THE RELATIONSHIP BETWEEN PERCEPTUAL-MOTOR DEVELOPMENT AND INTELLECTUAL ABILITY IN CHILDREN IN GRADES ONE THROUGH FOUR

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The Relationship Between Perceptual-Motor Development and Intellectual Ability in Children in Grades One Through Four

by

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Abstract

The present study investigated the relationship between perceptual-motor development and intellectual ability in a selected group of children in St. John's, Newfoundland. Relationships were also studied when the sample was divided according to Grade Levels One through Four, high and low intellectual achievement levels, and sex.

The sample consisted of 100 students. The Purdue Perceptual-Motor Survey was administered to test perceptual-motor development and the Ravens Coloured Progressive Matrices to test intellectual ability.

The major findings of the study were as follows:

1. A Pearson product moment correlation coefficient established a significant relationship between perceptual-motor development and intellectual ability for the total sample.
2. Significant relationships were also found for Grade Levels One, Two, and Three, when the sample was divided according to grade level. There was no significant correlation between perceptual-motor development and intellectual ability, however, for Grade Four subjects.
3. Partial correlations, with the effects of grade level controlled, revealed a significant relationship between perceptual-motor development and intellectual ability for both high and low intellectual achievers.

4. A significant relationship was also found between the two variables for both boys and girls through a partial correlation controlling the effects of grade level.

The findings of the study did not, however, show a perfect correlation between the two variables. This seems to indicate that teachers can, therefore, expect to find some low intellectual achievers who have little or no difficulty in performing perceptual-motor activities; and likewise they can expect to find some high intellectual achievers who do not perform well on perceptual-motor activities. The support for the hypotheses of the study and the theory from which they were derived served to confirm the basic theory underlying the Kephart-Roach research.

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CHAPTER I

INTRODUCTION TO THE PROBLEM

Records indicate that man has continually shown concern about the nature of intelligence. Philosophers dating back to the Golden Age of Greece have pointed to the interest in how learning takes place, in what ways memory may be enhanced, and how events are organized and interpreted.

These same concerns may be seen in writings by scholars in more recent history. Two related problems have emerged: (a) What is the makeup of human intelligence? and (b) How may cognitive functioning be enhanced through exposure to formal and informal educational experiences?

Relationships between intellectual and physical functions were explored by the first experimental psychologists in England, Germany, and the United States toward the latter part of the 1800's. Since some of the first psychological experiments by William Wundt in Leipzig involved tests of simple sensory-motor functioning, tests of reaction time, and the accuracy of the "muscle sense," it seemed logical to Cattell in the United States and Sir Francis Galton in England, to determine whether these basic measures were in some way predictive of so-called higher intellectual functions. They were aided in their search by Karl Pearson, a student of Galton's, and others who began to develop and refine basic statistical tools, including the concepts underlying averaging, distribution statistics, and correlation coefficients (Anastasi, 1968, p. 8).

Observing the obvious motor incoordination in many retarded children, these early experimental psychologists tried to determine whether basic motor and sensory measures could predict the degree of academic and cognitive abilities possessed by individuals along the scale of intelligence.

However, careful comparisons of the manner in which basic tests of sensory and motor functioning ranked people, contrasted to the way in which tests of verbal comprehension, problem solving abilities, and similar measures ranked these same individuals, failed to show even moderate relationships. So, in spite of the obvious fact that the severely retarded inevitably show rather marked motor problems, children with subnormal, average, and superior intelligence were found to reflect a wide variety of basic movement attributes when exposed to simple laboratory tests sampling the quality of their sensory and motor faculties (Crow & Crow, 1958, p. 291).

During these same years, however, several educators persisted in the belief that placing the child in situations which involve action might have educational advantages, and that certain performance tests might be at least partly predictive of how a child might function in life situations. So, standardized intelligence tests began to be expanded to include "performance" items, which were intended to tap certain perceptual and motor qualities (Anastasi, 1968, p. 9).

During the last two decades, perceptual-motor development has received much attention as one of the prerequisites for both academic and intellectual achievement. There have been conflicting theories as to what is meant when one refers to the perceptual-motor domain. Cohen (1968) defined it as

> All those functions of the body that have a voluntary motor component and depend upon some kind of sensory feedback and some kind of sensory perception prior to the motor act. (p. 25)

Keogh and Smith (1968), in reply to Cohen's definition of the term, maintained that the term could be reversed to motor-perceptual ability because the two terms could not be divorced, nor could a distinction be made between what is perceptual and what is motor.

Noting the manner in which infants seem to explore their worlds in direct ways, Kephart has suggested that motor activities are imperative for the development of perceptual abilities. Also, that these abilities are the basic supports of all learning, including academic tasks requiring higher levels of intellectual functioning (Kephart, 1960, p. 230). So, as would be expected, Kephart's program advocates the extensive use of movement activities, sometimes paired with visual exploration, which will purportedly heighten the child's perceptual awareness of his world and lead to more successful functioning in a variety of endeavors. Kephart maintained that

> To deal with our symbolic material the child requires a stable spatial world. Such a stable spatial world can be established only through the development of a system of spatial relationships learned first in the motor activities of the child and later projected onto perceptual data. (p. 230)

Frostig (Belmont, 1973), another proponent of this theory, took a similar view in suggesting that a

> sensory motor phase is the first in a developmental sequence which leads to "language" and "perceptual" phases and then to the development of higher cognitive processes. (p. 321)

There have been research studies (Bradley, 1971; Fisher, 1970; O'Connor, 1968; Slacks, 1969) which did not agree that mastery of lower (perceptual-motor) processes is necessary to higher (cognitive) processes. Individuals who reported such studies noted that some children, when given extensive training in perceptual-motor tasks, were able to show an improvement in tasks involving identical cognitive processes but showed no significant increase in school achievement. The performance profile of these children raised a serious question concerning the relationship between perceptual-motor development and intellectual achievement. Obviously, researchers have been unable to answer the question completely. There seems to be a need for further investigation pertaining to the relationship between perceptual-motor development and intellectual achievement.

Although, as indicated, there have been conflicting theories as to what constitutes the perceptual-motor domain, the present study attempts to deal with two areas which generally have been accepted as being within the domain: kinesthetic awareness and visual perception.

Statement of the Purpose

The purpose of this study was to provide additional information concerning the relationship between perceptual-motor development and intellectual ability. Relationships were also studied when the sample was divided according to grade levels, intellectual achievement levels, and sex.

It appears that many of the studies which have been conducted in this area have dealt with perceptual-motor development and low intellectual achievers. The basic premise of such studies seems to be that low perceptual-motor achievement is related to low intellectual ability. However, leading proponents in the area of perceptual-motor development (Kephart, 1960; Frostig, 1968; Roach, 1966) have claimed that perceptual-motor development is a prerequisite to high intellectual ability as well. Before such a theory can be universally accepted, more pertinent information concerning the relationship between perceptual-motor development and high intellectual achievers seemed needed. Because the subjects who participated in the present study were both low and high intellectual achievers, it was believed that additional information could be obtained concerning the relationship between perceptual-motor development and intellectual ability.

Statement of the Problem

The problem of the study was to investigate the relationship between performance on a perceptual-motor test and performance on an intellectual ability test. Relationships between performance in the two areas were also studied for subgroups based on grade levels, intellectual achievement levels, and sex.

The research question investigated was:

Is there a significant positive relationship between perceptual-motor development and intellectual ability?

Major Hypotheses

1. There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability.
2. There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to grade levels:
   a. Grade One
   b. Grade Two
   c. Grade Three
   d. Grade Four
3. There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to intellectual achievement groups:

a. high intellectual achievement
b. low intellectual achievement

controlling the effects of grade level.

4. There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to sex:

a. boys
b. girls

controlling the effects of grade level.

The .05 level of confidence was selected as the criterion for establishing the statistical significance of the correlation coefficients.

Definition of Terms

The following definition of terms apply to this study:

Intellectual ability: The level of performance attained on the Ravens Coloured Progressive Matrices (RCPM).

High intellectual achievers: Those students who were achieving above grade level as judged by the students' past and present school teachers.

Low intellectual achievers: Those students who were achieving below grade level as judged by the students' past and present school teachers.

Achievement levels as used in this study can be considered only as a nominal variable since it is considered across grade levels. High achievement can be ranked above low achievement for any one grade level. However, the relationship between high achievement in a low grade and low achievement in the successive grade is not in any predetermined order.

Perceptual-motor ability: The level of performance attained on the Purdue Perceptual-Motor Survey (PPMS).

Setting of the Study

The study was conducted in MacDonald Drive Elementary School and Vanier Elementary School, St. John's, Newfoundland.

The sample of 44 girls and 56 boys included in this study was restricted to pupils selected from Grades One, Two, Three, and Four enrolled at MacDonald and Vanier schools during the 1978-79 school year.

Procedures

The procedures employed in the study were:

1. Permission to conduct the study was obtained from the Avalon Consolidated School Board and both school principals involved.
2. Information pertaining to sex, grade level, and chronological age of the children was obtained.
3. The following tests were administered to 100 children in grade levels one through four.
   - (a) Ravens Coloured Progressive Matrices (RCPM) to measure intellectual ability.
   - (b) Purdue Perceptual-Motor Survey (PPMS) to measure perceptual-motor development.

Analysis of the Data

Pearson product moment correlations were found between scores on the RCPM and the PPMS for the sample as a whole and for each grade level. Partial correlations, with the effects of grade level controlled, were found for each sex and achievement level.

