A STUDY OF THE RELATIONSHIP BETWEEN PERCEPTUAL-MOTOR ABILITY AND INTELLECTUAL ABILITY IN KINDERGARTEN-AGE CHILDREN

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN PHYSICAL EDUCATION IN THE GRADUATE SCHOOL OF THE TEXAS WOMAN'S UNIVERSITY

COLLEGE OF

HEALTH, PHYSICAL EDUCATION AND RECREATION

BY

DAISY E. HERNDON, B. S.

DENTON, TEXAS

AUGUST, 1970

ACKNOWLEDGEMENTS

The writer is grateful for the opportunity of having completed this thesis under the direction of Doctor Joel Rosentswieg.

Appreciation is extended to Doctor June Ford Shelton and Mr. Gene Hayes for their suggestions as members of the thesis committee.

Further acknowledgement is given to Mrs. Vanice Gilbert, Mrs. Jonnie Hockaday, and the children in the senior kindergarten class of the Selwyn School, and to Dr. Juanita Prater, Mrs. Wayne Robersen, and the children in the kindergarten class of the Texas Woman's University Demonstration School.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

The relationship of perceptual-motor skills to general intelligence has recently become the concern of many professional educators. In the past this area has been of interest mainly to growth and development specialists and physical educators. Many of the newer programs of perceptual-motor training have been implemented by individuals who have a limited knowledge of the psychological, physiological, and kinesiological involvements in motor learning. The professional background of physical educators tends to emphasize these areas, suggesting that physical educators should provide leadership in understanding the relationship that exists between perception, motor activities, and intelligence.

The possibility of determining a simple, quick, inherently interesting, and inexpensive test of perceptual-motor skills for kindergarten-age children that may be given and interpreted by classroom teachers could be a valuable contribution to elementary school education. Espenschade and Eckert provide a rationale for such a test in their book Motor Development.[1] "Through his continuous

---

[1]Anna S. Espenschade and Helen M. Eckert, Motor Development (Columbus, Ohio: Charles E. Merril), 1967.

explorations of both space and things he (the child) learns the nature of objects, of space, and to some extent of himself."[1] This is the value of motor activity in childhood. The state of Texas does not have universal public kindergarten schools at the present time. Such education will be state sponsored and available to every child in the near future.

Statement of the Problem

The present investigation entailed a study of the relationship between selected perceptual-motor skills and intellectual ability of forty-six kindergarten-age students in the Texas Woman's University Demonstration School and the Selwyn School of Denton, Texas, during the fall semester of the academic year of 1969-1970.

The investigator endeavored to determine the relationship between selected perceptual skills, as measured by the Singer-Brunk Figure Reproduction Test and the Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale, and intellectual ability as measured by the Kuhlmann-Anderson Measure of Academic Potential Test.

Definition and/or Explanations of Terms

For the purposes of clarification, the following definitions and/or explanations of terms have been established

---

[1]Espenschade and Eckert, p. 106.

for the use in the study:

Perceptual-Motor Ability: In the present study the term perceptual-motor ability refers to a comprehensive approach implying the sensory recognition, mental orientation, and neuromuscular output of motor skills.

Intellectual Ability: In the present study the term intellectual ability refers to the performance of kindergarten-age students as measured by the Kuhlmann-Anderson Measure of Academic Potential Test for Kindergarten.

Purpose of the Study

The general purpose of the study was to determine if a significant relationship exists between selected tests that may be used by classroom teachers to measure the perceptual-motor ability and intellectual ability of kindergarten-age students. Specifically, the following hypotheses will be tested:

1. There is no significant relationship between the Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale and the Figure Reproduction Test by Singer and Brunk.
2. There is no significant relationship between the Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale and the Kuhlmann-Anderson Measure of Academic Potential Test.

3. There is no significant relationship between the Figure Reproduction Test by Singer and Brunk and the Kuhlmann-Anderson Measure of Academic Potential Test.

Delimitations of the Study

The study is subject to the following delimitations:

1. The reliability, validity, and objectivity of the selected instruments for the measurement of perceptual-motor ability and intellectual ability.
2. The selection of forty-six kindergarten students from the Texas Woman's University Demonstration School and the Selwyn School of Denton, Texas, during the fall semester of the academic year of 1969-1970.
3. The selected sample as being representative of the population at large.

Survey of Related Literature

A survey of previous research studies indicates that the present study does not duplicate any known investigation. The following review of completed research studies are presented in the belief that such a review may be of assistance in the development of the research design or in better understanding the broad areas to be considered.

A. In 1923, Oseretsky[1] developed a motor development scale to measure the following areas of motor proficiency: (1) general static coordination (2) dynamic manual coordination (3) general dynamic coordination (4) motor speed (5) simultaneous voluntary movement (6) asynkinesia or lack of precise movements. These six areas were believed to serve as indices for general coordination of hands, motor speed, ability to perform without superfluous movement, and simultaneous voluntary movement. The orginal battery of tests, scored on a pass-fail basis, included eighty-five items and was designed for children four to sixteen years of age. On each of ten age levels, there were six tests of motor proficiency. The test was designed for feeble minded and motor disordered children as well as normal ones. In 1929 Oseretsky shortened the number of tests to thirty and presented a group method of examining motor functions of children.[2] With another revision of his scale in 1931, Oseretsky felt that a general motor age and the

---

[1]Nicolaus I. Oseretsky, A Metric Scale for Studying the Motor Capacity of Children, 1923, pp. 24. Quoted in Rudolf Lassner, "Annotated Bibliography on the Oseretsky Tests of Motor Proficiency," Journal of Consulting Psychology, Vol. 12, 1948, p. 40.

[2]Nicolaus I. Oseretsky, "A Method of Group Rating of Motor Abilities in Childhood and Youth," Gosmedizat, Moscow, (original in Russian), (1929), p. 60, quoted in Lassner, Rudolf, "Annotated Bibliography of the Oseretsky Tests of Motor Proficiency," Journal of Consulting Psychology, Vol. 12, 1948, pp. 37-47.

development of single motor components could be determined.[1]

B. In 1951 Sloan[2] investigated the relationship between motor proficiency and intelligence. This investigation, the First Lincoln Adaptation of the Oseretsky Motor Development Scale, used two groups of subjects, one of endogenous mental defective and one of normal intelligence, matched for age (mean age 10) and sex. The following conclusions were stated by Sloan: (1) motor proficiency was positively related to intelligence, (2) no sex differences were found, and (3) with mentally defective subjects, the degree of difficulty was found to vary directly with task complexity.[3]

In 1954 Sloan[4] published the Lincoln-Oseretsky Motor Development Scale Manual. The thirty-six item test was considered the soundest adaptation of the original Oseretsky Scale. Subjects ranged from ages six to fourteen, with 380 males and 369 females being used. Sloan found that

---

[1]Nicolaus I. Oseretsky, "Methods of Investigating Motor Components," Zietschrift fur Angewandte Psychologie, XVII, (1931), p. 162, English Translation by Elizabeth Lang, unquoted in Thams, Paul Fredrik, "A Factor Analysis of the Lincoln-Oseretsky Motor Development Scale," (Unpublished Ph. D. dissertation, University of Michigan, 1955).

[2]William Sloan, "Motor Proficiency and Intelligence," American Journal of Mental Deficiency, Vol. 55, (1951), pp. 404-5.

[3]Ibid., pp. 404-5.

[4]William Sloan, Manual for the Lincoln-Oseretsky Motor Development Scale, #37018 (Chicago: C. H. Stoelting Co., 1954), p. 63.

passing the items depended upon age, but there were no differences in motor performance attributed to sex.

C. In 1968, Pearman[1] undertook a study to determine if the number of test items on the Lincoln revision of the Oseretsky Motor Development Scale could successfully be reduced. The stated time to test an individual using the Lincoln revision of the Oseretsky Motor Development Scale was sixty to ninety minutes. Pearman used fifty-five fourth, fifth, and sixth-grade students as subjects. The subjects were selected from the Training School of Western Kentucky University at Bowling Green, Kentucky.

On the Lincoln revision of the Oseretsky Motor Development Scale there were fifty-three tests to administer with 159 points being the maximum possible. Pearman used the Pearson Product-Moment Coefficient of Correlation to analyze the data. An item intercorrelation was obtained and each item was correlated with the composite score from the battery of tests.

Pearman found that seven test items had a high multiple correlation with the composite score of the total items contained in the Lincoln revision of the Oseretsky Motor Development Scale. Pearman concluded that these seven

---

[1]Roger Pearman, "An Analysis of the Lincoln-Oseretsky Motor Development Scale with an Emphasis on the Reduction of Total Test Items" (unpublished Master's thesis, College of Education, Western Kentucky University), 1968.

test items, which take ten minutes to administer, were a reliable and valid assessment of an individual's perceptual-motor ability.

Singer and Brunk[1] conducted a study to determine the relationship between perceptual-motor ability and intellectual ability and forty-eight third-grade and forty-three fourth-grade children. The subjects were selected from an elementary school serving children from upper middle-class families. The mean Intelligence Quotient for the subjects was 108.

The Figure Reproduction Test, developed by Singer and Brunk, was administered to groups of approximately twenty-five subjects. The investigators constructed the test to measure "problem-solving ability as represented by perceptual-motor activity." Using a wooden board, six and one-half inches square, on which four rows and four columns of nails protruded and were spaced one and one-half inches apart, the subjects attempted to reproduce fourteen geometrical patterns with rubber bands. The patterns were projected onto a screen and ranged from simple to complex figures. Two minutes were alloted for each pattern.

