AN INVESTIGATION OF SELECTED VISUAL-PERCEPTUAL AND MOTOR PARAMETERS OF YOUNG TRAINABLE MENTALLY RETARDED CHILDREN

A Dissertation

Presented to

The College of Education of the

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

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by

Norman W. Charlton II

December 1970

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ABSTRACT

An attempt was made to determine if predictors of social status, gross motor performance, fine motor performance, and visual-perceptual performance could adequately determine criteria of intelligence quotient, mental age, or chronological age so as to be useful in academic design, or screening programs.

Forty-eight trainable mentally retarded children were identified
Gordon Smith Rehabilitation
from the pre-school population of the Harris County Center for the Retarded. Mean intelligence quotient was 43.1 months, mean mental age was 33.6 months; and mean chronological age was 81 months.

No significant relationships were determined between any of the predictors and intelligence quotient. Social status was not related to mental age or chronological age. Gross motor, fine motor, and visual-perceptual performances were related to factors of mental age and chronological age ("r" ranging from .325-.710). Multiple correlation techniques developed relationships of .7238 and .5563 between the predictors and criteria of mental age and chronological age respectively. These were judged insufficient for a basis of curriculum design or screening programs.

Instrumentation used included the McGuire-White Index of Social Status, the Marianne Frostig Developmental Test of Visual Perception, the Slosson Intelligence Test for Children and Adults, and selected items from the 1955 revision of Lincoln-Oseretsky, the Purdue Perceptual Motor Survey, and an experimental curriculum designed by Connor and Talbot.

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CHAPTER I

BACKGROUND OF THE RESEARCH PROBLEM

A. INTRODUCTION

Educators working with the mentally retarded have long been aware that a large number of children appear to be pseudo-retardates, the products of impoverished environments. The first report of the President's Committee on Mental Retardation, in a graphic illustration of mental retardation by cause, indicated that this figure may be as high as seventy-five percent of the retarded population.[1] In the concluding pages of this report, President Kennedy was advised of ten areas in urgent need of attention. Heading this list was a need for mental retardation services to be made available in urban and rural America to more of the people with particular emphasis on low income, disadvantaged neighborhoods.

The seventh recommendation required immediate major attention to be given to early identification and treatment of the mentally retarded. This section further detailed:

> The majority of children identified as mentally retarded are not discovered until they reach school age.
> By that time, as many as three or four years...precisely the years during which the child learns most...have been lost, during which several programs could have been preparing the child to live usefully with his handicap.

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[1]MR 67: _A First Report to the President on the Nations Progress and the Remaining Great Needs in the Campaign to Combat Mental Retardation_, A report prepared by the President's Committee on Retardation, U. S. Government Printing Office: 1967 0-269-237, p. 1.

> Screening of infants and pre-school children for symptoms of mental retardation (as well as other handicaps) should be part of every community's public health services. School districts should offer special pre-school classes whose purpose is to begin, with the identified retarded child under five years old, the careful course of education and training that will produce a socially competent and economically productive adult.[2]

Two of the most urgent needs of the retarded are therefore a need for services to be placed where they can be made available, and a need for identification of retarded children at the earliest possible time. This clearly indicates that techniques for evaluating children and determining which individuals will need special services must be developed.

Recently much interest has turned to the role of gross motor, fine motor, and visual perceptual skills as they are related to school achievement and the learning process. G. N. Getman has built a model of acquired learning from a base he entitles, "The Visuomotor Complex."[3] Newell Kephart has stressed an integration of perception and learning and cautions:

> The total perceptual motor process should be considered in every learning activity which we set up for the child. Learning experiences should be designed for him in terms of this total process in order to obtain the desired results.[4]

Marianne Frostig has indicated that perception is the "major development task of the child between the ages of 3 and approximately 7½

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[2]Ibid, p. 27.

[3]Getman, G. N., "The Visuomotor Complex in the Acquisition of Learning Skills" in Learning Disorders, (Jerome Hellmuth, Editor), Seattle, Washington: Special Child Publications, 1965, pp. 49-76.

[4]Kephart, Newell C., The Slow Learner in the Classroom, Columbus, Ohio: Charles E. Merrill Books, Inc., 1960, p. 63.

years of age..."[5] Others have supported, from slightly different positions, similar views.

This study was an attempt to understand the relationships between certain identifying characteristics of the retarded and their performance on selected gross motor, fine motor and visual perceptual items. It did not deal with the population of the retarded, but selected a rather narrowly defined sample restricted on variables of chronological age, intelligence quotient, general health, and placement. The underlying thought behind these restrictions was the identification of the existing relationships, if any, in a sample grouping that included young, deprived, trainable children, yet enough variability on these factors to give some insight into the effects of these variables.