Limitations of the Study

1. Selection of subjects was limited to MacDonald and Vanier Schools. Generalization to other populations is not possible.
2. The Purdue Perceptual-Motor Survey was scored through subjective ratings. Although an acceptable interjudge reliability coefficient was calculated, this margin of error must be considered.
3. Norms of the tests were based on scores made by children in the United States.

Summary

In Chapter I the general rationale for the study was given. The problem and hypotheses tested were presented. Included also were limitations of the study and definition of terms.

The related literature is reviewed and discussed in Chapter II. Chapter III includes a detailed description of the instruments, sample, procedures, and statistical treatment of the data. The results of the analysis of the data are reported in Chapter IV. Chapter V includes a summary of the investigation, conclusions, implications, and recommendations for possible further study.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study was to provide additional information concerning the relationships between perceptual-motor development and intellectual ability of a selected group of children in St. John's, Newfoundland. Relationships were also studied when the population was grouped according to grade levels, intellectual achievement levels, and sex.

Inherent in the theories of Delacatto (1963), Frostig (1968), and Kephart (1960) is the basic assumption that adequate conceptual development is dependent upon accurate visual-perceptual-motor skills. This assumption was also supported, to a great extent, by the theoretical formulations of Bruner (1957), Gibson (1969), Inhelder and Piaget (1964), Vernon (1960), and Wohlwill (1962). Based on the theories purported by these writers, it appears that there is a precise relationship between perceptual-motor ability and conceptual ability. A comprehensive review of the literature, however, reveals some contradictory evidence relative to a relationship between tested perceptual-motor abilities and intellectual ability.

The review of the literature presented in this investigation includes only those studies and/or reports which are concerned with perceptual-motor development and its relationship to intellectual ability. Particular attention is devoted to studies which dealt with the relationships for: (a) grade level groups and performance on perceptual-motor tests and intellectual ability tests; (b) high and low achievement level groups and the relationship between performance on perceptual-motor tests and intellectual ability tests; and (c) sex groups and the relationship between performance on perceptual-motor tests and intellectual ability tests.

The review of the literature is presented in the following order: (a) literature concerned with grade levels and performance on perceptual-motor tests and tests of intellectual ability; (b) literature concerned with intellectual achievement levels and performance on perceptual-motor tests and tests of intellectual ability; and (c) literature concerned with sex and performance on perceptual-motor tests and tests of intellectual ability. Research reported in the literature has been presented in the section which seemed most nearly related to the primary group of variables to be considered in the study.

Grade Level: Perceptual-Motor Performance and Intellectual Relationship

The majority of research that has been conducted with perceptual-motor relations has related perceptual-motor ability to reading. It was not until the middle 1960's that an interest was shown in investigating the relationships of perceptual-motor ability to the area of intelligence. Therefore, only a limited amount of research that has been conducted pertaining to the relationship between perceptual-motor ability and intellectual ability is available.

Egeland (1967) investigated the relationship of visual-motor skills with intellectual achievement. The Bender-Gestalt Test was used to measure visual-motor skills. The intelligence criteria consisted of scores on the Word Knowledge, Word Discrimination, Reading, and Arithmetic tests of the Metropolitan Achievement Tests, Primary I Battery, Form A. The sample contained 117 randomly selected grade one boys from the Iowa City School District. The mean age of the subjects was 6 years and 7 months. The mean Wechsler Intelligence Scale for Children (WISC) Full Scale IQ score was 112.8 with a standard deviation of 12.1. The results were a significantly positive correlation between the Bender-Gestalt scores and the WISC scores.

Thomas and Chissom (1974) conducted a study for the purpose of predicting grade one intellectual performance. Data were selected on two perceptual-motor variables and one intellectual measure for 38 kindergarten children. During the kindergarten year, the subjects were administered the Frostig Developmental Test of Visual Perception and the Shape-O Ball Test to measure perceptual-motor ability. Composite teacher ratings were used to measure intellectual ability. One year after the kindergarten data were collected, the 28 grade one children who remained from the original population were administered the Metropolitan Reading Test. Results of the study indicated that all of the predictor measures were, in fact, poor predictors of grade one performance. Thomas and Chissom atated that the failure of these perceptual-motor measures to predict grade one performance may have been due to several factors such as maturation, environmental influences, or subject mortality resulting in a biased sample.

Keogh and Smith (1967) conducted a longitudinal study of the relationship between visual-motor performance and intellectual ability beginning at the kindergarten level. The Bender-Gestalt Test was used to measure the visual-motor performance of 73 kindergarten children selected from a middle-class California school district. Six years later, the intellectual achievement of these same subjects was determined by the Iowa Test of Basic Skills. A correlational analysis of the data revealed that a significantly positive relationship did exist between the perceptual-motor scores obtained during the kindergarten year and the intellectual achievement scores made by the same subjects six years later. The researchers further reported that the Bender-Gestalt was 82% accurate in predicting grade six reading achievement. Keogh and Smith, therefore, maintained that the Bender-Gestalt was a useful predictor of educational ability in the upper elementary school grades.

Singer (1968), in an attempt to compare the relationships of intellectual ability, academic achievement, and perceptual-motor abilities, tested 42 grade six students and 30 grade three students registered at the Illinois State

University laboratory school. The students at the school were generally from upper middle-class families. Their academic achievement was, on the average, two grade levels above their grade placement and their average I.Q. was approximately 116.5. The Lorge-Thorndike Test and the Metropolitan Achievement Test were used to determine the students' intellectual ability and academic achievement. The Stoelting hand dynamometer, Multiple-angle Testing Unit, stabilometer, Figure Reproduction Test, Bounce-Ball-in-the-Basket Test, Minnesota Rate of Manipulation Test, and the pursuit rotor were used to measure students' perceptual-motor abilities. The data indicated very low association among all the measures for grade three children. None of the motor and physical variables correlated significantly with the Lorge-Thorndike Verbal and Non-Verbal I.Q.s. Balance and discrimination reaction time scores correlated with the Metropolitan Achievement Test at the lowest acceptable level of significance. Analysis of the data for grade six children yielded findings similar to those obtained for grade three children. The author stated that the following conclusions were warranted from the study:

> 1. Intercorrelations among variables related to the cognitive domain, physical characteristics, and perceptual-motor abilities are low and most often not significantly related within grade six and grade three children.
>
> 2. Interrelationships of the experimental variables are not higher in grade three children than grade six children.
>
> 3. As measured by the tests employed in this study, those tasks that are more perceptually

> motor-orientated do not correlate any higher with intellectual ability tests than do simple motor tasks and physical characteristics with intelligence tests. (p. 1331)

Little (1971) conducted a study for the purpose of investigating the relationships between perceptual-motor proficiency and both intellectual ability and academic achievement. The investigation also sought to determine if perceptual-motor proficiency scores, when combined with intellectual ability scores, were more efficient predictors of academic achievement than intellectual ability scores alone. The sample consisted of 91 grade three children. The children were administered the Purdue Perceptual-Motor Survey, the Lorge-Thorndike Intelligence Tests: Multi-Level Edition, and the Iowa Tests of Basic Skills. A positive relationship between the subjects' perceptual-motor proficiency and intellectual ability was supported (a) by the significant Pearson r's obtained between the total Purdue Perceptual-Motor Survey score and nonverbal I.Q. and total I.Q. scores, and (b) by the significant multiple r's obtained between the eleven subtests of the Purdue Perceptual-Motor Survey and the verbal I.Q. and total I.Q. scores. Little concluded that perceptual-motor proficiency scores, when combined with intellectual ability scores, were not more efficient predictors of academic achievement than were intellectual ability scores alone.

Plack (1971) conducted a study to evaluate the Purdue Perceptual-Motor Survey as a predictor of intellectual ability. The study was composed of 120 grade four students. The Purdue Perceptual-Motor Survey, the throw and catch test, the zig-zag run from the Johnson Battery, and the forward skip from the Loechler Modification of the Johnson Motor-Ability Test were administered to measure perceptual-motor ability. Intelligence was measured by the Stanford Achievement Battery. Within the limitations of the study, the author drew the following conclusions: (a) almost all correlation coefficients between the Purdue Perceptual-Motor Survey did predict achievement in skills measured by the Stanford Achievement Battery; and (b) the components of the Purdue Perceptual-Motor Survey did predict achievement in motor skills as measured by the selected instruments.

Chissom (1971) assessed the relationship between motor skills and intellectual aptitude. Seventy-nine grade one boys and 90 grade three boys, representing 50% of the population of five elementary schools, were tested. The mean ages of the groups were 80.5 months for the grade one students and 107.9 months for the grade three subjects. A series of motor tests was used to measure motor achievement. The Otis-Lennon Mental Ability Test, Elementary 1, Form J, served as a measure of intellectual aptitude. A significant relationship was found between motor abilities and measures of intellectual aptitude for grade one boys. No significant relationship was obtained, however, between motor abilities and the criterion measures of intellectual aptitude for the group of grade three boys.

Although research evidence has been limited, it seems to be apparent that children in kindergarten and grade one who have possessed normal intelligence but whose motor responses have been inadequate have tended to experience difficulty in building a systematic body of information and have shown limitations in learning. Whether the children overcame these difficulties or compensated for them as they grew older is not clear.