The Pintner Elementary Test and the Stanford Achievement Test were also administered to all subjects. The former

---

[1]Robert N. Singer and Jason W. Brunk, "Relation of Perceptual-Motor Ability and Intellectual Ability in Elementary School Children," Perceptual and Motor Skills XXIV (June, 1967), pp. 967-970.

test is made of pictures and reading parts and the latter of the following eight items: word reading, paragraph meaning, vocabulary, spelling, word study skills, arithmetic computation, arithmetic reasoning, and arithmetic application.

Singer and Brunk found significant intercorrelations among all the intellectual ability test items. Correlations of the Pintner Pictures subtest, vocabulary subtest, word study skills subtest, arithmetic reasoning subtest, and arithmetic application subtest with the Figure Reproduction Test were low and positive but generally not significant. Because of the low correlations obtained in the study, it was stated that there was little relationship between intellectual ability and success on the Figure Reproduction Test. Singer and Brunk suggested that the sample studied had already matured to the point where achievement becomes task-specific, thus possibly explaining the lack of significance.

E. Singer[1] undertook a study to compare the interrelationship of physical, perceptual-motor, and academic achievement variables in forty-two sixth-graders and thirty third-grade children. All subjects were students at the Illinois State

---

[1]Robert N. Singer, "Interrelationship of Physical, Perceptual-Motor, and Academic Achievement Variables in Elementary School Children," Perceptual and Motor Skills XXVII (December, 1968), pp. 1323-1332.

University Laboratory School, Normal, Illinois. The average Intelligence Quotient for the subjects was 116.5.

Various tests were administered. Intelligence potential and academic achievement were measured by the Lorge-Thorndike Test and Metropolitan Achievement Test. To determine grip strength in the preferred hand and unpreferred hand, a Stoelting hand dynamometer was used. The Elgin Multiple-Angle Testing Unit measured extension strength and flexion strength in the elbow and the hip.

Perceptual-motor ability was tested by the Figure Reproduction Test which was developed by Singer and Brunk. The subjects were also administered the Bounce-Ball-in-Basket Test for ball-throwing accuracy, and the Minnesota Rate of Manipulation Test to measure hand-arm movement speed. A stadiometer was used to measure each subject's height, and a standard scale was used to determine the weight of each subject.

The statistical evaluation for the third grade students revealed an average correlation of 0.35 on all measures. There were no significant correlations on motor and physical variables with the Lorge-Thorndike Verbal and Nonverbal Intelligence Quotients. Low but significant correlations were present on balance and discrimination reaction time scores with the Metropolitan achievement Test. There were also low but significant correlations on the grip strength tests and the elbow-flexion strength,

discrimination reaction time, height, weight, and the Figure Reproduction Test.

Analysis of data for the sixth-grade subjects were similar to those for the third-graders. Few coefficients of correlation attained significance. Only some of the strength tests correlated significantly with the intelligence test results. The interrelationship of the perceptual-motor, physical, and cognitive variables of the sixth-graders did not surpass those found for the third-graders.

In 1968 Costen[1] studied the relationship of selected perceptual-motor skills and academic achievement of sixty fourth-grade children. The subjects were attending elementary schools in Denton, Texas, during the spring semester of 1967-68.

The children were divided into two groups, achievers and underachievers, upon the basis of the results of the Kuhlmann-Anderson Test of intelligence and the Wide Range Achievement Test. The Purdue Perceptual-Motor Survey and the Lincoln-Oseretsky Motor Development Scale measured the selected perceptual-motor skills.

After analyzing the data, Costen indicated several important findings for the achievers. General dynamic coordination was significantly related to reading. None of

---

[1]Bettye Windham Costen, "A Study of the Relationship Between Perceptual-Motor Skills and Academic Achievement in Fourth-Grade Children" (unpublished Ph. D. dissertation, Texas Woman's University), 1968.

the perceptual-motor subtests related significantly to spelling. There was a negative significant relationship between arithmetic and the components identified as body image and differentiation, ocular control, and simultaneous voluntary movements. Balance, posture, and general dynamic movement related significantly to the total score upon the Wide Range Achievement Test.

For the underachievers the findings were comparable. Body image and differentiation related significantly to reading. None of the perceptual-motor skills subtests related significantly to spelling. Body image and differentiation, form perception, general dynamic coordination, and the total score of the Purdue Perceptual-Motor Survey correlated significantly to arithmetic. Body image and differentiation significantly related to the total score of the Wide Range Achievement Test.

For all subjects, subtests of the Wide Range Achievement Test were related significantly with the subtests of the Purdue-Motor Survey and Lincoln-Oseretsky Motor Development Scale. The Lincoln-Oseretsky Motor Development Scale was more discriminant than the Purdue Perceptual-Motor Survey. The correlations between the Purdue-Motor Survey and the Lincoln-Oseretsky Scale for the achievers was positive but low, and for the under-achievers, was positive though not statistically significant.

Upon the basis of the findings, Costen concluded that the relationships between perceptual-motor skills and academic achievement of fourth-graders were too low to be of predictive value. As expected, achievers performed significantly better than the underachievers on perceptual-motor skills.

Summary

The present investigation was concerned with a study of the relationship between perceptual-motor ability and intellectual ability of forty-six kindergarten-age children. The subjects were enrolled in the kindergarten class of the Texas Woman's University Demonstration School and the senior kindergarten class of the Selwyn School of Denton, Texas, during the academic year of 1969-1970.

In the foregoing chapter the investigator defined the terms used throughout the study and listed the limitations imposed upon the various aspects of the study. The hypotheses investigated were that there is no significant relationship between the Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale and the Figure Reproduction Test by Singer and Brunk, nor the Kuhlmann-Anderson Measure of Academic Potential Test, nor between the latter test and the Figure Reproduction Test by Singer and Brunk.

A review of selected related research has indicated that no previously completed investigation duplicated the present one. In the following chapter, the investigator will discuss the selection of instruments, the selection of subjects, procedures preliminary to the collection of data, sources of data, and methods of collecting data.

CHAPTER II

PROCEDURES FOLLOWED IN THE DEVELOPMENT OF THE STUDY

The present investigation entailed a study of the relationship between intellectual ability and the perceptual-motor skills of forty-six kindergarten age children enrolled in the kindergartens of the Selwyn School and the Texas Woman's University Demonstration School, of Denton, Texas, during the academic year of 1969-1970. Specifically, the Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale,[1] the Figure Reproduction Test by Singer and Brunk,[2] and the Seventh Edition, Form K, of the Kuhlmann-Anderson Measure of Academic Potential Test[3] were used to measure the variables of perceptual-motor skills and intelligence.

---

[1]Roger Pearman, "An Analysis of the Lincoln-Oseretsky Motor Development Scale with an Emphasis on the Reduction of Total Test Items" (unpublished Master's thesis, College of Education, Western Kentucky University), 1968.

[2]Robert N. Singer, "Interrelationship of Physical, Perceptual-Motor, and Academic Achievement Variables in Elementary School Children," Perceptual and Motor Skills XXVII (December, 1968), pp. 1323-1332.

[3]Rose G. Anderson, The Kuhlmann-Anderson Test, Princeton, New Jersey: Personnel Press, Inc., 1961).

Presented in this chapter are the procedures followed in the development of the study. The procedures are reported under the following headings: sources of data, preliminary procedures, selection and description of the intelligence test, selection and description of the perceptual-motor tests, selection of the subjects, procedures related to the collection and treatment of data, collection of data related to intelligence and academic achievement, treatment of data related to intelligence and academic achievement, collection of data related to perceptual-motor skills, treatment of the data, and the procedures related to writing the final written report. A summary concludes the chapter.

Sources of Data

Both human and documented sources were utilized in the development of the present study. The human sources included forty-six kindergarten-age children enrolled in the senior kindergarten of the Selwyn School, Denton, Texas, and the kindergarten of the Texas Woman's University Demonstration School, Denton, Texas, during the academic year of 1969-1970. Other human sources enlisted were school administrators and teachers in the same schools as well as authorities from the Texas Woman's University in the areas encompassed by the study.

The documentary sources consisted of books, periodicals, theses, dissertations, the Kuhlmann-Anderson Measure

of Academic Potential Test, the Singer-Brunk Figure Reproduction Test, and the Pearman modification of the Lincoln revision of the Oseretsky Test for Perceptual-Motor Ability.

Preliminary Procedures

A series of preliminary procedures were completed prior to the collection of data. Among these were reviewing related literature, conferring with qualified persons regarding various aspects of the study, selecting the instruments to be utilized in the collection of data, determining criteria for the inclusion of children in the study, developing and presenting a tentative outline for the study in a Graduate Seminar, revising the outline on the basis of suggestions offered by committee members, filing a prospectus in the Office of the Dean of Graduate Studies, and formulating plans for recording the data to be collected.

Selection and Description of Instruments

The data relating to intellectual ability and perceptual-motor skills were collected through the administration of standardized tests. The standard criteria of reliability, validity, objectivity, and administrative feasibility served as the basis for selecting each instrument.