B. STATEMENT OF THE PROBLEM

The problem of this study was to determine whether a composite of predictors, selected according to current research findings, the experiences of the investigator, and the administrative facility of the items would obtain multiple correlation coefficients that were sufficiently high as to be usable as predictors of criterion of intelligence quotient, mental age or chronological age when applied to a sample of young, trainable retarded children.

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[5] Frostig, Marianne, and Horne, David, "An Approach to the Treatment of Children with Learning Disorders," in Learning Disorders (Jerome Hellmuth, Editor), Seattle Washington: Special Child Publications, 19~~65~~ 72, p. 297.

Involved in this study were concommitant problems as follows:

Determine the relationships, through correlation techniques, that existed between each of the predictor categories and the criterions.

C. NEED FOR THE STUDY

The need for this study was based on the paucity of information available concerning the motor and visual-perceptual performance abilities of the retarded. Such information would allow educators or other service personnel, to determine adequate screening techniques with the retarded, or serve as a base for education programming.

Early childhood education programs, beginning with Seguin[6] have advocated sensory-motor training as a starting point in educational programs for retarded children. This emphasis has continued in modern formulations, such as Piaget's developmental stage theories.[7] Yet, the very basic questions as to the motor and perceptual capacities of the retarded child are still largely unanswered. Francis and Rarick, working with older educable children refuted the belief that these children do not show deficiencies in motor skill development,[8] but the motor parameters of young retarded children, and particularly trainable children are largely unexplored.

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[6]Seguin, E., Idocy: and Its Treatment by the Physiological Method, Albany, New York: Bradow, 1866.

[7]Piaget, Jean, The Origin of Intelligence in Children, New York: International Universities Press, 1952.

[8]Francis, R. J., and Rarick, G. L., "Motor Characteristics of the Mentally Retarded," American Journal of Mental Deficiency, 63, 1959, 792-811.

This study, and others dealing with the avenues of development from various contexts, is needed to supplement the missing body of knowledge concerning the motor and perceptual abilities of young retarded children. Obviously, limited educational resources made it even more imperative that techniques were explored that might be of value in determining identification of children likely to have difficulties in school and later life. This study was needed as a pilot model from which these identification techniques might evolve.

D. DEFINITIONS OF TERMS USED

Mentally Retarded, this term and its derivatives, denotes: "subaverage intellectual functioning which originates during the developmental period and is associated with impairment in adaptive behavior.[9] This definition is the core of the classification system developed by R. F. Heber with the support of the National Institute of Mental Health, and the American Association on Mental Deficiency. The word trainable, when it prefaces retarded was meant to indicate the child whose functioning and adaptive behavior is such that goals of programs designed for the child are not academic mastery, but improvement of mental, physical and social behavior so that the child may become socially cooperative and economically useful within his home, or a somewhat sheltered condition.

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[9]Heber, R. F., "A Manual on Terminology and Classification in Mental Retardation," American Journal of Mental Deficiency, 64, 1959, Monograph Supplement (revised edition) 1961, p. 3.

Gross Motor, refers to performances, or motor activities, that involve the total musculature of the body, or large portions of it, with particular emphasis on the large muscle groups.

Fine Motor, refers to performances, or motor activities in which control or precision is a major factor, rather than the movement.

Visual Perception, a process described by Frostig[10] as involving five areas of operationally defined perceptual skills, as follows: (1) Eye Motor Coordination, defined by a test of eye-hand skill involving the drawing of continuous lines between boundaries, or from one point to another without the aid of guidelines, (2) Figure Ground, involves the ability to detect shifts in perception of figures against increasingly complex grounds, (3) Constancy of Shape, denotes an ability to recognize geometric figures presented in a variety of sizes, shades, textures and positions, and discriminate these from similar geometric figures, (4) Position in Space, involves rotating and reversing figures and retaining the ability to discriminate original drawings, and (5) Spatial Relationships, involves a replication of a spatial pattern through the analysis and duplication of that pattern by constructing lines of various lengths and angles using dots as guide points.

Chronological Age, determined by subtraction of a person's birthdate, by year, month and day from the day of the close of the second week

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[10]Frostig, Marianne, Lefever, W. and Whittlesey, J. R. B., Administration and Scoring Manual for the Marianne Frostig Developmental Test of Visual Perception, Palo Alto, California: Consulting Psychologists Press, 1964.

of testing. If the number of days was 15 or under, they were dropped, 16 or over, they were counted as an additional month.