Achievement Level: Perceptual-Motor Performance and Intellectual Relationship

Skubic and Anderson (1970) presented a study related to perceptual-motor performance and intellectual achievement with high and low achievers. The Stanford Achievement Test was administered to 300 pupils nearing completion of grade four. All pupils who scored in the three lowest stanines on three subtests were designated as the low intellectual achiever group and all those who scored in the top three stanines on all three tests were designated as the high intellectual achiever group. The California Test of Mental Maturity was then administered to the two groups to determine whether any of the subjects were below normal in intelligence. One pupil scored below normal and was eliminated from the study. The remaining 41 subjects in the low intellectual achiever group and the 45 subjects in the high intellectual achiever group were then given a battery of 11 perceptual-motor tests. The results indicated that intellectual achievement correlated highly with performance on a battery of perceptual-motor tests. The high intellectual achiever group performed significantly better than the low intellectual group on six of the eleven items of the perceptual-motor battery. The low intellectual achievers, as a total group, did not outperform the high intellectual achievers on any test in the battery. Skubic and Anderson stated that these correlations, in a study of children within the range of normal intelligence, were encouraging since many previous studies had failed to find significant relationships among these factors at older age levels except when comparing retarded subjects to those of normal intellectual development. The researchers indicated that such findings may have been due to the type of motor tests used.

One aspect of a study by Kalakian (1971) tested the possibility of predicting intellectual ability from perceptual-motor efficiency. Twenty educable mentally retarded children with a mean chronological age of 10.4 years, enrolled in special education classes, served as subjects. The mental age of subjects, as measured by the Peabody Picture Vocabulary Test, ranged from 7.0 to 8.75 years. The Purdue Perceptual-Motor Survey was utilized as a measure of perceptual-motor efficiency. The Lower Primary California Achievement Test was utilized as the measure of intellectual ability. Kalakian concluded that measures of perceptual efficiency were capable of predicting intellectual ability.

Another study dealing with low achievers and the relationship between visual perception and intellectual ability was conducted by Narramore (1970). The subjects in the study were 71 students from classes for the educable mentally retarded in Kentucky. The students ranged in age from 6 to 10 years and in intelligence from I.Q.s of 50 to 80. Measuring instruments utilized in the study were the Stanford Achievement Test, Form W, Primary I Battery, and the Marianne Frostig Developmental Test of Visual Perception. It was concluded that visual perceptual development is a significant factor in the intellectual ability of educable mentally retarded children.

McDonald (1972) investigated the relationship between intellectual ability and perceptual-motor ability with educable intellectually deprived junior and senior high-school students. McDonald also investigated to see whether selected students performing at high, medium, and low levels intellectually would achieve at significantly different levels on perceptual-motor skills. Sixty educable intellectually deprived junior and senior high-school students were administered the following tests: Wide Range Achievement Test, the Purdue Pegboard Test, a rail-walking device, a dynamic balance, a cable jump test, and Cratty's Sixteen Developmental Steps in the formation of the Body Image and the Body's Position in Space to test perceptual-motor skills. The results of the study showed that perceptual-motor skill of body image related significantly with intellectual performance. Also, when the subjects were grouped by the scores they obtained on the Wide Range Achievement Test (WRAT), a significant difference was found between the group scoring high and the group scoring low on the WRAT and their body image score.

The research, as previously stated, is very limited in the area of investigating relationships between perceptual-motor ability and intellectual ability for different achievement levels. Also, much of the research reported has dealt with low achievers. From the studies which have been reported, there seemed that there was evidence to support a strong relationship between perceptual-motor ability and intellectual ability for low achievers. It was not clear, though, whether such a relationship exists for high intellectual achievers.

Sex: Perceptual-Motor Performance and Intellectual Relationship

Gill, Herdtner and Lough (1968) set up a study to test the hypothesis that there is a significant difference in the relationship of perceptual-motor ability and intellectual achievement when the groups are based on sex. Their study included 184 middle-class children from nursery through grade three. All participating children were given the Frostig Developmental Test of Visual Perception and a modified Rod-and-Frame Test (MRFT) to measure perceptual ability. The Metropolitan Achievement Test was given to measure intellectual achievement. The Pearson Product Moment correlation statistical technique indicated that there was a sex difference in the strength of the relationships among the variables. The modified Rod-and-Frame Test was shown to be a moderate predictor of intellectual ability for boys, but not for girls. When the Frostig Developmental Test of Visual Perception was administered, however, none of the boys' scores correlated very strongly with their Metropolitan Achievement scores. The correlations of girls' scores between the Frostig subtests and Metropolitan factors were, without exception, larger than the correlations for boys. The difference between the correlations of scores on the Frostig test and the Metropolitan Achievement Test for boys and girls was significant at the .001 level.

Another aspect of Little's (1971) study, previously reported, dealt with the relationship of perceptual-motor ability to intellectual ability when the groups were based on sex. The sample consisted of 44 boys and 47 girls in grade three. Analysis of the data revealed that girls' perceptual-motor scores were significant predictors of intelligence, whereas boys' perceptual-motor scores were not significant predictors.

The studies by Chissom (1971) and Egeland (1967), previously reported, used only boys as subjects. A significant relationship was found between perceptual-motor ability and intellectual ability for grade one boys in both studies. Chissom also studied grade three boys. No significant relationship was found between perceptual-motor ability and intellectual ability.

The results of reported studies do not clearly establish the relationship of performances on perceptual-motor and intelligence tests for either boys or girls.

There seems to be some evidence that performance on perceptual-motor tests may be more related to intelligence for girls than for boys.

Summary

Studies of the relationships between perceptual-motor test scores and intellectual ability test scores have been reviewed in this chapter. The research in the area is inconclusive. The dearth of studies concerned with the variables would suggest the need for more research that is related to the multi-faceted components of perceptual-motor performance and intellectual ability. From the studies that have been reported (Chissom, 1971; Egeland, 1967; Keogh and Smith, 1967), there appears to be a positive relationship between perceptual-motor ability and intellectual ability at the kindergarten and grade one levels. There also seems to be a positive relationship between perceptual-motor ability and intellectual ability for children who are low achievers (Kalakian, 1971; McDonald, 1972; Narramore, 1970). It further appears that the sex of the child may affect specific perceptual abilities related to intellectual ability. In the studies reported by Gill et al. (1968) and Little (1971), higher correlations between perceptual-motor abilities and intellectual ability were found for girls than for boys. The one exception was the section of the study by Gill et al. (1968) when the results on the MRFT showed it to be a moderate predictor of intellectual ability for boys but not for girls.

Since the present study investigated the correlations between perceptual-motor ability and intellectual ability when the sample was grouped by grade levels, intellectual achievement levels, and also sex, no one study reported in this chapter is, by itself, totally relevant. However, when the entire study collection is considered, the relevancy is more than evident.

CHAPTER III

METHODS AND PROCEDURES

This chapter comprises a description and explanation of the design and procedures used in the investigation. The problem of the study was to investigate the relationship between performance on a perceptual-motor test and performance on an intellectual ability test. Relationships were studied when the sample was grouped by grade levels, intellectual achievement levels, and sex.

In order to conduct this study, it was necessary to:

1. Select a population.
2. Select appropriate instruments to measure intellectual ability and perceptual-motor development.
3. Administer the tests and collect the test data.
4. Perform statistical analyses on the data.

Description of the Sample

The sample included in the study was restricted to pupils selected from Grades One, Two, Three, and Four in MacDonald Drive Elementary School and Vanier Elementary School, St. John's, Newfoundland during the 1978-79 school year.

According to Dobbins (1978) "relationship analyses depend upon the extent of individual differences in the variables." To ensure a wide range of intellectual ability, Rummel (1964) suggests the use of stratified sampling (p. 76). To achieve this, classroom teachers of Grades One, Two, Three, and Four of MacDonald Drive and Vanier Schools were asked to rate their pupils on high or low intellectual achievement according to their professional opinions. Fifty children were then randomly selected from each of the high and low intellectual achievement groups for inclusion in the study. Ismail, Kephart, and Cowell (1963) and Roach (1962) have cited teacher ratings as a satisfactory technique for evaluating overall intellectual achievement.

This population was chosen for the following reasons:

1. The large enrollment of the two selected schools enabled the investigator to select a viable number of students for the study.
2. Grade One, Two, Three and Four levels appeared to be most appropriate because most research reports that perceptual-motor abilities are generally developed by age ten (Frostig and Horne, 1964).
3. The normative data presented for most perceptual-motor tests surveyed were developed with children between six and ten years of age.
4. Most of the research dealing with perception has dealt with low intellectual ability groups. It was the investigator's purpose to see if these results would apply to a high intellectual ability group as well.

The sample in the study was 100 students, selected from Grades One, Two, Three, and Four.

Selection of the Appropriate Instruments

The Purdue Perceptual-Motor Survey was selected for the determination of perceptual-motor ability and the Ravens Coloured Progressive Matrices was used to assess the intellectual ability of each student.

On the basis of reviews of the tests included in the *Seventh Mental Measurements Yearbook* (Buros, 1972), it was decided that the instruments were not only adequate, but were among the most appropriate. This statement is based on several facts:

1. The Ravens Coloured Progressive Matrices is a nonverbal untimed test designed to assess present capacity for intellectual activity of children aged 5-11. Norms and test items were revised in 1956 and were considered to be relatively recent and comprehensive.
2. Of all the perceptual-motor instruments investigated, the Purdue Perceptual-Motor Survey seemed to be the most appropriate instrument that had been developed for use with regular Grade One, Two, Three and Four children. The other instruments had been developed for use with atypical or with preschool children.
3. The Purdue Perceptual-Motor Survey and the Ravens Coloured Progressive Matrices met the following specifications: (a) they were easy to administer

and require a minimum of special equipment; (b) they were representative of behavior familiar to all children; (c) they had scoring criteria simple and clear enough that a minimum of training was necessary for administration; (d) they had norms which were established with great care; (e) they were widely used with previous research studies; and (f) they were comprehensive in the coverage of the area for which they were designed.