Selection and Description of Intelligence Test

A number of tests for measuring intelligence have been standardized, and are recognized as reputable instruments

for use at the kindergarten level. Of the recognized tests, some are administered individually, primarily under clinical conditions, although the majority of the intelligence tests are used in school situations; and, therefore, of obvious necessity, are group tests. The Kuhlmann-Anderson Measure of Academic Potential Test was selected for use in the present study because the reviews were most favorable, as evidenced by Michael's statement concerning the ". . . carefully constructed items in various forms . . . " and ". . . several new features that are in agreement with a great deal of modern thinking about the assessment of knowledge."[1] The Kuhlmann-Anderson Measure of Academic Potential Test was also readily available.

All standard criteria are fulfilled by the Kuhlmann-Anderson Measure of Academic Potential Test, Seventh Edition, Form K. The test is appropriate for the kindergarten level, and is not prohibitive in time, needing approximately sixty to seventy-five minutes to complete the test. The test is not culturally biased and can be objectively evaluated. A coefficient of correlation for reliability of .85 was given.[2] Concurrent validity of the Kuhlmann-Anderson Measure of Academic Potential Test with other intelligence tests was

---

[1]William B. Michael, "Review of the Kuhlmann-Anderson Test," The Sixth Mental Measurements Yearbook (Highland Park, New Jersey: The Gryphon Press, 1965), p. 735.

[2]Anderson, Technical Manual, p. 20.

reported as 0.84.[1] Full descriptions in the Technical Manual enabled a facile administration, scoring, and interpretation of the collected data in a standard manner.

Selection and Description of the Perceptual-Motor Tests

Prior to the selection of the tests to be employed in measuring perceptual-motor skills, the investigator surveyed the related literature to determine inherent perceptual and motor functions. The test selected should test areas designated as perceptual-motor in nature; be reliable, valid, and objective; be administratively feasible for a classroom teacher; and possess scoring criteria which are clear enough so as not to elicit mere subjective evaluations.

Upon the basis of the foregoing criteria, the investigator, with the approval of the thesis director, selected the Singer-Brunk Figure Reproduction Test and the Pearman modification of the Lincoln Revision of the Oseretsky Motor Development Scale as measures of perceptual-motor skills for the present study. A description of the Singer-Brunk Figure Reproduction Test is presented in Appendix C. Addresses of where the other tests may be obtained are also presented in the Appendices.

The Singer-Brunk Figure Reproduction Test purports to measure the perceptual motor ability of elementary school

---

[1] Ibid., p. 15.

age children. Previous studies have indicated that this test would be well adapted to kindergarten-age children. A request was made for a copy of the original series of geometrical designs to be reproduced by the children being tested, but the test was not available.[1] Therefore, a series of eleven geometrical designs was developed and tested in a pilot study and was found acceptable.[2] Construct validity was assigned by Singer and Brunk to the initial test and was assumed for the new geometric figures developed by Herndon. No coefficient of correlation for reliability has been established for the modification of the Singer and Brunk Figure Reproduction Test used in the present investigation.

The Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale purports to measure general static coordination, dynamic manual coordination, general dynamic coordination, motor speed, simultaneous voluntary movements, and asynkinesia (lack of precision of movement, or surplus movement). In revising the initial Oseretsky test, Sloan excluded forty-nine of the original eighty-five items. Of those eliminated, many lacked reliability; some appeared too culturally or intellectually

---

[1]Robert N. Singer, personal letter.

[2]Herndon, Daisy E., unpublished study, Texas Woman's University, 1969.

loaded; others entailed the possibility of physical injury; and still others required expensive equipment. The remaining thirty-six items constitute the Lincoln revision of the Oseretsky Motor Development Scale. In modifying the Sloan revision of the Oseretsky test, Pearman eliminated all but seven of Sloan's forty-nine items on the basis of statistical analysis. The Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale was computed by Pearman to have a reliability coefficient of 0.86. Because Pearman used items that were part of the Lincoln revision of the Oseretsky Motor Development Scale, item validity was assumed to be similar to the original test. The time necessary to administer the Scale to each subject was approximately fifteen minutes. Scoring was objective, with items being scored upon the basis of a three point scale depending upon the number of trials one, two, or three, to pass a specified skill. Items are primarily novel skills; Therefore, learned responses are not believed to be elicited.

Selection of the Subjects

The following criteria were utilized in the selection of subjects. Each subject must (1) be a kindergarten-age child, from age five years, one month to six years, two months, (2) be enrolled in the kindergarten of the Texas Woman's University Demonstration School or the senior kindergarten of the Selwyn School in Denton, Texas, during the

academic year of 1969-1970, and (3) have no known uncorrected visual or auditory handicap.

Procedures Related to the Collection and Treatment of Data

The data upon which the present investigation was based were obtained through the following techniques: a study of available documentary materials, the administration of the Kuhlmann-Anderson Measure of Academic Potential Test, and the administration of the Singer and Brunk Figure Reproduction Test and the Pearman Modification of the Lincoln Revision of the Oseretsky Test for Perceptual Motor Ability.

Data pertaining to intelligence as measured by the Kuhlmann-Anderson Measure of Academic Potential Test was first collected from the kindergarten class of the Selwyn School. It was a group test, and only one administration was necessary. The following week data pertaining to perceptual-motor ability as measured by the Singer-Brunk Figure Reproduction Test was collected from the Selwyn School. For the latter test, one individual was tested at a time, and eight to ten subjects were tested daily. Approximately four weeks later, data pertaining to intelligence as measured by the Kuhlmann-Anderson Measure of Academic Potential Test was collected from the Texas Woman's University Demonstration School. Again, only one administration was necessary. The following week data pertaining

to perceptual-motor ability as measured by the Singer-Brunk Figure Reproduction Test was collected from the Texas Woman's University Demonstration School. One individual was tested at a time, and eight to eleven subjects were tested daily. Approximately five weeks later, the Pearman modification of the Lincoln Revision of the Oseretsky Motor Development Scale was individually administered to students of the senior kindergarten class at the Selwyn School. Testing four to six subjects daily, the investigator completed the measurements in five days. The following week the same test was individually administered to students of the kindergarten class at the Texas Woman's University Demonstration School. Testing four to six subjects daily, the investigator completed the measurements in four days. All data were analyzed by use of the Ollivetti-Underwood Programma 101 Desk Computer.

Collection of Data Related to Intelligence and Academic Achievement

The data related to intelligence were collected through the standard administration of the Kuhlmann-Anderson Measure of Academic Potential Test, Seventh Edition, Form K. Answer sheets were hand scored by the investigator and validated by other individuals. The two schools were tested four weeks apart, with all the subjects from each school present for a single testing period. No assistants were necessary.

The total composite raw scores from the Kuhlmann-Anderson Measure of Academic Potential Test were used in all computations.

Collection of Data Related to Perceptual-Motor Skills

The data related to perceptual-motor skills were collected through the administration of the Singer-Brunk Figure Reproduction Test and the Pearman modification of the Lincoln Revision of the Oseretsky Motor Development Scale.

For the Singer-Brunk Figure Reproduction Test, the score for each item was determined by the time needed for the reproduction of eleven figures. Each figure had a two minute time limit to be reproduced. The fewer seconds it took a subject to reproduce the geometrical figures, the better his score.

With regard to the Pearman Modification of the Lincoln Revision of the Oseretsky Test for Perceptual-Motor Ability, total raw scores for each of the subtests were used. Scores were determined by the subject either passing or failing to reproduce the movement in three trials.

Treatment of the Data

The Pearson Product-Moment Coefficient of Correlation was utilized to measure all relationships. The correlations were tested for significance by reading the Values of the

Correlation Coefficient for Different Levels of Significance Table.[1]

Procedures Related to Writing the Final Written Report

Upon completion of the statistical treatment of the data and the testing of the hypotheses of the study, the report was summarized, a conclusion determined, and the implications of the study discussed. The final procedures included making recommendations for further studies, compiling a bibliography, and developing an Appendix.

Summary

The procedures followed in the development of the study were presented in this chapter. Preliminary procedures involved the selection of instruments and the selection of subjects.

Instruments selected were the following: the Kuhlmann-Anderson Measure of Academic Potential Test as the measure of intelligence, the Singer-Brunk Figure Reproduction Test and the Pearman modification of the Lincoln revision of the Oseretsky Motor Development Scale as the measures of perceptual-motor skills.

---

[1]Sir Ronald A. Fisher and Frank Yates, Statistical Tables (New York: Hafner Publishing Company, Inc., 1963), p. 63.

Subjects for the study were forty-six kindergarten-age children enrolled in the kindergarten of the Texas Woman's University Demonstration School and the senior kindergarten of the Selwyn School of Denton, Texas.

All data were analyzed by the Pearson Product-Moment Coefficient of Correlation. Significance of the coefficients of correlation were determined through the use of appropriate tables. The final procedures included those related to summarizing and writing the final report. In Chapter III the investigator will present and analyze the data.

CHAPTER III

PRESENTATION AND ANALYSIS OF THE DATA

In this chapter the data will be presented and analyzed. Tabular and narrative formats are provided for ease of interpretation.

The purpose of the present study was to determine if a significant relationship exists between selected tests that may be used by classroom teachers to measure perceptual-motor ability and intellectual ability of kindergarten-age children. The majority of perceptual-motor tests are clinical in nature and either require special training and/or excessive time to be widely used. The two perceptual-motor tests used in the present study are 1) the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale, which is a derivitive of a well-known and frequently used test, and 2) a modification of the Singer-Brunk Figure Reproduction Test, which is a relatively new and untried instrument. Both of the tests were selected because they seemed appropriate to meet the stated purpose of the study, both were economical of time and appeared to be valid and reliable, although no previous study of kindergarten-age children has been reported with either test. The Kuhlmann-Anderson Measure of Academic Potential

Test was selected to measure intelligence on the basis of stated criteria.