Mental Age, calculated by adding the basal age and the months credit above the basal age, as measured on the Slosson Intelligence Test for Children and Adults.[12]

Intelligence Quotient, obtained by dividing the mental age by the chronological age and multiplying by 100.

E. LIMITATIONS

This study acknowledges the following limitations:

1. A sample limited to the pre-school enrollment of the Harris County Center for the Retarded.
2. A sample limited by the child's ability to respond to the first item (balance beam walking) on the gross motor test battery. Limitation is not performance, but comprehension by the child, as evidenced, by the attempt to perform of the instructions given. Seven children were excluded from the sample, and in each case, these children had been judged by clinical personnel to be severely retarded.
3. A sample limited to children that did not display gross physical abnormality, such as absence of a limb, orthopedic corrective devises or obvious visual incapacity. One child was eliminated from the sample because of visual incapacity.

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[12]Slosson, Richard L., *Slosson Intelligence Test for Children and Adults*, East Aurora, New York: Slosson Education Publications, 1963.

4. Certain aspects of the fine motor, gross motor, and visual perceptual test items required a subjective evaluation of the performance. The experiences of the investigator prior to testing were such that a tendency towards any unreliability was thought to be adequately negated, a position supported in analysis of gross motor performance reliability.

5. A tendency of a sample of this sort to be skewed, and therefore not normally distributed, because of the limitation of the range of intelligence. This was dealt with through transformation of the raw scores to a normal distribution prior to analysis.

CHAPTER II

SURVEY OF THE RELATED LITERATURE

A research of the literature revealed a limited number of articles relating the variables of this study with the mentally retarded. The majority of articles dealing with the specific variables and similar items, were applied either as an indicator of change within an experimental grouping, or as a delineator of abilities of different groups, such as the disturbed or minimally brain injured, in which the intelligence quotients were controlled to within one standard deviation of the mean for the general population.

This chapter is divided into five parts, each dealing with a major variable of the study. They are (1) The Trainable Mentally Retarded Child, (2) The Marianne Frostig Developmental Test of Visual Perception, (3) Gross and Fine Motor Abilities of the Retarded, (4) The McGuire White Index of Social Status, and (5) The Slosson Intelligence Test for Children and Adults. In each of the areas of test variability specific attention is given to previous applications within the area of mental retardation.

Gross and Fine Motor Abilities were grouped because of the frequency of their presentation within the same study. Separation of the two within the review of the literature would have necessitated needless repetitions. Several studies in fact discussed relationships in which gross and fine motor performances were grouped without a factor weight for either.

A. THE TRAINABLE MENTALLY RETARDED CHILD

Literature dealing with the development of the potential of the severely retarded child can be traced as far back as 1801 with Itard's publication of his work with the Wild Boy of Aveyron. Williams and Wallin[13] reported that residential programs for retarded children began in the United States, and certain European countries as early as the 1850's. Residential school programs developed from that period onward, with the more moderately retarded usually grouped with the more severely retarded.

An interest in individual differences among children became the educational vogue during the waning years of the nineteenth century, and with this interest came the concept of special classes for the retarded. Williams and Wallin point out that these classes:

> were quite heterogeneous at first, due in part at least to the lack of measuring devices. From about 1908 on, however, the Binet Simon Test and its many adaptations came into general use.[14]

The Binet-Simon Test was an instrument designed to select children for special classes, and was among the first to differentiate among degrees of retardation. These differences became somewhat categorized into three general levels, closely related to the concept of educability. The concept of uneducable applied to those categories of intelligence falling below test scores of 50. Residential programs were available for these

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[13] Williams, Harold M, and Wallin, J. E., Education of the Severely Retarded Child, Washington, D. C., Superintendent of Documents, U. S. Government Printing Office, Bulletin 1959, No. 12. 32 pp.

[14] Ibid. pp. 1-2.

individuals, but educational provisions were practically non-existent.

Parents began to organize in the mid-1930's demanding better programs for the more severely retarded. Their efforts led to the formation of the National Association for Retarded Children in 1940. A distinction was needed between the more severely retarded, and the child classified as educable. It was largely this group's efforts in seeking this distinction that the word "trainable" came into general use.