The following are brief descriptions of the two instruments used in the study:

Instrument I: The Purdue Perceptual-Motor Survey

The Purdue Perceptual-Motor Survey is a qualitative scale which allows a clinician to observe perceptual-motor behavior in a series of behavioral performances and to designate areas which need remediation. This survey had been subjected to standardization techniques and had been found to be valid and reliable. The pages from the manual concerning validity and reliability are included in Appendix A.

The survey was designed for evaluation of five major areas of perceptual-motor development: (a) balance and posture; (b) body image and differentiation; (c) perceptual-motor match; (d) ocular control; and (e) form perception. A more complete description of these sections is presented in the five subheadings immediately following.

Balance and Posture. This section of the test consisted of various jumping activities which helped in the assessment of children's development of laterality, body image, and rhythm, and of their gross-motor level of neuromuscular control. The series of jumping tasks included bilateral activities, unilateral activities, alternating tasks in a regular pattern, and irregular alternating patterns. The raters determine whether the subject used both sides of his body in a parallel manner and whether he could sustain regular and irregular patterns with rhythmic and coordinated control. Following the directions of the manual, each of the eight items were rated individually. Then all were averaged to render one score for overall performance in jumping.

Body Image and Differentiation. This section of the test consists of five tasks: (a) identification of body parts; (b) imitation of movements; (c) an obstacle course; (d) Kraus-Weber; and (e) Angels-in-the-Snow.

Identification of body parts--this facet of the test was designed to ascertain the children's level of awareness of body parts, and their ability to name various body members and to determine to what degree they were aware of the bilateral relationship between paired members.

Imitation of movements--the principal areas of performance which this item attempts to measure are neuromuscular control and the translation of visual clues into motor movements. Each subject will be asked to imitate the unilateral, bilateral, and contralateral movements executed by the test administrator.

Obstacle course--this part of the test consists of three tasks which indicate how the child reacts spatially to his environment. The tasks include having a child step over a stick, go under a stick, and go between a stick and a wall.

Kraus-Weber--this test of physical fitness was originally developed to measure physical strength and muscular fitness. The test was included in the survey because of the reported high correlation of performance on this test and school achievement. The task requires the subject to lie flat on a mat and raise his shoulders for a count of 10. The second part of this section involves having the subject raise his legs straight off the mat for a count of 10.

Angels-in-the-Snow--this task was designed to assess development in and to detect problems in neuromuscular differentiation and the ability to handle right-sidedness or left-sidedness. The subjects were asked to move a limb or various combinations of limbs from visual cues and verbal directions.

Perceptual-Motor Match. Chalkboard tasks were used to assess directionality and perceptual-motor matching ability. The subjects were asked to perform four different tasks: (a) the drawing of a circle; (b) the drawing of two circles simultaneously, one with each hand; (c) the drawing of a lateral line from one prescribed point to another; and

(d) the drawing of two straight vertical lines simultaneously, one with each hand.

Ocular Control. This series of four tasks is designed to determine the ability of the child to establish and maintain visual contact with a target. In the educational process, the child must be able to control the direction of gaze in order to obtain adequate and consistent visual information. It is this behavioral aspect of the ocular problem which concerns the teacher and which was evaluated in the ocular control series of tasks. Likewise, it is the voluntary neuromuscular control of the movement of the eye for information gathering which was investigated, not its refractive or pathological status. The four performances rated using a penlight for visual stimulus were both eyes together, right eye alone, left eye alone, and convergence.

Form Perception. In this subtest the children were asked to copy seven simple geometric forms: circle, cross, square, triangle, diamond, and divided rectangle. Children whose chronological ages were between 6 years and 6 years 11 months were given Forms 1 through 5. Children who were 7 years or older were given all seven forms as per instructions in the test manual. Performance was rated on the basis of the form perception the child demonstrated and also the method of organizing drawings on a page. These visual achievement forms were originally used by Gesell (1941) in his work with preschoolers and have also been the subject of a research study by Lowder (1956). Lowder found that there was a significant relationship between this copying task and school achievement. His results were based on a sample of 1510 children in Grades One through Three.

Instrument II: Ravens Coloured Progressive Matrices

The Coloured Progressive Matrices Sets A, Ab, B is composed of three sets of twelve problems arranged to assess the chief cognitive processes of which children under 11 years of age are usually capable. The three sets provide three opportunities for a child to develop a consistent theme of thought, and the scale of thirty-six problems as a whole is designed to assess as accurately as possible, mental development up to intellectual maturity.

To make the test independent of verbal instructions, the problems are printed on coloured backgrounds. Children merely point out which of the six choices below the diagram complete the pattern. Although, according to the manual, the test could be given in group form past the age of eight years, each child was tested individually to reduce standard error. Following is a brief description of the order and nature of the problems solved:

Set A--The Apprehension of Identity and Change in Continuous Patterns. Twelve patterns are shown, one by one, with a missing section. Six pattern pieces are illustrated below the main diagram as choices to complete the pattern. The Set A sequence of problems involves simple, continuous pattern-completion involving the perception of similarity, identity, orientation, and correlate creation.

Set Ab--The Apprehension of Discrete Figures as Spatially Related Wholes. Twelve more patterns are introduced consecutively testing discrete pattern-completion involving the perception of difference, similarity, identity, closed symmetry and orientation of a missing part.

Set B--The Apprehension of Analogous Changes in Spatially and Logically Related Figures. The final twelve diagrams with missing pattern sections are introduced testing discrete pattern-completion with the perception of difference, similarity, identity, symmetry, orientation of a missing part with addition, subtraction or double subtraction of a given character from a given figure.

Validity and reliability information and norming procedures for the Ravens Coloured Progressive Matrices are included in Appendix B.

Collection of the Data

Both tests were administered and scored by the investigator and an assistant familiar with the two tests. To ensure consistency, directions were memorized and a satisfactory inter-rater correlation coefficient was computed. The appropriate levels of the Purdue Perceptual-Motor Survey and the Ravens Coloured Progressive Matrices were administered over a four week period in November 1978 to selected Grade One, Two, Three, and Four children.

The Purdue Perceptual-Motor Survey was administered individually by the investigator and the assistant testor using recommended standardized procedures. Tests were administered in a large, quiet, well-ventilated room at each school. The amount of time involved in the testing of each child varied according to the astuteness of the child and the ease with which the child understood directions. The average time necessary to complete the two tests was approximately forty minutes per child.

The Ravens Coloured Progressive Matrices was administered individually in book form. The same room was used for both tests in each school.

Raw scores for the Purdue Perceptual-Motor Survey and the Ravens Coloured Progressive Matrices are included in Appendix C.

Statistical Analysis of the Data

Pearson correlation coefficients and partial correlation coefficients were used to establish if relationships exist between perceptual-motor ability and intellectual ability. The Pearson product moment correlation coefficient was used to determine the relationships for the total sample and for each grade level. Partial correlation coefficients with the effect of grade level controlled for, were used for each sex and achievement level.

The Pearson correlational coefficient offers two advantages:

1. It allows one to look at the linear relationship between the two variables. As the size of the absolute value of the coefficients increases, the strength of the relationship increases. Large

absolute values mean that the two variables are closely related, and small absolute values mean that the relationship between the two variables is weak.

2. The sign of the coefficient indicates the direction of the relationship. The largest possible positive value is +1.00 and the largest negative value is −1.00.

Summary

In this chapter a description of the sample was given and the criteria for forming subgroups explained. The testing instruments were described and the reasons for using such instruments were given. Collection of the data was discussed, and the techniques for the analysis of the data were described.

In Chapter IV the results of the statistical analysis of the data are reported. A summary of the investigation, conclusions, implications and recommendations for possible further study are discussed in Chapter V.

CHAPTER IV

REPORT OF THE FINDINGS

The purpose of this study was to provide additional information concerning the relationship between perceptual-motor development and intellectual ability of a selected group of children in St. John's, Newfoundland. Relationships were also studied when the sample was divided according to grade levels, intellectual achievement levels, and sex.

In previous chapters a general overview of the study, review of background literature, and description of the procedures and instruments used in the investigation were discussed. In this chapter the analysis of the data is presented. It is based on scores obtained on the Ravens Coloured Progressive Matrices and the Purdue Perceptual-Motor Survey administered to the 100 Grade One, Two, Three, and Four students. These students attended either MacDonald Drive Elementary School or Vanier Elementary School during the academic year of 1978-79.

The sample included 100 Grade One, Two, Three and Four children. The mean chronological ages and standard deviations for subgroups and for the total sample are presented in Table 1. Each grade level was quite homogeneous in relation to chronological age. Standard deviations were consistently small.

TABLE 1

Mean Chronological Ages of Subjects by Grade Levels, Achievement Levels, Sex, and Total Sample.