Descriptive Data of the Sample Studied on the Selected Tests

The results of the Kuhlmann-Anderson Measure of Academic Potential Test for the participants from the kindergarten classes at the Texas Woman's University Demonstration School and the Selwyn School of Denton, Texas, were higher than the population as represented in the Kuhlmann-Anderson Test, Manual for Administering.[1] The mean Intelligence Quotient for the Seventh Edition booklets of the test is 100, and the Standard Deviation is 16. The mean Intelligence Quotient for the participants in the present study was 104.5, and the Standard Deviation was 12.2. The mean of the raw scores for the sample measured was 42.13. The standard deviation for the raw scores was 12.20, and the standard error of the mean was 1.80. Table 1, page 29 presents this data in tabular form.

There is no data with which to compare the results of perceptual motor ability of kindergarten-age children as measured by the Singer-Brunk Figure Reproduction Test. Previous studies involved other grade levels. The mean for this test on the sample measured was 10.78. The standard

---

[1]Anderson, Manual for Administering, p. 27.

deviation was 4.69, and the standard error of the mean was 0.69. Table 1 presents this data in tabular form.

TABLE 1

DESCRIPTION OF SUBJECTS WITH RESPECT TO THE KUHLMANN-ANDERSON MEASURE OF ACADEMIC POTENTIAL TEST, THE SINGER-BRUNK FIGURE REPRODUCTION TEST, AND THE PEARMAN MODIFICATION OF THE LINCOLN REVISION OF THE OSERETSKY MOTOR DEVELOPMENT SCALE

Test	Mean	Standard Deviation	SEM
K-A	42.13	12.20	1.80
S-B	10.78	4.69	0.69
P-L-O	17.17	7.44	1.10

Similarly, there is no data with which to compare the results of perceptual-motor ability of kindergarten-age children as measured by the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale. The mean on this test for the sample measured was 17.17. The standard deviation was 7.44, and the standard error of the mean was 1.10. Table 1 presents this data in tabular form.

Relationship Between the Singer-Brunk Figure Reproduction Test and the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale

Table 1 presents the relationship between the Pearman Modification of the Lincoln Revision of the Oseretsky Motor

Development Scale and the Singer-Brunk Figure Reproduction Test for the sample measured. The Pearson Product-Moment technique was used to obtain the coefficient of correlation for the two tests that were compared. The resulting correlation coefficient between the two tests was -0.89. This is significant at the .001 level of significance. A negative relationship was found because the data for the Singer-Brunk Figure Reproduction Test was obtained in seconds with the lowest scores being the better scores, while the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale was scored in points with the greatest number of points indicative of better performance. Thus, a student having a low score on the Singer-Brunk Figure Reproduction Test would tend to score high on the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale and vice versa. A high coefficient of determination ($r^2 = 0.79$) suggests that both tests measure approximately the same thing and, therefore, both may be used to measure perceptual-motor skills of kindergarten-age children.

Relationship Between the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale and the Kuhlmann-Anderson Measure of Academic Potential Test

The relationship between intellectual ability as measured by the Kuhlmann-Anderson Measure of Academic

Potential Test and perceptual-motor ability as measured by the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale was studied through the correlation of total scores. Partial scores were not considered. The Pearson Product-Moment Technique was used to determine the coefficient of correlation. The resulting coefficient of correlation between the two tests was 0.47, which is significant at the .001 level of confidence. Table 2 presents this coefficient of correlation.

TABLE 2

CORRELATION COEFFICIENTS AMONG VARIABLES

	S-B	K-A
P-L-O	* -.89	* 0.47
S-B		*-0.55

Significance for 44 degrees of Freedom at .05 = 0.29

* Significant at .001 level

The relationship of the two variables, the Kuhlmann-Anderson Measure of Academic Potential Test and the Pearman revision of the Lincoln Modification of the Oseretsky Motor Development Scale is not believed to be a chance factor, yet it is not high enough to consider for predictive purposes. It would seem that intelligence, as measured by the Kuhlmann-Anderson Measure of Academic Potential Test, and perceptual-motor ability, as measured by the Pearman Modification of the

Lincoln Revision of the Oseretsky Motor Development Scale, are positively related but not to a sufficiently high degree to ensure success reciprocally.

Relationship Between the Singer-Brunk Figure Reproduction Test and the Kuhlmann-Anderson Measure of Academic Potential Test

The relationship between intellectual ability as measured by the Kuhlmann-Anderson Measure of Academic Potential Test and perceptual-motor ability as measured by the Singer-Brunk Figure Reproduction Test were studied through the correlation of each total score. The Pearson Product-Moment Technique was used to determine the coefficient of correlation. The resulting coefficient of correlation between the two tests was -0.55. This coefficient of correlation was significant at the .001 level of significance. A negative correlation exists because the Singer-Brunk Figure Reproduction Test favors scores of decreasing value while the Kuhlmann-Anderson Measure of Academic Potential Test favors scores of increasing value. Similar to the relationship found to exist for the Pearman Modification of the Lincoln revision of the Oseretsky Motor Development Scale with the Kuhlmann-Anderson Test, the relationship for the Singer-Brunk Figure Reproduction Test with the Kuhlmann-Anderson Test is not a chance relationship, yet it is not high enough for predictive purposes.

Summary

In this chapter the investigator presented and analyzed the data. The findings of the study indicated that there was a highly significant negative relationship between the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale and the Figure Reproduction Test by Singer and Brunk. This negative relationship occured because the data for the Figure Reproduction Test by Singer and Brunk was obtained in seconds, with the lowest scores being the better scores, while the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale was scored in points with the greatest number of points indicative of better performance. A student having a low score on the Singer-Brunk Figure Reproduction Test would tend to score high on the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale and vice versa. A highly significant relationship between the two tests was also found. A highly significant negative relationship between the Singer-Brunk Figure Reproduction Test and the Kuhlmann-Anderson Measure of Academic Potential Test was similarly found. Neither of the latter two coefficients of correlation may be considered sufficiently high enough to suggest a predictive potential from raw scores.

Chapter IV will present a summary of the study. A test of the hypotheses, a conclusion to the study, and recommendations for further studies will be presented.

CHAPTER IV

SUMMARY, CONCLUSION, AND RECOMMENDATIONS FOR FURTHER STUDIES

Summary

The present investigation concerned a study of the relationship between perceptual-motor skills and intellectual ability of forty-six kindergarten-age children. The subjects were enrolled in the kindergarten of the Texas Woman's University Demonstration School and the senior kindergarten of the Selwyn School of Denton, Texas, during the academic year of 1969-1970.

The Kuhlmann-Anderson Measure of Academic Potential Test was employed to measure intellectual ability. The Figure Reproduction Test by Singer and Brunk and the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale were used to measure perceptual-motor skills. The Kuhlmann-Anderson Measure of Academic Potential Test is a standardized test with wide acceptance. It is a group test and was administered at both schools in two sessions. Standard directions were followed in the administration of the intelligence test. The Figure Reproduction Test by Singer and Brunk is a simple and quick, inherently interesting, inexpensive test of perceptual-motor skills

for kindergarten-age children. It may be given and interpreted by classroom teachers and used to screen children with perceptual-motor problems. Although the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale is a relatively new test, Pearman suggests there is a sufficiently high enough correlation with the Lincoln Revision of the Oseretsky Motor Development Scale that the modified test could be used by classroom teachers rather than the entire battery of tests included in the Lincoln Revision. The results of the three tests were treated with the Pearson Product-Moment Technique to determine coefficients of correlation between the tests.

Findings of the Study

An anlysis of the data revealed the following findings:

1. The correlation between the Singer-Brunk Figure Reproduction Test and the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale was negative and high ($r = -0.89$).

2. The correlation between the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale and the Kuhlmann-Anderson Measure of Academic Potential Test was positive but not sufficiently high to ensure success reciprocally ($r = 0.47$).

3. The correlation between the Singer-Brunk Figure Reproduction Test and the Kuhlmann-Anderson Measure of Academic Potential Test was negative but not high enough for predictive purposes ($r = -0.55$).

Tests of the Hypotheses

Upon the basis of the results of the analysis of data, the following hypotheses were tested:

Hypothesis I

> There is no significant relationship between the Pearman modification of the Lincoln Revision of the Oseretsky Motor Development Scale and the Figure Reproduction Test by Singer and Brunk.

A significant difference at the .001 level of probability as determined from the Values of the Correlation Coefficient for Different Levels of Significance Table[1], led to the rejection of the Null hypothesis.

Hypothesis II

> There is no significant relationship between the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale and the Kuhlmann-Anderson Measure of Academic Potential Test.

A highly significant coefficient of correlation ($r = 0.47$), was found between the two tests, therefore, the Null hypothesis was rejected.

---

[1]Fisher and Yates, Statistical Tables, p. 63.

Hypothesis III

There is no significant relationship between the Figure Reproduction Test by Singer and Brunk and the Kuhlmann-Anderson Measure of Academic Potential Test.

The high significant difference ($P<.001$) found between the Singer-Brunk Figure Reproduction Test and the Kuhlmann-Anderson Measure of Academic Potential Test in the study led to the rejection of the Null hypothesis.

