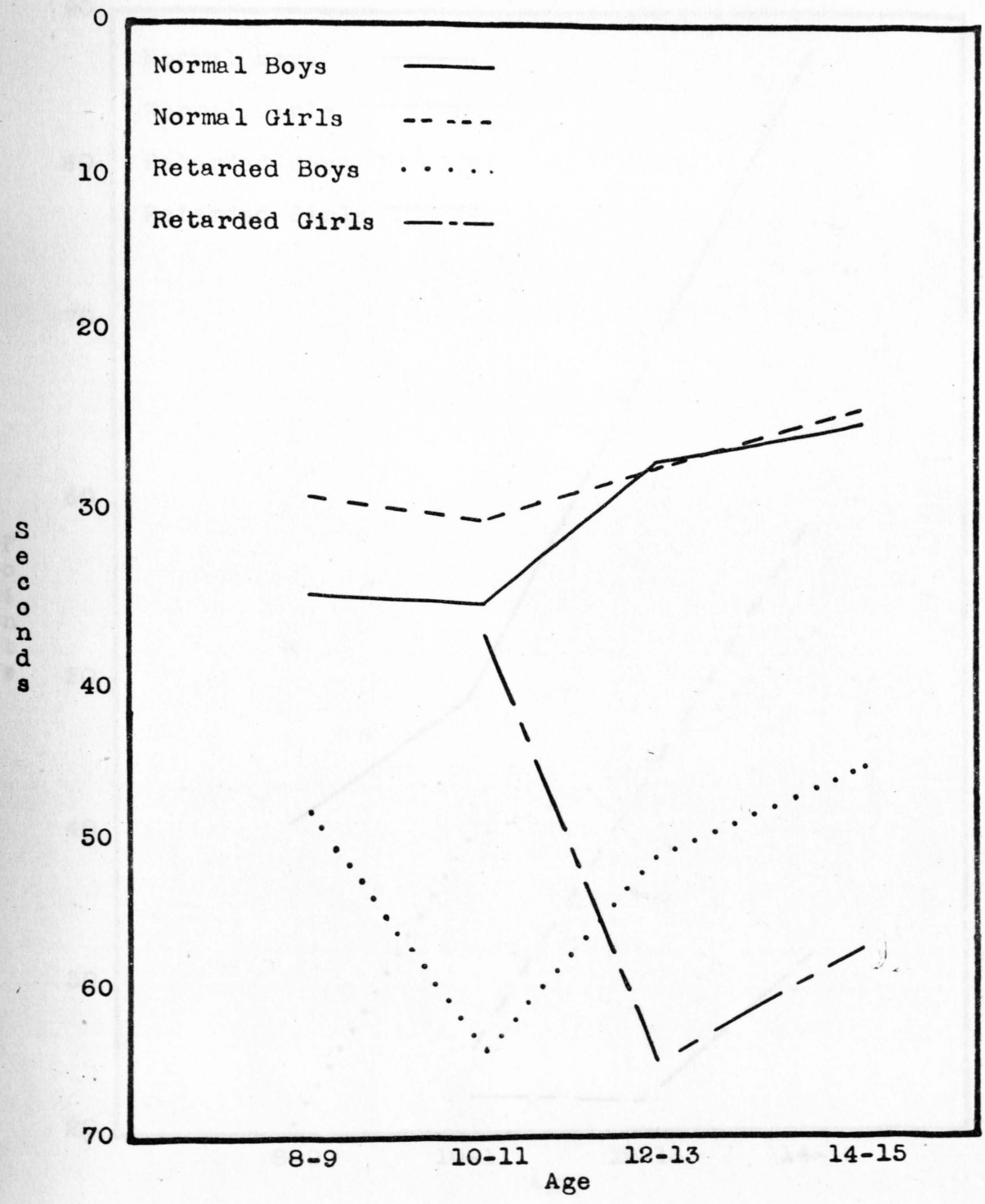

Figure 4. Comparison of Mean Performance Times (seconds)