Groups	Number in Group	Mean Chronological Age	Standard Deviation
Grade 1	26	74.1	3.37
Grade 2	25	83.2	5.00
Grade 3	29	99.5	6.90
Grade 4	20	109.2	5.00
High Academic Achievers	51	91.9	6.37
Low Academic Achievers	49	91.2	7.15
Total Boys	56	91.7	6.89
Total Girls	44	91.3	6.62
Total Sample	100	90.78	14.34

Testing the Hypotheses

Hypotheses were tested using the correlations derived from the Statistical Package for the Social Sciences computer program. Results of testing the four hypotheses will be presented in the order in which the hypotheses were stated in Chapter 1.

Hypothesis One

There is no significant positive correlation between the performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability.

The scores from the Ravens Coloured Progressive Matrices and the Purdue Perceptual-Motor Survey were subjected to the Pearson product moment coefficient of correlation procedure. The resulting correlation was 0.67 ($p < .001$). However, this may be a spurious correlation since results may be partially due to the effects of grade level as was anticipated in Chapter III.

On the basis of these results Hypothesis One was rejected. There was a significant positive correlation between the performance on the Purdue Perceptual-Motor Survey and performance on the Ravens Coloured Progressive Matrices significant at the .001 level.

Hypothesis Two

There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to grade levels:

a. Grade One

b. Grade Two

c. Grade Three

d. Grade Four

The means and standard deviations for both the RCPM and the PPMS were computed for each grade level and total sample and are reported in Table II.

TABLE II

Mean Scores for Subjects on the Ravens Coloured Progressive Matrices and the Purdue Perceptual-Motor Survey by Grade Level and Total Sample.

	RCPM		PPMS	
	Mean	Standard Deviation	Mean	Standard Deviation
Grade 1	21.5	6.6	49.0	11.3
Grade 2	23.6	5.4	56.2	9.2
Grade 3	25.8	5.7	61.4	8.6
Grade 4	30.4	3.9	63.8	6.9
Total Sample	25.0	6.3	57.4	10.7

To verify that there was a difference in performance on the RCPM and the PPMS between grades, and that grades and performance increase concurrently, a one-way analysis of variance was carried out for each test.

The results of the one-way ANOVA for the Purdue Perceptual-Motor Survey are reported in Table III. Significant differences between grade levels were detected. To discern exactly where these differences lay and to what significance, the Scheffé procedure was used. This test showed that subjects of Grades Two, Three, and Four scored higher than the subjects of Grade One. Also, that Grade Four subjects scored higher than Grade Two subjects. Other differences were not significant at the .10 level.

The Scheffé level of significance of .10 was employed because this procedure is considered to be a very rigorous test and usually a less rigorous significance level is chosen (Ferguson, 1976, p. 297).

TABLE III

Analysis of Variance Between Grade Levels on PPMS.

Source	df	Sum of Squares	Mean Squares	F Ratio
Between groups	3	3153	1051.0	12.3
Within groups	96	8195	85.4	
Total	99	11348		

The one-way ANOVA for the Ravens Coloured Progressive Matrices also revealed significant differences between grade levels. The Scheffé test showed that subjects in Grades Three and Four scored higher than did subjects in Grade One. Also, subjects in Grade Four scored higher than did subjects in Grades Two and Three. Other differences were not significant at the .10 level of confidence. The results of the one-way ANOVA for the RCPM are reported in Table IV.

TABLE IV

Analysis of Variance Between Grade Levels on RCPM

Source	df	Sum of Squares	Mean Squares	F Ratio
Between groups	3	969.6	323.2	10.5
Within groups	96	2957.3	30.8	
Total	99	3926.9		

Because the analyses of variance showed that there was a tendency for performance on both tests to increase as grade level increased, it is probable that the reported overall correlation of 0.67 is partially due to the effects of grade level.

Correlations between the PPMS and the RCPM were then computed for each grade level as shown in Table V. The correlations based on grade level are significantly different from zero with the exception of Grade Four. However, these correlations tend to decrease with the increase of grade level.

TABLE V

Correlations Between RCPM and PPMS Based on Grade Levels

Grade Level	Correlation Coefficient
Grade One	0.69**
Grade Two	0.52*
Grade Three	0.54*
Grade Four	0.40

*$p < .01$
**$p < .001$

On the basis of these results Hypotheses Two a, b, and c were rejected. There was a significant positive correlation between performance on the Purdue Perceptual-Motor Survey and performance on the Ravens Coloured Progressive Matrices when the sample was divided according to grade levels:

a. Grade One

b. Grade Two

c. Grade Three

Hypothesis Two d was accepted. There was no significant correlation between performance on the two tests for

Grade Level Four.

Hypothesis Three

There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to intellectual achievement groups:

a. high intellectual achievement

b. low intellectual achievement

controlling the effects of grade level.

The technique of partial correlation was used to ascertain the effect of grade level upon the test results of the Ravens Coloured Progressive Matrices and the Purdue Perceptual-Motor Survey for two reasons:

1. the reported overall correlation of the RCPM and the PPMS of 0.67 was possibly spurious.
2. the results of the one-way analyses of variance indicated that raw scores on both tests tended to increase as grade level increased.

The partial correlation coefficient controlling the effects of grade level for high intellectual achievers was 0.54, significant at the .001 level of confidence. The partial correlation coefficient controlling the effects of grade level for low intellectual achievers was 0.28, significant at the .05 level of confidence.

On the basis of these results Hypothesis Three a and b were rejected. There was a significant positive correlation between the performance on the Purdue Perceptual-Motor Survey and performance on the Ravens Coloured Progressive Matrices when the sample was divided according to intellectual achievement groups:

a. high intellectual achievement

b. low intellectual achievement

controlling the effects of grade level.

Hypothesis Four

There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to sex:

a. boys

b. girls

controlling the effects of grade level.

The partial correlation coefficient controlling the effects of grade level for boys was 0.68, significant at the .001 level of confidence. The partial correlation coefficient controlling the effects of grade level for girls was 0.46, significant at the .001 level of confidence.

Table VI shows the computed partial correlation coefficients, controlling the effects of grade level, between raw scores on the RCPM and raw scores on the PPMS for intellectual achievement groups and sex.

TABLE VI

Partial Correlations Between RCPM and PPMS, with the Effects of Grade Level Controlled for Groups Based on Intellectual Achievement and Sex.

Groups	Correlation Coefficients
High Intellectual Achievers	0.54**
Low Intellectual Achievers	0.28*
Boys	0.68**
Girls	0.46**

$^{*}p < .05$
$^{**}p < .001$

On the basis of these results Hypothesis Four a and b were rejected. There was a significant positive correlation between performance on the Purdue Perceptual-Motor Survey and performance on the Ravens Coloured Progressive Matrices when the sample was divided according to sex:

a. boys

b. girls

controlling the effects of grade level.

Summary

This chapter contains an analysis of the data and the testing of the four hypotheses which emerged from the Statement of the Problem in Chapter I. In Chapter V conclusions, implications, and recommendations for further study are discussed.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Summary of the Investigation

The purpose of this study was to provide additional information concerning the relationships between perceptual-motor development and intellectual ability of a selected group of children in St. John's, Newfoundland.

In November of 1978, two instruments, the Ravens Coloured Progressive Matrices and the Purdue Perceptual-Motor Survey were administered to a group of 100 Grade One, Two, Three, and Four children attending either MacDonald Elementary School or Vanier Elementary School.

The data from the two administered instruments were organized and analyzed by using Pearson correlation coefficients and partial correlation coefficients to provide information concerning the research hypotheses of the study. The .05 level of significance was selected as the criterion for establishing the statistical significance of the relationships investigated.

The hypotheses investigated were:

1. There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability.
2. There is no significant positive correlation between performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance

on the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to grade levels:

a. Grade One
b. Grade Two
c. Grade Three
d. Grade Four

3. There is no significant positive correlation between the performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to intellectual achievement groups.

a. high intellectual achievement
b. low intellectual achievement

controlling the effects of grade level.

4. There is no significant positive correlation between the performance on the Purdue Perceptual-Motor Survey measuring perceptual-motor development and performance on the Ravens Coloured Progressive Matrices measuring intellectual ability when the sample is divided according to sex:

a. boys
b. girls

controlling the effects of grade level.

Conclusions

Having recognized certain limitations at the beginning of the study, several conclusions based on the major findings seemed to be evident. They were:

1. There was a significant correlation between scores attained on the perceptual-motor test (PPMS) and the intellectual ability test (RCPM) for the total sample.

2 a, b, and c. There was a significant correlation between scores on the perceptual-motor test and the intellectual ability test for Grades One, Two, and Three.

2 d. There was no significant relationship between scores attained on the perceptual-motor test and the intellectual ability test for Grade Four subjects.

3 a and b. There was a significant correlation between scores attained on the perceptual-motor test and the intellectual ability test for both low and high intellectual achievers.

4 a and b. There was a significant correlation between scores attained on the perceptual-motor test and the intellectual ability test for both boys and girls.

Discussion and Implications

1. The significant correlation between perceptual-motor ability and intellectual ability has been documented quite convincingly, both by the present study and by most of the research studies reviewed which examined this relationship. The findings of the study did not, however, show a perfect correlation between the two variables. This seems to indicate that teachers can, therefore, expect to find some low intellectual

achievers who have little or no difficulty in performing perceptual-motor activities; and, likewise, they can expect to find some high intellectual achievers who do not perform well on perceptual-motor activities. Stated another way, it would be erroneous for teachers to assume that all children who score low on an intellectual ability test have perceptual-motor problems. Neither can teachers assume that all children who score high on perceptual-motor tests should also score high on intellectual ability tests. It should be emphasized also, that a positive correlation indicates only a relationship, and the strength of that relationship, and in no way implies causation. The fact remains that teachers cannot assume that low perceptual-motor achievers will also be low intellectual achievers or that high perceptual-motor achievers will also be high intellectual achievers. Nor can it be concluded that perceptual-motor training, a program in which children participate in certain selected motor activities to improve intellectual ability, will necessarily remediate low intellectual achievement.