Conclusion

The Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale and the Singer-Brunk Figure Reproduction Test seem to measure similar aspects of perceptual-motor skill, and although they do not have a high predictive relationship with intelligence, they are related to intelligence in more than a casual way.

Other tests of perceptual-motor skill usually require either special equipment, specialization in psychometrics, and/or a longer testing period than the Singer-Brunk Figure Reproduction Test and the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale. Because the Motor Development Scale test requires special equipment and has a copyright, it is believed that the Singer-Brunk Figure Reproduction Test, which consists of only one piece of equipment and is simple to build, should be the preferred test for classroom teachers to screen

children for perceptual-motor problems at the kindergarten-age level.

Limitations

Should the investigator repeat the study, the following changes would be made:

1. Coefficients of correlation for reliability would be determined for the kindergarten population to further strengthen the results of this study.

2. The investigator would utilize an assistant during the administration of all tests in order to facilitate the collection of data.

Recommendations for Further Studies

The present investigation was necessarily limited in scope. Varied approaches and research designs are needed to resolve questions related to perceptual-motor proficiency; therefore, the following recommendations for further studies are offered:

1. A study of the interrelationships of intelligence and perceptual-motor skills of subjects at extreme levels of perceptual-motor performance, expecially for the pre-school and elementary school-age children.

2. A study of the relationships of a wide variety of tasks in perceptual discrimination to motor skill of subjects with extreme levels of skill in various sports

and modern dance with kindergarten-age children

3. A study of the relationship of a wide variety of tasks of perceptual discrimination to the attainment of skill of beginners in various sports and modern dance.

4. Testing a larger sample of kindergarten-age subjects to determine coefficients of correlation for reliability and validity.

5. Comparing the kindergarten-age student with younger and older children with respect to perceptual-motor skills as determined by the Singer-Brunk Figure Reproduction Test.

APPENDICES

APPENDIX A

DESCRIPTION OF INTELLIGENCE TEST

The Kuhlmann-Anderson Test[1]

Administration of the Test. Materials necessary for the test include: Form K test booklets, pencils, a stop watch, a manual of directions for administering the tests, a manual which contains directions for scoring tests and interpreting scores, a technical manual.

In the Texas Woman's University Demonstration School, the test was administered in the cafeteria. The test at the Selwyn School was administered in a classroom. A rearrangement of the facility, and lack of interruptions, somewhat remediated the otherwise disadvantageous situation. The investigator administered the test in its entirety, and no assistants were necessary.

The investigator followed the directions as they appear in the Manual for Administering the Kuhlmann-Anderson Test with a copyright of 1963 and revised in 1965. It may be obtained from Personnel Press, Inc., Princeton, New Jersey.

---

[1]Rose G. Anderson, The Kuhlmann-Anderson Test (Princeton, New Jersey: Personnel Press, Inc., 1961).

APPENDIX B

DESCRIPTION OF PERCEPTUAL-MOTOR TESTS

Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale

Administration of the Test. Equipment consisted of the kit for the Lincoln-Oseretsky Motor Development Scale, a stopwatch, a well-lighted, relatively spacious room free from extraneous objects, a table and chair suited to the child's height. Physical conditions for testing were ideal. The clinic room was used at the Texas Woman's University Demonstration School, and a classroom was used at the Selwyn School.

The directions for the administration of each of the following seven items of the Pearman Modification of the Lincoln Revision of the Oseretsky Motor Development Scale were taken directly from the Manual for the Lincoln-Oseretsky Motor Development Scale:[1]

Test Item 5	Touching Fingertips
Test Item 13	Making a Ball
Test Item 14	Winding Thread
Test Item 16	Describing Circles in the Air
Test Item 17	Tapping
Test Item 20	Placing Matchsticks in a Box
Test Item 31	Tap Feet and Describe Circles

The Manual may be obtained from the Stoelting Company, Chicago, Illinois.

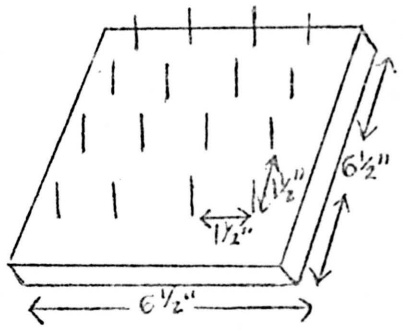
---

[1]William Sloan, Manual for the Lincoln-Oseretsky Motor Development Scale (Chicago: The Stoelting Company, 1954).

APPENDIX C

The Singer-Brunk Figure Reproduction Test

Administration of the Test. Equipment consisted of a stopwatch, which was used to time performance with a maximum of two minutes allowed for completion of each of the eleven tests, rubberbands with which to reconstruct geometrical patterns (from a simple line to very complex patterns) presented to subjects on a piece of paper, a well-lighted, relatively spacious room free from extraneous objects, a table and chair suited to the child's height, and a $6\frac{1}{2}$" x $6\frac{1}{2}$" board with sixteen nails $1\frac{1}{2}$" apart as illustrated.



The geometrical figures used and the recording sheet are presented in this appendix.

Verbal Directions.

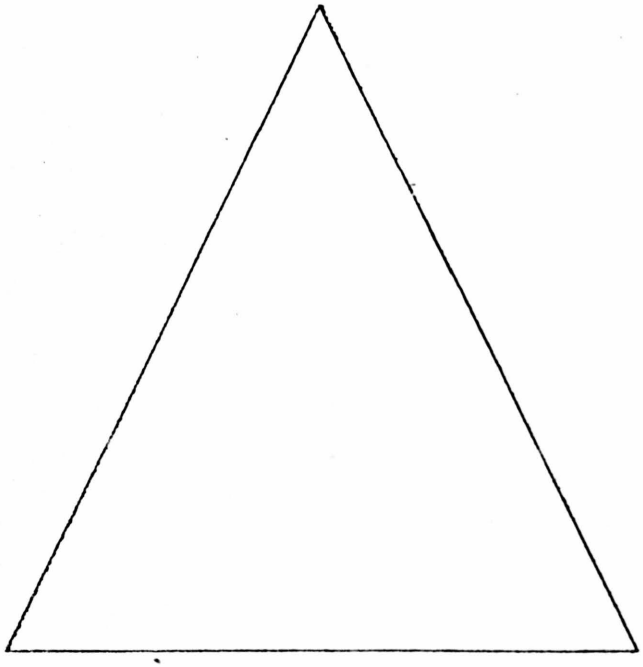
> There are some pictures in this book. Can you make the same pictures with this rubberband, using the nails in this board to hold the rubberband in place? Try to make your picture the size of the picture you see.
>
> Here is the first picture. Can you make the rubberband look like this picture, using the nails

> in this board to hold the rubberband in place? Try to make your picture the size of the picture you see.

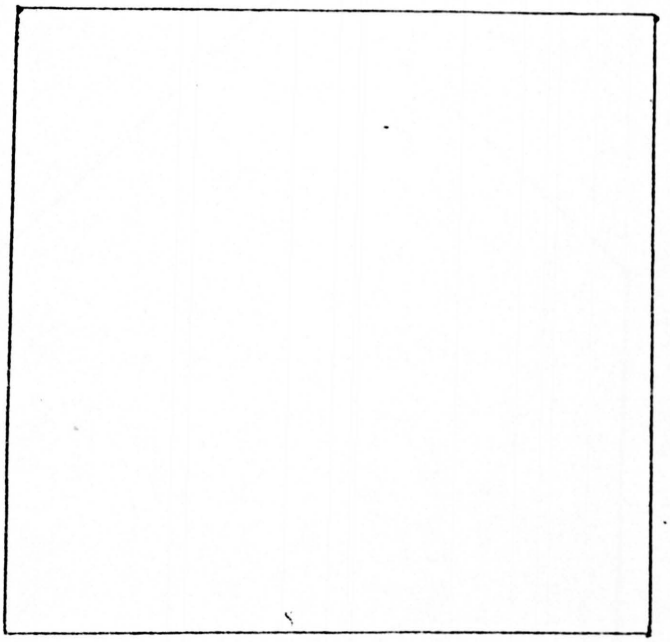
The latter paragraph preceeded each picture. After two minutes were spent on an uncompleted picture, the investigator would ask, "Would you like to try the next picture?" The answer without exception from the subject was "Yes." So, the subject attempted the next picture.