Robinson and Robinson discuss the distinction between the terms as follows:

> The terms educable mentally retarded and trainable mentally retarded were popularly used from the 1920's through the 1950's and are still employed widely, though sometimes with modified meanings. They correspond with the terms moron and imbecile, formerly in vogue. Educable retarded children have been defined as having the I.Q.'s from 50 to 75; they are expected eventually to achieve academic work at least to the third-grade level and occasionally to the sixth-grade level by school-leaving age; as adults, they are expected to be socially adequate and capable of unskilled or semi-skilled work. Trainable children, with I.Q.'s of 25-49, are not expected to achieve functionally useful academic skills. Self-care and social adjustment within a restricted environment are envisioned as the goals of their school experience.[15]

Kirk and Johnson classified children of low intelligence along several dimensions, one being educational purpose. They also equate the educable child with the older classification of imbecile and describe him in this way:

> An imbecile child will probably develop some language, be trained to care for his bodily needs, and have trainability as far as daily habits and routines are concerned. He will,

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[15]Robinson, Halbert B. and Robinson, Nancy M., The Mentally Retarded Child, A Psychological Approach, New York: The McGraw-Hill Book Company, 1965, p. 461.

> however, require supervision and care in his home or in institutions throughout his life. In terms of I.Q. the imbecile rates between 20 or 25, and 45 or 50 on intelligence tests.[16]

Other terms have been used to describe the trainable child, among these, "semi-dependent," and "middle-grade defective." Kirk has summarized these terms by surveying the definitions given by the various states having programs for the trainable child, and has formulated the following characteristics:

> A trainable child is one who is (1) of school age, (2) developing at the rate of one-third to one-half that of the normal child (I.Q.'s on individual examinations roughly between 30 and 50), (3) of retarded mental development to such an extent that he is ineligible for classes for the educable mentally retarded but will, however, not be custodial, totally dependent, or requiring nursing care throughout his life, (4) capable of learning self-care tasks (such as dressing, eating and toileting) and capable of learning to protect himself from common dangers in the home, school, or neighborhood, (5) capable of learning social adjustment in the home or neighborhood and learning to share, respect property rights, and cooperate in a family unit and with the neighbors, and (6) capable of learning economic usefulness in the home and neighborhood by assisting in chores around the house or in doing routine tasks in a sheltered environment under supervision, even though he will require some care, supervision, and economic support throughout his life.[17]

Reviewing the goals of the public school programs for the state of California, Flora Daly states:

> The two broad goals of the curriculum for trainable mentally retarded children are, first, to develop the pupil as a person, a human being; and, second, to equip him with the skills which help him to gain a degree of mastery over his environment.[18]

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[16]Kirk, Samuel A., and Johnson, G. Orville, Educating the Retarded Child, New York: Houghton-Mifflin Company, 1951, p. 4.

[17]Kirk, Samuel A., Educating Exceptional Children, Boston: Houghton-Mifflin Company, 1962, p. 133.

[18]Daly, Flora M., "The Program for Trainable Mentally Retarded Pupils in the Public Schools of California," Education and Training of the Mentally Retarded, 1:3, October, 1966, p. 115.

Daly further suggests that the process of growth as a person is done primarily through the sensory motor channels, with special attention given to opportunities for children to express themselves in nonverbal ways through play involving gross muscle movement, rhythms, music, and various art forms. Among the factors retarding achievement of the educational goals of the trainable retarded in California, Daly states:

> ...there is a lack of a systematized instructional program appropriate in breadth of educational activities and progressively scaled to achieve the social competencies we are reaching for.[19]

B. THE MARIANNE FROSTIG DEVELOPMENTAL TEST OF VISUAL PERCEPTION

The Marianne Frostig Developmental Test of Visual Perception is an attempt to develop a "perceptual quotient" with a function within the area of visual perception similar to that served by the intelligence quotient as it relates to mental abilities. Initial structuring of the test items emphasized a simplicity of design that would allow their application with nursery school children. Working with a group of children diagnosed as having minimal brain damage, in which most of the children further evidenced visual or auditory perceptual disturbances as detected by the Bender-Gestalt, Goodenough, or the Wepman Test of Auditory Discrimination, the following was observed:

> Disturbances in visual perception were by far most frequent symptoms and seemed to contribute to the learning difficulties. Children who had difficulty in writing seemed to be handicapped by poor <u>eye-hand coordination</u>,

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[19] <u>Ibid</u>. p. 118.

and children who could not recognize words often seemed to have disturbances in figure-ground perception. Other children were unable to recognize a letter or word when it was written in different sizes or colors, or when it was printed in upper case print and they were used to seeing it in lower case. It was postulated that these children had poor form constancy. Like everyone else who has worked with young children, we noticed that many children produced letters or words in "mirror writing." Such reversals or rotations indicated a difficulty in perceiving position in space, while interchanging the order of letters in a word suggested difficulties in analyzing spatial relationships (as well as indicating the possibility of auditory perceptual difficulties).[20]

Preliminary items to measure these discrepancies were designed and a pilot test was conducted in 1959. Scoring and evaluation methods were refined in a subsequent form developed in 1960, and the present form was published in 1961. The final form of the test selected items in each of the areas of visual perception that evidenced good age progression and a low degree of carry-over from other areas of visual perceptual abilities.