2. Results of the present research, along with most of the other related research studies reviewed, indicated that perceptual-motor development as presently measured is more significantly related to and predictive of intellectual ability for young children than it is for the older children. This finding suggests several possibilities and has important implications for educators.

One possibility is that somewhere between Grades One and Three, children move from a mode of learning which is more dependent on perceptual-motor development to a mode of learning which is more dependent on other aspects of development. If this possibility can be established as fact, then future research concerned with determining characteristics which are related to intellectual ability for subjects over the Grade Three level should concentrate on seeking out characteristics other than perceptual-motor development. If it were established that learning style does change significantly by about age 9, it would follow that perceptual-motor training programs should be considered inappropriate as a method for remediating low intellectual ability for older children. Perceptual-motor training programs may be used in an effort to improve perceptual-motor performance, but different types of programs must be designed for the purpose of remediating intellectual problems.

3. Another possibility which may be considered as an implication of the finding that perceptual-motor performance seems to be related to intellectual ability for only young children is that research may not have as yet uncovered aspects of perceptual-motor ability which may be significantly related to the intellectual ability of older subjects. Perceptual-motor abilities significant to this population may be different from those which have been shown to be significant for young children. The

instruments presently available for measuring perceptual-motor ability may be totally inadequate for use with older subjects.

4. When relationships of performance on a perceptual-motor test and an intellectual ability test were examined by achievement levels, a significant relationship of performance on the two types of tests was found for high academic achievers. The same degree of relationship, however, did not exist for low intellectual achievers. Although relationship between performances on the two measures has been established for high and low intellectual achievers, no implications can be assumed that remediation of perceptual-motor difficulties will result in improved intellectual performance. Perceptual-motor training programs should be one of many attempts made to help children who are experiencing academic difficulty.

5. Even though the relationship between performances on the perceptual-motor test and the intellectual ability test was stronger for boys, there was a significant relationship between perceptual-motor ability and intellectual ability for both boys and girls. The difference in the correlation was not great enough to imply that a special perceptual-motor program or that the perceptual tasks in the curriculum should vary significantly with sex.

Recommendations for Further Study

Based upon the results of the study, the following recommendations are made:

1. Further research needs to be conducted in order to investigate the correlation of perceptual-motor ability with intellectual ability when the sample consists of children from other regions of North America, and other cultures.
2. Further research needs to be conducted in order to investigate the correlation of perceptual-motor ability with intellectual ability when groups are based on academic achievement levels, socioeconomic levels, and/or motivational levels.
3. Further research using different methods of teaching, different types of materials, and different program content should be conducted to determine what kind of program best fits the specific needs of children who have low perceptual ability.
4. Further research studies need to be conducted in order to investigate which specific perceptual-motor tasks correlate with certain intellectual abilities, such as reading and mathematics, for Grade One, Two and Three students.
5. Further research studies need to be conducted in order to investigate the correlation of perceptual-motor ability with intellectual ability using tests other than the Purdue Perceptual-Motor Survey and the Ravens Coloured Progressive Matrices.
6. Further research needs to be conducted to develop perceptual-motor tests appropriate for assessing perceptual-motor development of older children.

7. Investigations should be made to determine whether causal relationships can be found between selected perceptual-motor skills and selected areas of intellectual achievement. Further, if such causal relationships were established, research should be conducted to determine which type(s) of perceptual-motor training items most effectively remediate specific perceptual-motor deficiencies.

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APPENDIX A

VALIDITY AND RELIABILITY FOR THE PURDUE PERCEPTUAL-MOTOR SURVEY

Validity and Reliability for the Purdue Perceptual-Motor Survey

Item Validation

Chi-squares were computed on each item. The results of this analysis are shown below. This analysis was accomplished by assigning any child who obtained a rating of 1 or 2 on an item to a fail category, while assigning any child who made a rating of 3 or 4 on an item to a pass category. The two categories for comparison were achievers and non-achievers. The chi-square values are all statistically significant at the .05 level of significance, with the exception of organization in the Developmental Drawing subtest. This item probably needs revision in terms of dealing with non-retarded children. The item is still a useful item with children whose abilities are known to be below average.

Item 26 which is "Form" in the Developmental Drawing subtest, is significant, but the chi-square value is considerably smaller than the other items. An interesting experience resulted from the administration of this item to the first four grades. One of the very important scoring criteria for this item is segmenting of the form. However, it was noted by all examiners that almost all children who had been exposed to script printing tended to break down the forms into separate parts, therefore segmenting their performance. The scoring criteria of this subtest will undoubtedly need some revision when it is used with more sophisticated child populations. It is felt that it does have considerable value with children who are having problems at a level lower than those in either one of the two samples considered in this study.

Chi-Square Values[a] for Individual Items of the Perceptual-Motor Survey

1. Walking Board: Forward	48.731
Backward	21.853
Sidewise	25.926
2. Jumping	28.869
3. Identification of Body Parts	24.264
4. Imitation of Movement	46.023
5. Obstacle Course	63.081
6. Chalkboard: Circle	57.814
Double Circles	33.328
Lines, Lateral	47.623
Vertical	27.214
7. Kraus-Weber (Items 4 and 5 only)	37.896
8. Angels-in-the-Snow	48.445
9. Ocular Pursuit Movements:	
Both Eyes, Lateral	46.233
Vertical	41.201
Diagonal	67.888
Rotary	46.732
Right Eye, Lateral	48.553
Vertical	33.367
Diagonal	46.981
Rotary	28.480
Left Eye, Lateral	57.894
Vertical	58.576
Diagonal	48.059
Rotary	30.739
10. Developmental Drawing: Form	7.610
Organization	1.309[b]
11. Rhythmic Writing: Rhythm	61.381
Reproduction	45.435
Orientation	66.381

[a]Yates Correction for Continuity applied.

[b]Not significant at the .05 level of significance.

Coefficient of Stability

Since the survey can in no way be considered as a test with homogeneous items, it was decided that the most efficient way to arrive at a reliability estimate was to use the coefficient of stability. A comparison of test-retest scores yielded a coefficient of stability of .946, which not only represents the stability of the scoring criteria but also the stability between examiners, since no examiner tested the same child in both the test and retest situation. The 30 children used to establish this coefficient were randomly selected from the normative sample. The time interval between original test and retest was 1 week.

Intercorrelations of Items and Subtests

The intercorrelations for each item on the survey are given below. These intercorrelations were established by using the normative sample of 200. A correlation of .14 is statistically different from zero at the .05 level; of .18 at the .01 level. With the exception of the ocular pursuit items, all intercorrelations can essentially be considered low, and indicate, in some cases, a small but definite relationship. The high intercorrelations between the items on the ocular pursuit subtest indicate that this subtest could probably be broken down into fewer overall rated performances. In the final form of the scale, this item has been reduced in line with these results.

Intercorrelations of subtest scores are presented in the next tabulation. All intercorrelations are .40 or below with the exception of the Chalkboard subtest and the Rhythmic Writing subtest. The correlation between these two subtests is .48. These subtests were, as mentioned earlier, developed to examine many of the same constructs and the moderate correlation here is not surprising.

It is felt that the low correlations between subtest scores indicate that many areas of perceptual-motor behavior are being measured by the scale and overlap is at a minimum.

Intercorrelations of Items of the
Perceptual-Motor Survey

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1. Walking Board: Forward	--	53	43	15	14	15	20	12	13	27	16	19	18	15	11	16	07	11	10	13	08	14	18	11	15	19	16	28	24	28
2. Walking Board: Backward		--	44	26	27	27	18	27	34	29	17	16	20	13	17	13	07	11	12	10	07	18	21	12	21	11	11	30	37	22
3. Walking Board: Sidewise			--	07	18	15	19	16	24	18	15	11	24	06	10	08	07	09	09	09	08	11	10	24	07	-02	08	18	24	29
4. Jumping				--	29	37	03	32	23	26	28	16	24	21	22	15	23	22	14	24	25	21	27	20	28	11	19	28	44	14
5. Identification of Body Parts					--	29	14	28	25	26	28	12	24	26	31	23	21	27	24	17	19	30	32	27	31	12	22	23	32	16
6. Imitation of Movements						--	08	32	20	31	27	03	29	39	40	34	31	34	24	23	29	32	32	15	25	11	18	21	33	11
7. Obstacle Course							--	10	08	10	13	08	16	16	16	11	20	14	12	23	27	19	22	18	21	06	16	15	12	17
8. Chalkboard: Circle								--	48	42	34	15	21	09	14	11	08	22	17	19	13	16	15	13	17	10	20	29	38	29
9. Chalkboard: Double Circle									--	32	40	09	28	11	21	12	05	20	20	19	11	13	16	19	20	20	17	20	37	25
10. Chalkboard: Lines, Lateral										--	41	22	25	22	18	21	13	32	26	23	19	26	20	10	13	17	24	31	35	35
11. Chalkboard: Lines, Vertical											--	19	24	17	20	17	16	28	20	22	22	20	18	13	13	-19	27	25	29	26
12. Kraus-Weber (items 4 and 5)												--	14	17	14	21	08	12	12	20	10	22	15	30	22	08	14	31	17	24
13. Angels-in-the-Snow													--	27	32	23	22	26	20	23	24	30	28	16	23	11	06	19	27	10
14. Ocular Pursuits: Both Eyes, Lateral														--	08	75	71	67	63	62	61	72	62	57	60	22	21	20	22	15
15. Ocular Pursuits: Both Eyes, Vertical															--	76	70	57	66	62	54	66	67	59	62	13	17	21	25	17
16. Ocular Pursuits: Both Eyes, Diagonal																--	80	61	62	68	61	68	67	64	58	20	26	20	20	17
17. Ocular Pursuits: Both Eyes, Rotary																	--	57	57	63	64	65	62	62	59	14	18	20	21	16
18. Ocular Pursuits: Right Eye, Lateral																		--	79	72	73	68	57	54	51	15	26	21	27	14
19. Ocular Pursuits: Right Eye, Vertical																			--	75	70	64	61	61	58	19	19	21	21	19
[illegible] Ocular Pursuits: Right Eye, Diagonal																				--	79	60	58	68	62	21	19	30	25	24
[illegible] Ocular Pursuits: Right Eye, Rotary																					--	56	56	64	58	24	20	16	18	15
22. Ocular Pursuits: Left Eye, Lateral																						--	83	71	75	19	25	32	31	28
23. Ocular Pursuits: Left Eye, Vertical																							--	74	75	18	31	32	33	29
24. Ocular Pursuits: Left Eye, Diagonal																								--	83	19	17	25	24	24
25. Ocular Pursuits: Left Eye, Rotary																									--	20	16	32	30	20
26. Developmental Drawing: Form																										--	34	08	16	15
27. Developmental Drawing: Organization																											--	25	42	29
28. Rhythmic Writing: Rhythm																												--	58	55
29. Rhythmic Writing: Reproduction																													--	54
30. Rhythmic Writing: Orientation																														--