DESIGN NUMBER 1

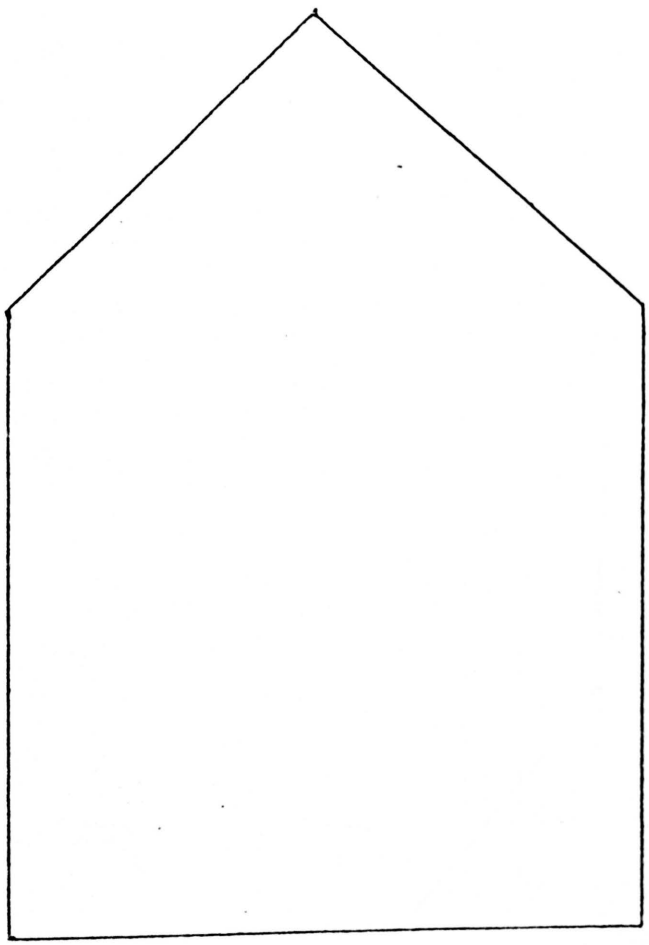
DESIGN NUMBER 2



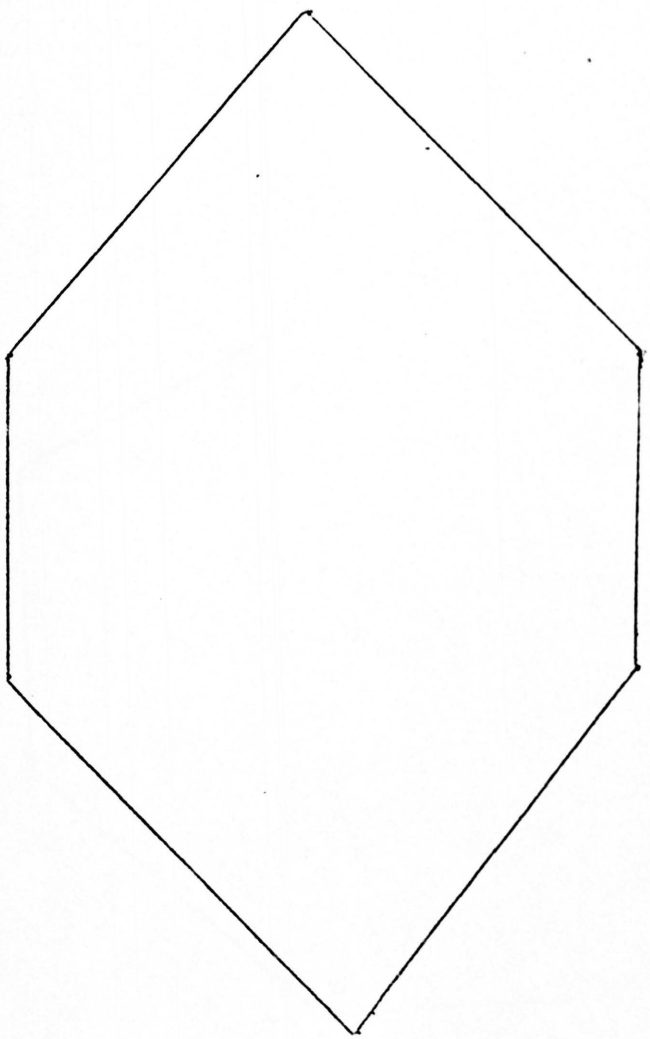
DESIGN NUMBER 3



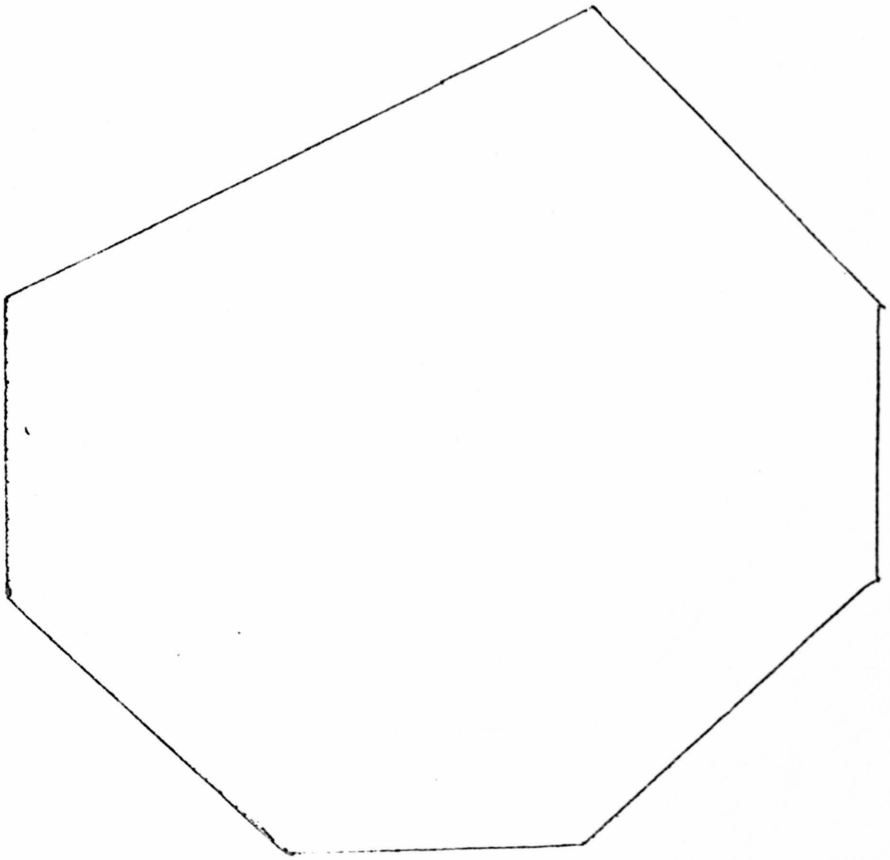
DESIGN NUMBER 4



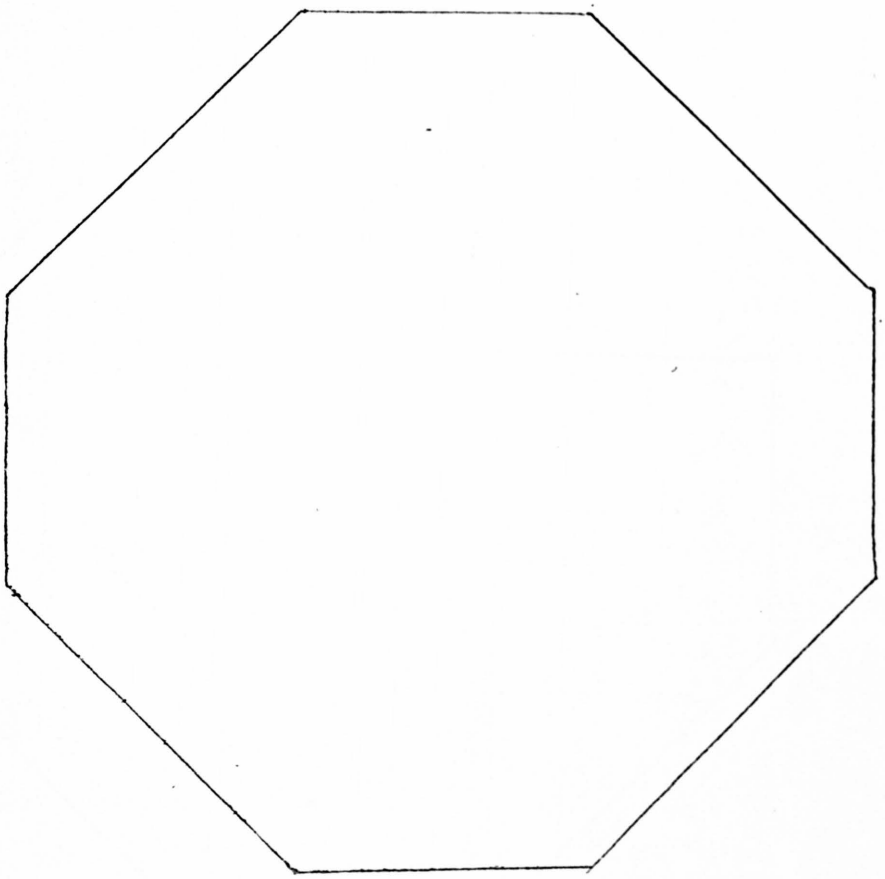
DESIGN NUMBER 5



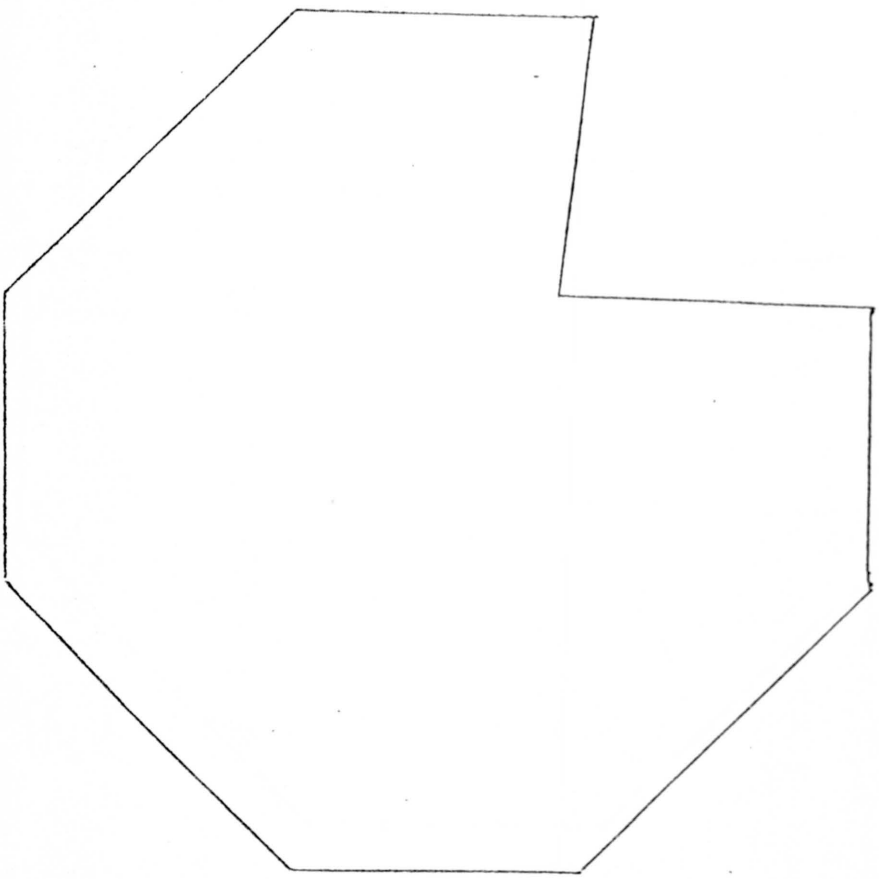
DESIGN NUMBER 6



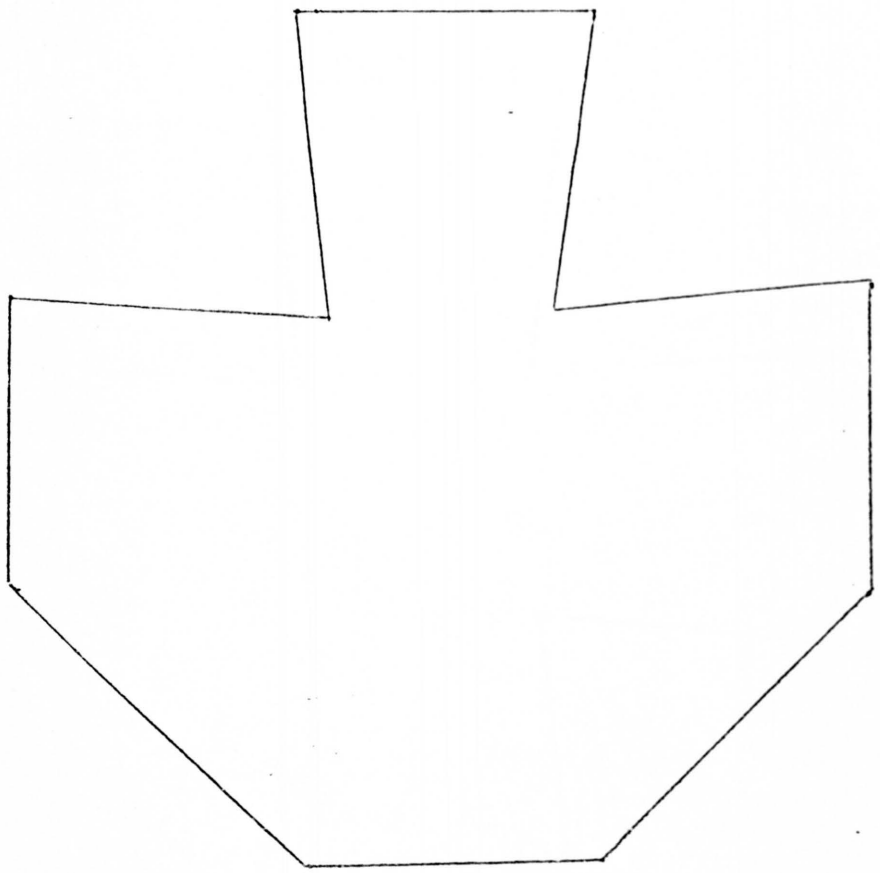
DESIGN NUMBER 7



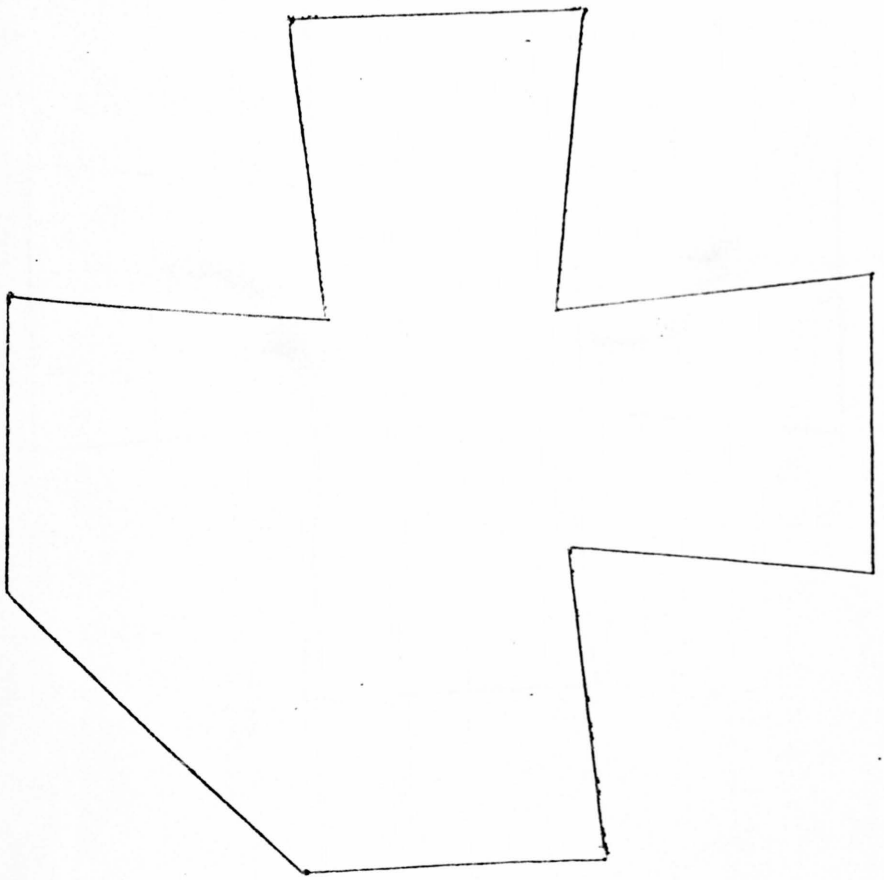
DESIGN NUMBER 8



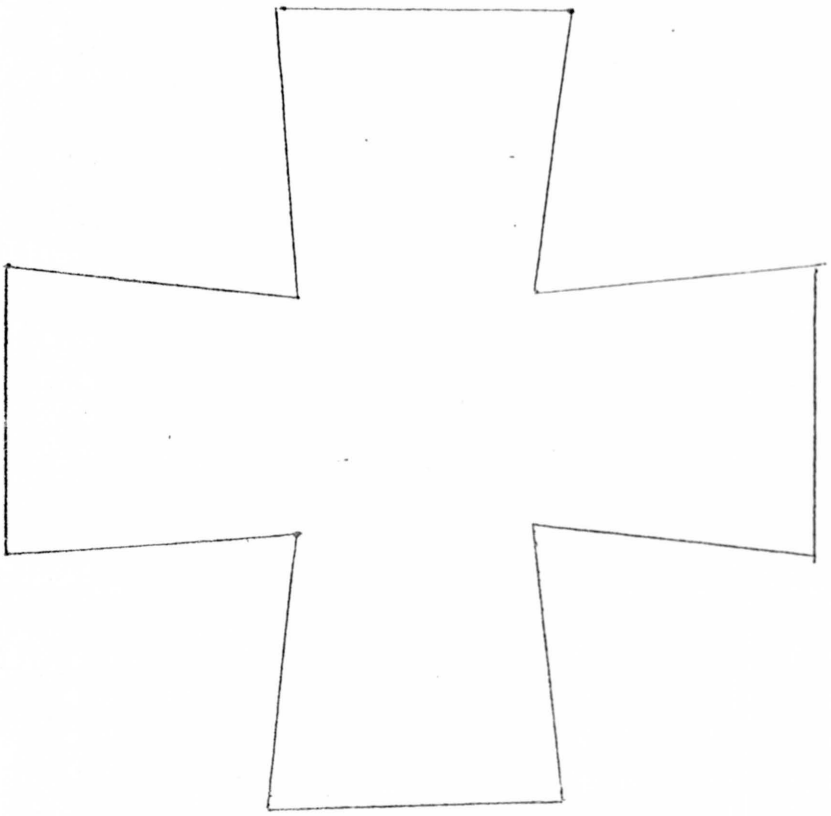