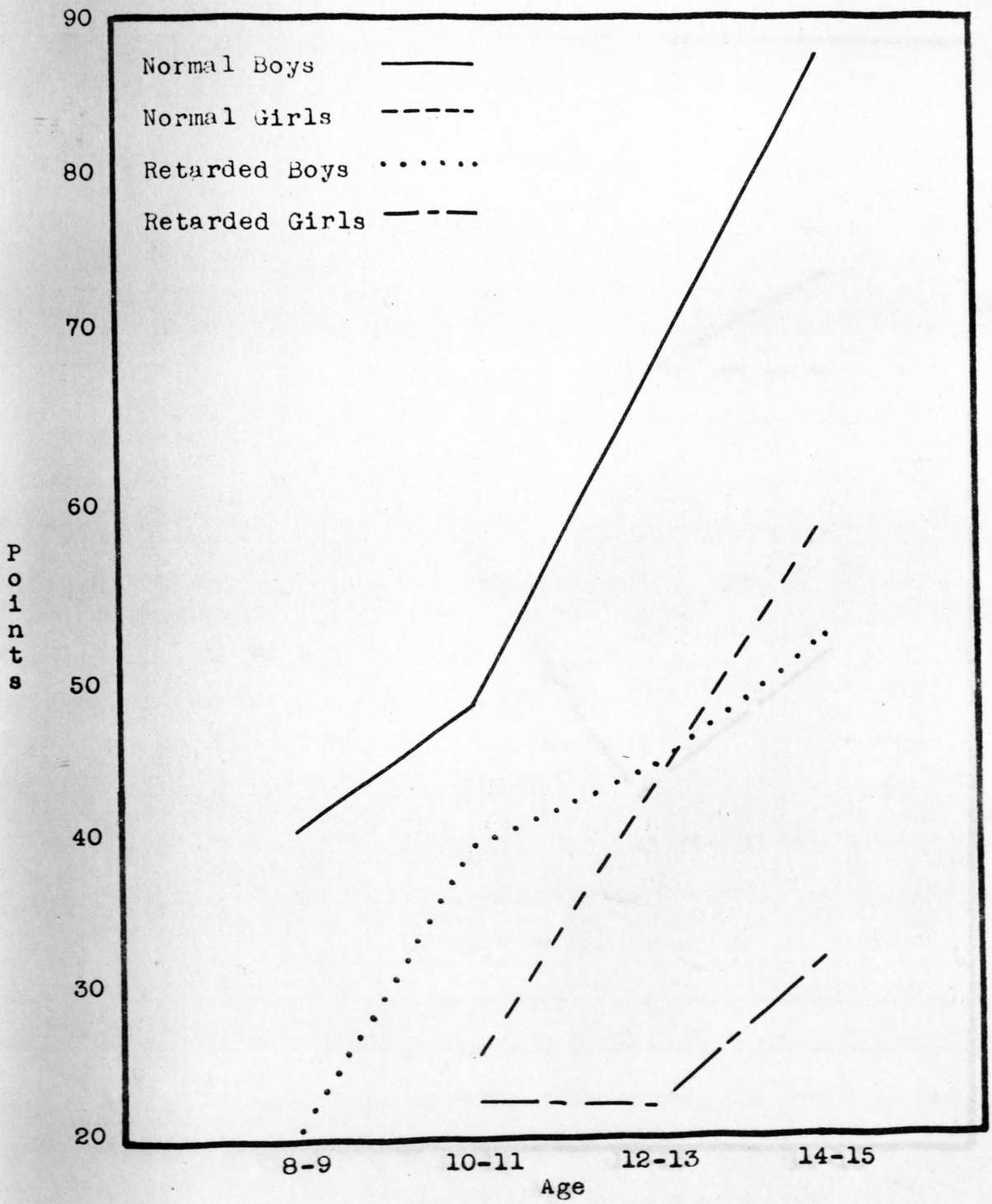

Figure 5. Comparison of Mean Scores for Accuracy Throwing

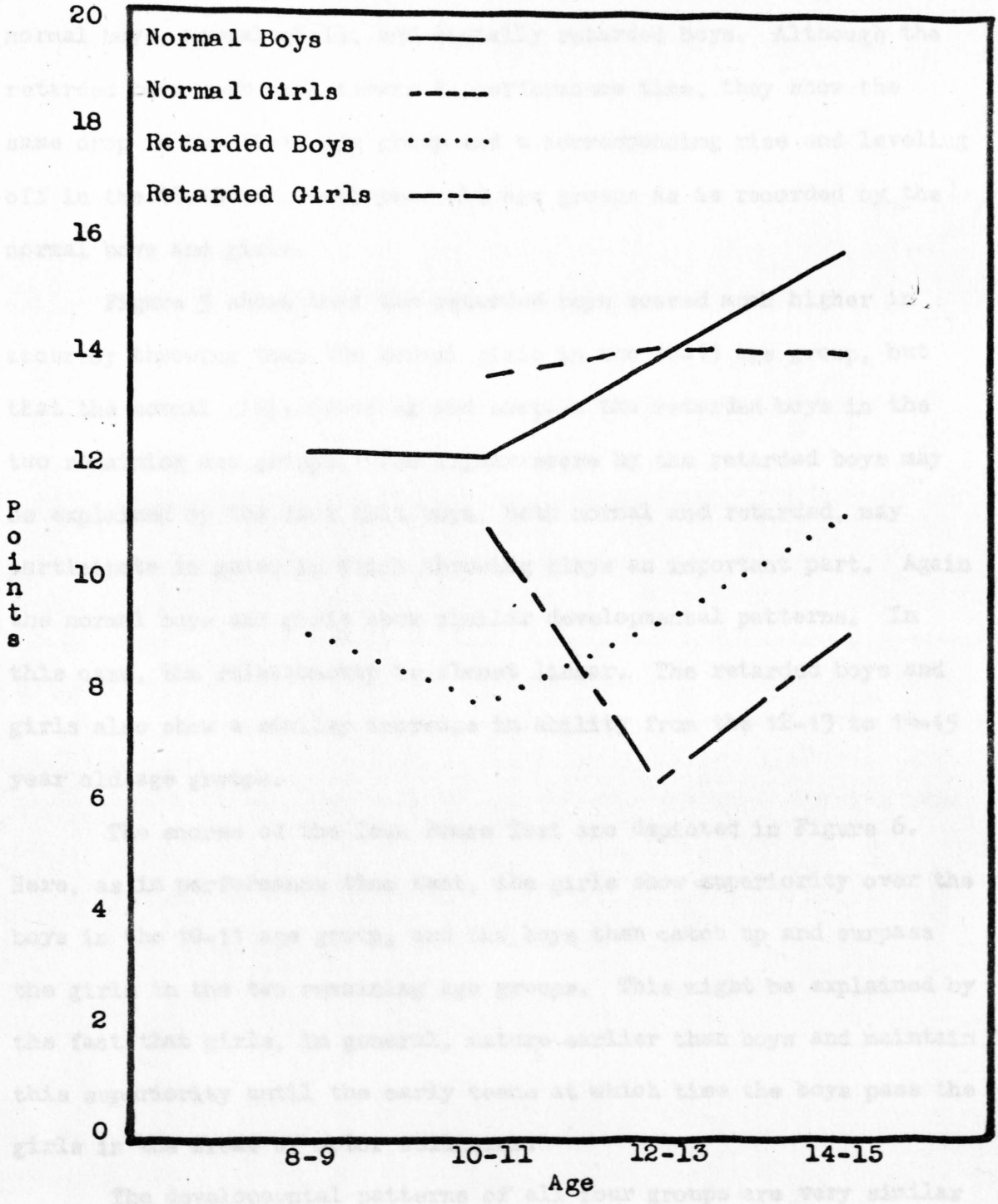

Figure 6. Comparison of Mean Scores for the Iowa Brace Test.

Figure 4 also indicates that similar patterns are exhibited by normal boys, normal girls, and mentally retarded boys. Although the retarded boys were much slower in performance time, they show the same drop in the 10-11 age group and a corresponding rise and leveling off in the 12-13 and 14-15 year old age groups as is recorded by the normal boys and girls.

Figure 5 shows that the retarded boys scored much higher in accuracy throwing than the normal girls in the 10-11 age group, but that the normal girls catch up and surpass the retarded boys in the two remaining age groups. The higher score by the retarded boys may be explained by the fact that boys, both normal and retarded, may participate in games in which throwing plays an important part. Again the normal boys and girls show similar developmental patterns. In this case, the relationship is almost linear. The retarded boys and girls also show a similar increase in ability from the 12-13 to 14-15 year old age groups.

The scores of the Iowa Brace Test are depicted in Figure 6. Here, as in performance time test, the girls show superiority over the boys in the 10-11 age group, and the boys then catch up and surpass the girls in the two remaining age groups. This might be explained by the fact that girls, in general, mature earlier than boys and maintain this superiority until the early teens at which time the boys pass the girls in the areas of motor abilities.

The developmental patterns of all four groups are very similar when comparing performance time and the Iowa Brace Test. This

similarity is not present when comparing these two tests with the accuracy throwing test.

In Table IV, it can be seen that the normal students are statistically superior to the retarded students in each of the three tests given. This difference is statistically significant beyond the five per cent level; as the table shows, the differences are statistically significant at the .005 per cent level.

Table IV. Comparison of Mentally Retarded and Normal Students' Means, Performance Time, Accuracy Throwing and the Iowa Brace Test

	$Mean_N$	$Mean_R$	df	t Ratio	Level
Performance time	30.12	54.31	135	5.42	.005
Accuracy throwing	51.70	33.60	137	5.03	.005
Iowa Brace Test	13.7	8.7	131	3.68	.005

Discussion of Findings

In most cases, when comparing by age groups, the findings of this study showed that the normal students were statistically better than the retarded students in the areas of the motor abilities measured. Of the 21 comparisons made, the differences were statistically significant at, or beyond, the five per cent level in 13 of these cases.