Intercorrelations of Subtests of the Perceptual-Motor Survey
(Grades 1-4), N = 200

Subtests	(2)	(3)	4	5	6	7	8	9	10	11
1. Walking Board	.20	.26	.27	.24	.37	.19	.25	.17	.15	.40
2. Jumping		.20	.37	.02	.37	.16	.24	.27	.18	.34
3. Identification of Body Parts			.29	.14	.36	.11	.23	.31	.21	.28
4. Imitation of Movements				.08	.39	.03	.29	.36	.18	.26
5. Obstacle Course					.14	.08	.15	.22	.14	.17
6. Chalkboard						.22	.33	.28	.32	.48
7. Kraus-Weber (items 4 & 5)							.14	.20	.13	.28
8. Angels-in-the-Snow								.30	.10	.23
9. Ocular Pursuit Movements									.30	.33
10. Developmental Drawing										.34
11. Rhythmic Writing										---

Total Score

The feasibility and desirability of using a total score on the survey now seem possible. The significant results obtained in the chi-square analysis demonstrated that a possible cutoff score which would distinguish between achievers and non-achievers might be established. A complete breakdown of total scores obtained on the survey by teacher ratings is given below. This analysis is based upon all 297 subjects. It omits the Rhythmic Writing subtest scores, since some of the children in the clinic sample were not administered this item and there was no way to adjust for this discrepancy.

Frequency of Total Scores on the Perceptual-Motor Survey by Teacher Ratings

Total Score	Teacher Rating				
	1	2	3	4	5
106-110					
101-105	2	1			
96-100	2	5	3	2	
91-95	1	5	3	1	
86-90	5	8	2	4	2
81-85	5	9	9	9	1
76-80	2	16	15	5	2
71-75	1	9	11	5	3
66-70	2	5	14	5	7
61-65	0	3	7	3	21
56-60	0	1	3	2	9
51-55	0	1	3	6	17
46-50	1		1	2	10
41-45				1	11
36-40					9
30-35					5
Totals	21	63	71	45	97 = 297

Key to Teacher Ratings: 1--Superior; 2--High Average; 3--Average; 4--Low Average; and 5--Non-achievers (Clinic Group).

The use of a cutoff score of 65 separates the achievers from the non-achievers with an overlap of approximately 15%. More precisely, a cutoff score at 65 included 17% of the achievers and included 85% of the non-achievers. Eighty-three percent of the achievers made a score of 66 or above, while only 15% of the non-achievers scored above 66.

A Pearson coefficient of correlation between total scores obtained on the Perceptual-Motor Survey and teacher ratings was computed. This coefficient is an estimate of concurrent validity. The concurrent validity coefficient was .654. According to Guilford (1956), this coefficient represents a substantial relationship.

An examination of the frequency of cases falling in each teacher rating category reveals a slightly disproportionate number in the high average category. In general, these ratings appear to approximate the expected curves of overall classroom performance and it is felt that the teacher's rating was a satisfactory composite criterion.

Source: E.G. Roach and N.C. Kephart, The Purdue Perceptual-Motor Survey (Columbus, Ohio: Charles E. Merrill, 1966).

APPENDIX B

Validity and Reliability of Ravens Coloured Progressive Matrices

STANDARDIZATION

During 1948, an experimental "board form" of the test, consisting of Sets A and B of the Standard Scale, and fifteen problems which had been found to be intermediary in difficulty between these two sets, was given individually by the author to 291 children, 5 to 10½ years of age, living in the Burgh of Dumfries, whose names began with the letters A, B or C. Where necessary, the age groups obtained in this way were equalized by the addition of children whose names began with the letter D.

A detailed Item Analysis was made of the figure chosen by each child to complete each of the 39 problems. Considering three consecutive scores at a time, by the method of moving averages, curves were plotted showing for each problem the increase in the percentage of correct choices made as the total score on the scale increased from 10 to 39. From the results of this item analysis, three problems in Set Ab were removed, for which the percentage of correct choices fluctuated without a consistent upward trend as the total score on the scale increased. The remaining twelve problems were rearranged in order of difficulty. Two designs which the item analysis showed to be ambiguous were simplified. Confusing alternatives were revised, and their positions rearranged so as to provide as nearly as possible a uniform distribution of choices. The data for the resulting scale of 36 problems was finally re-worked.

Table V summarises the distribution of these children's erroneous choices for the final 1956 arrangement of the problems, and Table VI shows, for the same children, the contribution which each set made to the total score. Table VII gives the norms obtained when the children's correct solutions were re-totalled, with the omission of the three unsatisfactory problems in Set Ab.

Fifty-eight children, aged 6½ ± one year, and 61 children aged 9½ ± one year, who had been given the original scale, were subsequently re-tested with the revised scale of 36 problems. The results showed a test-retest correlation of 0.6 ± 0.06, and 0.8 ± 0.03 respectively.

The scores obtained by Dumfries children on Sets A and B alone, appeared to be slightly lower than those obtained when these tests were given in a similar form to Colchester children. A comparison between the sample of schoolchildren selected and the Dumfries school returns showed that it was an accurate cross-section of the school population. One reason might be that brighter children tended to live outside the burgh; there was also reason to think that young professional families tended to move away from the district.

The relatively low re-test reliability at 6½ years of age, compared with the re-test reliability of 0.8 at 9½ years of age, suggested that the scale was sensitive to fluctuations in the output of intellectual activity in early childhood, rather than to any defect in the scale itself.

The standard series of thirty-six problems was subsequently printed on coloured grounds in the form of a book, for use with children up to the age of 11 years, and for clinical work.

Final Standardization of the test, printed in colours.

To obtain a representative sample of approximately a hundred children of each year of age from 5 to 11½, lists of children living in the burgh of Dumfries, whose names began with the letters E to L inclusive, were prepared. From a total school population of 2700 children between these ages, a sample of 627 children were selected. During September-October, 1949, 608 of these children were tested individually by Miss Eunice White, M.A., and Mr. B. Leuliette, M.A.* 19 children had either moved out of the district or were suffering from a physical illness of long duration. Children suffering from mental disabilities were traced and tested. The sample tested represented approximately one-quarter of the total school population within this age range. Each child was given individually the Book Form of Sets A, Ab, B, printed in colours, and the Crichton Vocabulary Scale. Six weeks after the first test, one in every three children, aged 9 years, was given the same two tests again, together with the Terman-Merrill Scale Form L. Thirty-five children completed the second test, and the Terman-Merrill Form L. Thirty of these children completed the Terman-Merrill Form M six weeks later.

*Mr. Leuliette also computed the norms and inter-correlations, and prepared Tables V to VII inclusive.

Table VIII shows, for the children who were given the printed form of the test, the contribution which the score on each set makes to the total score. Table IX shows, at each half-year interval, the 5th, 10th, 25th, 50th, 75th and 95th percentile scores obtained by the children tested. The percentile scores for the Book Form of the test follow closely the percentile scores obtained for the Board Form. The form in which the test is presented does not appear to account for the slight irregularities. Allowing for small errors of sampling, particularly for the children given the Board Form of the test, there is sufficient agreement between the norms for the Book Form of the test, at least, to be regarded as a representative cross-section of the children living in the burgh of Dumfries. Even if the sample had been multiplied by 4 to include all the Dumfries school-children within this age range, the conclusions reached would still have been applicable with certainty only to Dumfries in 1949-50. Their usefulness elsewhere, at greater distances of time and space, must necessarily decrease with the different circumstances.

Table X compares, for children 9 years of age, the probable re-test reliability of the Matrices, Terman-Merrill and Crichton Vocabulary Scales, and the extent to which these three tests are inter-correlated. Looking back on the experimental investigations reported here, and comparing the results with the results of work carried out elsewhere (see Bibliography), it would appear that, in future, it would be more profitable to compare children's test performances at 6½, 8½ and 10½ years of age.