DESIGN NUMBER 9



DESIGN NUMBER 10



DESIGN NUMBER 11

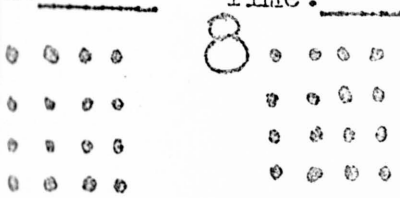


erceptual Motor Ability Date____ School____

tal Time:
bject #:

me:_____ 7 Time:_____

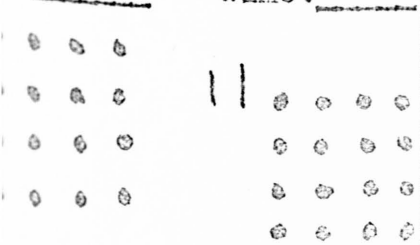
me:_____ Time:_____ 8



ne:_____ Time:_____ 9

ne:_____ Time:_____ 10

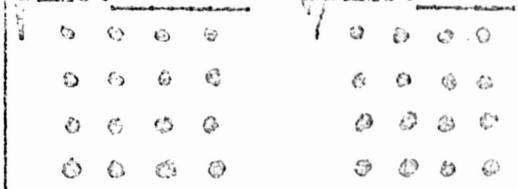
e:_____ Time:_____ 11



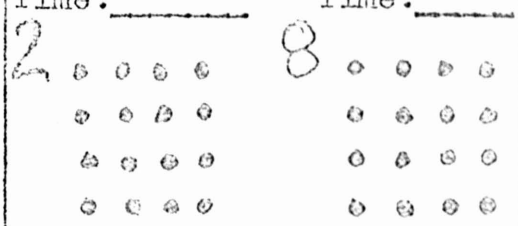
:_____ Time:_____

Total Time:
Subject #:

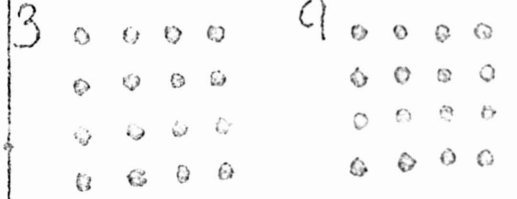
Time:_____ 7 Time:_____



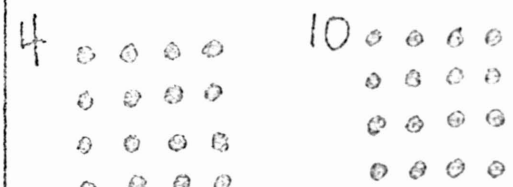
Time:_____ 8 Time:_____



Time:_____ 9 Time:_____



Time:_____ 10 Time:_____

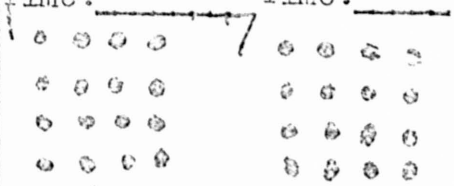


Time:_____ 11 Time:_____

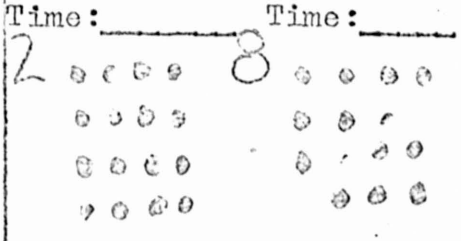
Time:_____ 6 Time:_____

Total Time:
Subject #:

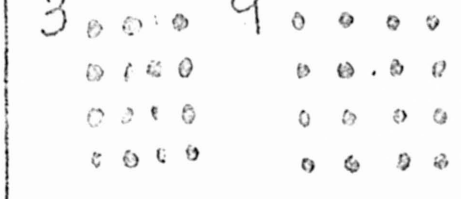
Time:_____ 7 Time:_____



Time:_____ 8 Time:_____

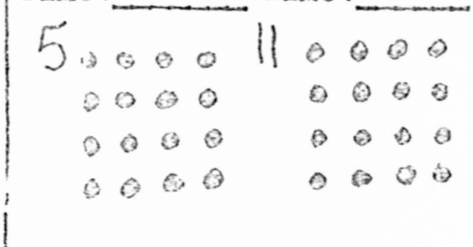


Time:_____ 9 Time:_____



Time:_____ 10 Time:_____

Time:_____ 11 Time:_____



Time:_____ 6 Time:_____

APPENDIX D

STATISTICAL FINDINGS

X*	Y*	Z*	Correlations
$\overline{X}$ = 10.7826	$\overline{X}$ = 42.1304	$\overline{X}$ = 17.1739	rXY = -0.5462
X = 21.9964	Y = 148.8554	Z = 55.3180	rXZ = -0.8876
X = 4.6900	Y = 12.2006	Z = 7.4376	rYZ = 0.4700
SEmX = 0.6915	SEmY = 1.7988	SEmZ = 1.0966	

*X = Singer-Brunk, Y = Kuhlmann-Anderson, Z = P-L-O

RAW DATA

Subject Number	Chronological Age	P-L-O Raw Scores	S-B Raw Scores	K-A Raw Scores
1	5.9	18	11	45
2	5.6	20	12	41
3	5.7	30	03	55
4	5.3	29	03	53
5	5.3	08	14	30
6	5.1	12	13	27
7	5.5	16	12	39
8	5.10	14	15	39
9	5.4	06	19	14
10	5.4	11	15	27
11	5.3	06	17	21
12	5.6	17	11	42
13	5.6	25	06	50
14	5.10	19	11	46
15	5.11	21	09	49
16	5.1	28	04	27
17	5.7	23	07	48
18	5.6	25	06	50
19	5.1	05	09	35
20	5.1	21	09	37
22	5.11	28	04	57
23	6.0	12	11	50
24	5.7	09	14	35
25	6.0	26	05	56
26	5.3	31	02	17
27	6.1	12	13	47
28	5.4	12	13	31
29	5.5	06	20	32
20	5.10	16	14	54
31	5.5	11	15	45
32	5.6	10	17	31
33	5.7	23	08	53
34	5.5	17	10	57
35	5.9	31	03	57
36	5.4	17	16	36
37	5.4	13	14	30
38	6.2	16	09	59
39	5.9	13	11	56
40	5.10	10	15	37
41	5.9	22	07	63
42	5.8	15	14	37
43	5.7	13	11	42
44	6.1	09	17	39
45	6.1	17	08	58
46	5.10	31	03	58

BIBLIOGRAPHY

LITERATURE CONCERNING PERCEPTUAL-MOTOR DEVELOPMENT IN RELATION TO INTELLECTUAL POTENTIAL

Books

Anderson, Rose G. The Kuhlmann-Anderson Test. Princeton, New Jersey: Personnel Press, Inc., 1961

Espenschade, Anna S. and Eckert, Helen M. Motor Development. Columbus, Ohio: Charles E. Merril, 1967.

Fisher, Sir Ronald A. and Yates, Frank, Statistical Tables. New York: Hafner Publishing Company, Inc., 1963.

Michael, William B. "Review of the Kuhlmann-Anderson Test." The Sixth Mental Measurements Yearbook. Highland Park, New Jersey: The Gryphon Press, 1965.

Sloan, William. Manual for the Lincoln-Oseretsky Motor Development Scale. Chicago: C. H. Stoelting Company, 1954.

Periodicals

Oseretsky, Nicolaus I. "A Method of Group Rating of Motor Abilities in Childhood and Youth." Gosmedizat. Moscow, (original in Russian), 1929, pp. 60, quoted in Lassner, Rudolf, "Annotated Bibliography of the Oseretsky Tests of Motor Proficiency, Journal of Consulting Psychology, Vol. 12, 1948, pp. 37-47.

Oseretsky, Nicolaus I. A Metric Scale for Studying the Motor Capacity of Children, 1923, p. 24. Quoted in Rudolf Lassner, "Annotated Bibliography on the Oseretsky Tests of Motor Proficiency." Journal of Consulting Psychology, Vol. 12, 1948, p. 40.

Singer, Robert N., and Brunk, Jason W. "Relation of Perceptual-Motor Ability and Intellectual Ability in Elementary School Children." Perceptual and Motor Skills, Vol. XXIV (June, 1967), pp. 967-970.

Singer, Robert N. "Interrelationship of Physical, Perceptual-Motor and Academic Achievement Variables in Elementary School Children." Perceptual and Motor Skills, Vol. XXVII (December, 1968), pp. 1323-1332.

Sloan, William. "Motor Proficiency and Intelligence." American Journal of Mental Deficiency, Vol. 55, (1951), pp. 404-405.

Unpublished Materials

Costen, Bettye Windham. "A Study of the Relationship between Perceptual-Motor Skills and Academic Achievement in Fourth-Grade Children." Unpublished Ph. D. Dissertation, College of Health, Physical Education, and Recreation, The Texas Woman's University, Denton, Texas, 1968.

Herndon, Daisy E. Unpublished Study, College of Health, Physical Education, and Recreation, The Texas Woman's University, 1969.

Oseretsky, Nicolaus I. "Methods of Investigating Motor Components." Zietschrift fur Angewandte Psychologie. XVII, (1931), p. 162, English Translation by Elizabeth Lang, unquoted in Thams, Paul Fredrik, "A Factor Analysis of the Lincoln-Oseretsky Motor Development Scale." (Unpublished Ph. D. Dissertation, University of Michigan, 1955).

Pearman, Roger. "An Analysis of the Lincoln-Oseretsky Motor Development Scale with an Emphasis on the Reduction of Total Test Items." Unpublished Master of Science Thesis, College of Education, Western Kentucky University, Bowling Green, Kentucky, 1968.

Singer, Robert N. personal letter, July 25, 1969.