The group comparison, normal against retarded, showed that the normal students were statistically superior to the retarded students beyond the five per cent level in all three tests given. This study would then refute the idea that because the mentally retarded students look the same physically that they have the same motor abilities as the normal students.

CHAPTER V

SUMMARY

Statement of Problem

The purpose of this study was to ascertain what differences, if any, exist between the selected motor abilities of the normal child and the mentally retarded child.

The motor abilities measured were: (1) motor educability as measured by a modified Iowa Brace Test, (2) performance time as measured by a multiple choice response timer, and (3) accuracy throwing as measured by the throwing of darts at a target of concentric circles.

Summary of Findings

The three tests administered showed that in nearly all age groups, the normal boys and girls were superior to the retarded students in the motor abilities measured. In relatively few age brackets was this difference not statistically significant.

When comparing the normal students as a whole against the retarded students as a whole, these differences were even more apparent and more statistically significant.

Conclusion

As a result of the findings of this investigation, it appears that statistically significant differences do exist between selected motor abilities of the normal child and the mentally retarded child.

Recommendations

1. Because of their apparent deficiency in certain important motor abilities, the mentally retarded students should be, wherever possible, separated from the normal students in the area of physical education as well as the academic areas.

2. As was indicated by the graphic presentations, the retarded students showed similar developmental patterns as the normal students. It may be assumed from this that through proper training, the retarded students can attain reasonable proficiency in the motor areas.

3. Because of their comparatively low motor abilities, physical education for the mentally retarded students should be carefully planned with these weaknesses in mind. The program should not be a cut-down version of the normal physical education program.

Recommendations for Further Study

1. It is recommended that this study be conducted again with a larger group of subjects participating. The retarded and normal students should be divided into groups according to intelligence, so it can be determined just where intelligence, or lack of it, begins to affect motor abilities.

2. A similar study should be undertaken with new items added to determine if the retarded students are inferior in other motor areas.

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APPENDIX A

DESCRIPTION OF THE IOWA REVISION OF THE BRACE TEST

1. One foot-touch head-Stand on the left foot. Bend forward and place both hands on the floor. Raise the right leg and stretch it back. Touch the head to the floor, and regain the standing position without losing the balance.

   It is a failure: 1. Not to touch the head to the floor.
   2. To lose the balance and have to touch the right foot down or step about.

2. Side leaning rest-Sit down on the floor, legs straight out and feet together. Put right hand on the floor behind you. Turn to the right and take a side leaning-rest position, resting on the right hand and the right foot. Raise the left arm and keep this position for five seconds.

   It is a failure: 1. Not to take the proper position.
   2. Not to hold the position for five seconds.

3. Stork stand-Stand on the left foot. Hold the bottom of the right foot against the inside of the left knee. Place the hands on the hips. Shut both eyes and hold the position for ten seconds without shifting the left foot about on the floor.

   It is a failure: 1. To lose the balance.
   2. To take the right foot down.
   3. To open eyes or remove hands from hips.

4. Single heel click-Jump into air and clap the feet together once before landing with feet any distance apart.

   It is a failure: 1. Not to clap feet together once.
   2. To land with feet touching.

5. Full left turn-Stand with feet together. Jump into the air and make a full turn to the left, landing on the same spot. Do not lose the balance or move the feet after they strike the floor.

   It is a failure: 1. Not to get all the way around.
   2. To move the feet after they strike the floor.

6. Hop backward-Stand on either foot. Close the eyes and take five hops backward.

   It is a failure: 1. To open the eyes.
   2. To drop the other foot.

7. Full squat-arm circles-Take a full squat position with arms out sideways. Wave the arms so that the hands make a circle about one foot across, and jiggle up and down at the same time for ten counts.

   It is a failure: 1. To move the feet about on the floor.
   2. To lose the balance and fall.

8. Half turn jump-left foot-Stand on the left foot and jump one half turn to the left, keeping the balance.

   It is a failure: 1. To lose the balance.
   2. To fail to complete the half turn.
   3. To touch the floor with the other foot.

9. Grapevine-Stand with both heels tight together. Bend down, extend both arms down between the knees, around behind the ankles, and hold the fingers together in front of the ankles without losing the balance. Hold this position for five seconds.

   It is a failure: 1. To fall over.
   2. Not to touch and hold the fingers of both hands together.
   3. Not to hold the position for five seconds.

10. Cross leg squat-Fold the arms across the chest. Cross the feet and sit down cross-legged. Get up without unfolding the arms or having to move the feet about to regain the balance.