In general, it can be seen that the Matrices test is most sensitive to functional fluctuations in the output of intellectual activity. The more the test has been improved, the more this has become evident. The Vocabulary Scale, on the other hand, has been found to be even less sensitive than the Terman-Merrill Scale. The correlation between the Matrices and the Vocabulary tests is, however, of an order which justifies using them together to assess a child's present capacity for observation and clear thinking, and the general information he has acquired to the present. The high correlation between the Terman-Merrill Scale and the Crichton Vocabulary Scale suggests that success in the Terman Scale depends largely upon acquired verbal ability. It can also be seen that a child's Matrices and Vocabulary test performances provide, in a clearly defined form, all the information obtained from a single test of "general intelligence".

The use of age norms for the quantitative assessment of general mental development and the calculation of I.Q.s, is always questionable. The most one can legitimately hope to do is to compare a child's behaviour with the behaviour of other children of the same age, and to assess his performance in terms of the frequency with which a similar performance is observed amongst other children of his age. Nevertheless, all such quantitative comparisons rest ultimately upon the psychologist's ability to distinguish certain qualitative differences in the performances compared.

TABLE V

Comparison of Erroneous Choices, made by representative groups of Children

Equivalent Age Median	Choices		Distribution of errors according to type	Chief Types			
	Right	Wrong		a + b	c + d + e	f + g + h	i + j
6½	15	21	Observed Frequency	1.5	3	13	3.5
			% of all errors	7	14	63	16
			Frequency of errors corrected for frequency of presentation	7	18	56	19
8½	21	15	Observed Frequency	0.1	1.4	11.0	2.5
			% of all errors	1	12	72	15
			Corrected for frequency of presentation	1	14	66	19
10½	27	9	Observed Frequency	0.05	0.5	7.5	1
			% of all errors	0	8	80	12
			Corrected for frequency of presentation	1	10	74	15

NORMS FOR THE BOARD FORM OF THE TEST

TABLE VI

Normal Score Composition

Total Score		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Expected Score on Each Set	A	6	6	6	7	7	8	8	8	9	9	9	9	9	9	10	10	10	10	11	11	11	11
	Ab	2	3	3	3	4	4	4	5	5	5	6	7	7	8	8	8	9	9	9	10	10	10
	B	2	2	3	3	3	3	4	4	4	5	5	5	6	6	6	7	7	8	8	8	9	10

TABLE VII

Working Perceptile Points estimated from the scores obtained by 291 Dumfries School children over 5 and under 10 years of age

Percentile Points	Chronological Age in Years								
	5½	6	6½	7	7½	8	8½	9	9½
95	21	23	24	25	26	27	29	30	31
90	19	21	22	23	24	25	27	28	29
75	15	17	18	20	21	23	24	25	26
50	12	14	16	17	18	20	21	22	23
25	10	11	13	14	16	17	18	19	20
10	—	10	11	12	13	14	15	16	17
5	—	—	10	11	12	13	14	15	16

Although carefully selected for the purpose of an experimental survey, the sample of 291 children was too small to estimate percentile points for the general population at all accurately.

NORMS FOR THE BOOK FORM OF THE TEST

TABLE VIII

Normal Score Composition

Total Score	10	11	12	13	14	15	16	17	18	19	20	21	22	23
A	5	6	7	7	7	7	8	8	8	8	8	9	9	9
Ab	3	3	3	3	4	4	4	5	6	6	7	7	8	8
B	2	2	2	3	3	4	4	4	4	5	5	5	5	6

Total Score	24	25	26	27	28	29	30	31	32	33	34	35
A	10	10	10	10	10	11	11	11	11	11	12	12
Ab	8	9	9	10	10	10	10	10	11	11	11	12
B	6	6	7	7	8	8	9	10	10	11	11	11

TABLE IX

Working Percentile Points calculated from the scores obtained by 608 Dumfries School children over 5 and under 11½ years of age

Percentile Points	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11
95	19	21	23	24	25	26	28	30	32	32	33	35
90	17	20	21	22	23	24	26	28	31	31	31	34
75	15	17	18	19	20	21	23	26	28	28	29	31
50	14	15	15	16	17	18	20	22	24	24	26	28
25	12	13	14	14	15	16	17	19	21	22	22	24
10	—	12	12	13	14	14	15	16	18	20	20	21
5	—	—	—	12	12	13	14	15	16	17	17	17

Figures in italics are interpolated for smooth working.

TABLE X

Comparisons between the Matrices, Terman-Merrill and Crichton Vocabulary Test correlations for children 9 years of age.

	Sets A, Ab, B	Terman-Merrill	Crichton Vocab.
Progressive Matrices, Sets A, Ab, B	.80 ± .05	.66 ± .06	.65 ± .07
Terman-Merrill Scale		.90 ± .02	.83 ± .04
Crichton Vocab. Scale			.95 ± .02

APPENDIX C

Raw Data Pertaining to Grade Levels, Sex,
Intellectual Achievement Levels,
PPMS Total Scores, and
RCPM Total Scores

	Pupil #	Age	Grade	Sex	Achievement Level	PPMS	RCPM
1	001	072	1	1	1	67	34
2	002	072	1	1	1	60	28
3	003	072	1	1	1	57	26
4	004	072	1	2	2	52	13
5	005	078	1	1	1	50	28
6	006	072	1	1	1	49	26
7	007	072	1	2	2	49	16
8	008	072	1	1	2	48	16
9	009	072	1	1	1	44	23
10	010	072	1	1	2	43	14
11	011	072	1	1	2	42	13
12	012	072	1	1	2	29	20
13	013	078	1	1	1	72	33
14	014	078	1	1	1	66	33
15	015	072	1	2	2	62	21
16	016	072	1	2	2	57	20
17	017	072	1	1	1	54	22
18	018	072	1	1	1	52	27
19	019	078	1	2	1	49	27
20	020	084	1	1	2	47	19
21	021	072	1	1	2	45	18
22	022	078	1	1	2	43	20
23	023	078	1	1	2	41	17
24	024	072	1	1	2	39	11
25	025	072	1	1	2	33	17
26	026	078	1	1	2	25	16
27	027	084	2	1	1	71	32
28	028	084	2	2	2	63	21
29	029	078	2	2	2	56	21

	Pupil #	Age	Grade	Sex	Achievement Level	PPMS	RCPM
30	030	084	2	1	1	62	23
31	031	084	2	1	1	54	29
32	032	084	2	2	2	59	20
33	033	084	2	1	1	54	28
34	034	072	2	2	2	51	21
35	035	078	2	1	2	51	19
36	036	078	2	1	2	46	20
37	037	072	2	1	1	43	24
38	038	084	2	1	1	43	24
39	039	084	2	2	1	70	29
40	040	090	2	2	2	69	22
41	041	084	2	1	1	68	34
42	042	084	2	2	1	67	25
43	043	090	2	1	1	65	35
44	044	084	2	1	2	58	13
45	045	090	2	1	1	58	25
46	046	084	2	1	1	57	27
47	047	084	2	2	2	54	22
48	048	090	2	1	2	50	19
49	049	090	2	1	2	50	17
50	050	084	2	1	2	50	21
51	051	078	2	2	2	36	18
52	052	096	3	2	2	61	12
53	053	090	3	1	2	55	24
54	054	096	3	2	2	71	25
55	055	096	3	1	1	68	33
56	056	096	3	2	1	68	32
57	057	096	3	1	1	66	30
58	058	102	3	2	2	66	24

	Pupil #	Age	Grade	Sex	Achievement Level	PPMS	RCPM
59	059	102	3	2	1	63	29
60	060	096	3	1	1	56	29
61	061	096	3	2	1	55	32
62	062	096	3	2	2	53	23
63	063	096	3	2	1	75	34
64	064	096	3	2	1	70	32
65	065	096	3	1	1	70	31
66	066	096	3	2	1	70	31
67	067	096	3	2	1	66	28
68	068	108	3	2	2	63	17
69	069	108	3	1	2	61	19
70	070	090	3	2	2	60	21
71	071	096	3	2	1	60	27
72	072	090	3	2	1	58	28
73	073	108	3	2	2	52	20
74	074	108	3	2	2	49	19
75	075	108	3	1	2	46	19
76	076	090	3	2	2	41	21
77	077	108	3	1	1	50	26
78	078	114	3	2	2	71	32
79	079	108	3	1	1	71	29
80	080	108	3	2	2	66	22
81	081	108	4	2	2	64	28
82	082	108	4	1	2	64	27
83	083	108	4	2	1	64	30
84	084	102	4	1	1	62	32
85	085	114	4	1	1	53	36
86	086	108	4	1	2	51	24
87	087	120	4	1	1	75	32

	Pupil #	Age	Grade	Sex	Achievement Level	PPMS	RCPM
88	088	114	4	2	1	74	33
89	089	108	4	2	1	73	31
90	090	108	4	2	1	70	35
91	091	108	4	1	1	69	33
92	092	102	4	2	2	69	29
93	093	108	4	2	1	69	34
94	094	120	4	2	2	63	24
95	095	108	4	1	1	65	34
96	096	108	4	2	1	62	34
97	097	102	4	1	1	61	30
98	098	114	4	2	1	57	32
99	099	108	4	1	2	56	26
100	100	108	4	1	2	56	23