    It is a failure: 1. To unfold the arms.
    2. To lose the balance.
    3. To be unable to get up.

APPENDIX B

RAW DATA: RETARDED BOYS

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
		8-9 Year Olds	
1	42.21	9	-
2	37.38	0	-
3	65.46	23	-
4	89.70	21	13
5	48.50	30	-
6	28.74	32	-
7	45.52	28	10
8	42.84	8	10
9	36.66	0	6
10	47.63	28	6
		10-11 Year Olds	
1	74.26	58	6
2	36.59	20	6
3	44.45	69	9
4	83.83	14	3
5	87.12	50	8
6	56.70	20	6
7	64.67	53	10
8	145.36	42	9

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	10-11 Year Olds (cont.)		
9	50.53	30	9
10	34.72	41	6
11	32.74	39	11
	12-13 Year Olds		
1	48.84	51	14
2	30.84	26	4
3	-	73	14
4	72.85	43	6
5	64.76	25	9
6	28.80	50	9
7	35.26	33	9
8	27.26	51	18
9	43.65	24	8
10	71.96	28	14
11	140.20	40	0
12	30.46	54	8
13	38.02	42	7
14	31.36	68	8
	14-15 Year Olds		
1	34.45	64	16
2	32.01	52	14
3	39.20	73	15
4	32.61	13	8

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	14-15 Year Olds (cont.)		
5	29.52	45	14
6	29.33	82	9
7	62.71	63	9
8	26.30	59	9
9	56.30	43	8
10	114.00	38	8

APPENDIX C

RAW DATA: RETARDED GIRLS

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	10-11 Year Olds		
1	37.02	25	11
2	44.84	19	9
3	34.58	48	11
4	31.28	6	9
5	35.82	2	12
6	40.80	32	13
	12-13 Year Olds		
1	123.00	16	2
2	41.32	31	9
3	39.35	46	4
4	145.07	4	4
5	90.23	1	6
6	67.32	32	2
7	109.64	0	Braces
8	34.22	22	11
9	46.15	29	10
10	37.56	43	7
11	33.73	14	8
12	48.22	8	6
13	41.03	31	5

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	14-15 Year Olds		
1	28.61	7	2
2	42.41	35	9
3	33.70	40	11
4	202.48	11	8
5	-	41	11
6	-	48	6
7	29.69	39	13
8	32.05	33	10
9	35.27	-	-

APPENDIX D

RAW DATA: NORMAL BOYS

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	8-9 Year Olds		
1	63.61	34	16
2	28.90	57	12
3	31.28	61	8
4	27.31	28	10
5	32.45	50	10
6	27.25	47	10
7	34.55	20	17
8	32.91	50	14
9	36.22	8	15
10	30.30	46	10
	10-11 Year Olds		
1	43.88	47	12
2	29.57	45	10
3	28.59	45	16
4	45.68	73	12
5	29.70	44	14
6	40.21	36	11
7	31.46	50	10

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	12-13 Year Olds		
1	23.72	62	17
2	31.22	69	17
3	24.28	85	17
4	23.48	78	14
5	24.39	60	15
6	27.07	51	14
7	29.11	58	10
8	32.93	72	11
9	28.00	63	16
10	39.52	76	7
11	28.54	60	11
12	30.01	81	19
13	27.88	73	14
14	23.02	54	13
	14-15 Year Olds		
1	23.55	72	17
2	29.42	108	18
3	27.16	99	15
4	26.77	101	15
5	25.30	87	14
6	26.65	75	14
7	29.13	79	17

APPENDIX E

RAW DATA: NORMAL GIRLS

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	10-11 Year Olds		
1	26.27	18	15
2	29.77	45	11
3	28.99	36	14
4	44.63	27	15
5	27.03	41	14
6	39.05	21	10
7	30.89	17	12
8	28.92	20	14
9	33.55	17	12
10	30.80	35	16
11	30.07	7	18
	12-13 Year Olds		
1	28.00	42	16
2	24.54	58	18
3	24.75	52	16
4	25.64	54	15
5	31.02	46	16
6	27.18	42	6
7	31.10	49	13
8	33.39	32	16

Subject No.	Performance Time (Seconds)	Accuracy Throw (Points)	Iowa Brace (Points)
	12-13 Year Olds (cont.)		
9	27.39	31	15
10	32.60	36	11
11	26.89	19	18
12	30.27	54	10
	14-15 Year Olds		
1	25.65	36	13
2	25.11	52	11
3	28.07	71	14
4	25.23	55	16
5	25.26	81	17
6	21.07	64	13