A test-retest reliability study was conducted by Maslow, Frostig, Lefever, and Whittlesey in 1963. Using 50 children diagnosed as having learning disabilities, and a three week interval between tests they found a correlation of .98. Another sample of 37 second grade children and 35 first grade children yielded a coefficient of .80. The individual subtests in a test-retest situation yielded correlations ranging from .42 to .80. A much larger sample of children from a normal population yielded a product moment correlation for the total test score of .69. Split-half

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[20]Frostig, Marianne, Maslow, Phyllis, Lefever, D. Welty, and Whittlesey, John R., The Marianne Frostig Developmental Perception, 1963 Standardization, Palo Alto, Calif: Consulting Psychologist Press, 1964, p. 464.

reliability correlation coefficients, calculated using Pearson Product-Moment techniques, corrected by the Spearman-Brown formula, on a sample of 1459 children were determined for one year age groups from 5 years to 9 years. These coefficients were .89, .88, .82, and .78. It was suggested that this decline with age was due to a flattening effect of perceptual maturation as measured by this test with increase in chronological age.[21]

Corah and Powell completed a factor analysis of the Frostig Test and determined relatively low correlations between subtests. They concluded that the concept of a Perceptual Quotient should be given more attention; that the Frostig test has a good age standardization; that the test has only a low positive relationship with I.Q., and that it may be a good measure of perceptual development.[22]

Allen, Haupt, and Jones administered the Frostig test and the Wechsler Intelligence Scale for Children to a sample of 65 educable retardates in special education classes in public school. Of the 65 retardates obtaining high perceptual quotients, and therefore indicating little perceptual skills impairments, a WISC full scale I.Q. mean of 75.4 was obtained. A second grouping of 20 children constituting the lower perceptual quotients, and demonstrating marked impairment in one or more areas of visual perceptual

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[21]Maslow, P., Frostig, M., Lefever, D. W., and Whittlesey, J. R. B., "The Marianne Frostig Developmental Test of Visual Perception, 1963 Standardization" _Perceptual and Motor Skills_, 19, 1964, pp. 463-499.

[22]Corah, N. L., and Powell, B. J., "A Factor Analysis of the Frostig Developmental Test of Visual Perception" _Perceptual and Motor Skills_, 16, 1963, pp. 59-63.

functioning achieved mean full scale scores of 54.8. Greater differences were observed between means of these groups when only the performance scales of the WISC were observed. The study concluded that the retarded child with apparently intact visual perceptual skills is generally more efficient than the retarded child with impaired perceptual development as measured by the WISC performance subtests.[23]

A second analysis of the same data, by Allen, et.al., indicated that while the test differentiated levels of perceptual development among retardates, it should not be employed to assess intelligence. This conclusion was reached by graphically presenting the Frostig subtest scale scores and mental age equivalents on vertical axis and chronological age on the horizontal axis. Presented in this manner, the low-perceiver group graphs for chronological age versus scale scores for each of the five subtests resulted in non-significant correlational curves. The chronological age versus the Frostig age equivalents for this same group produced almost circular distributions. The high perceivers graphs disclosed 8 out of 10 non-significant correlations. It was concluded that the Frostig test was designed for chronological ages between 3 and 9 years, and the retarded population had ranged between 8 and 14 years chronologically, resulting in an inability of the Frostig test to discriminate satisfactorily above a particular chronological level in retarded children who do not manifest

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[23]Allen, R. M., Haupt, T. D., and Jones, R. W., "Visual Perceptual Abilities and Intelligence in Mental Retardates," Journal of Clinical Psychology, 21, 1965, pp. 299-300.

more than a very mild degree of impairment in visual perceptual development. Exactly where this level of chronological age, or impairment is located with retarded children was undetermined.[24]

Ruth Sprague reviewed the research on visual perception in the young school age child as it related to the Frostig items, and she concluded that there was substantial support for acceptance of visual perceptual items as important during the developmental period. She also noted the absence of literature concerning problems in visual perception of the implications for learning in the presence of a dysfunction. Using a sample of 40 public school children, Sprague completed a factor analysis of the Frostig Test, the Draw-A-Person, the Metropolitan Readiness, the Metropolitan Reading Achievement Tests, and other data drawn from the school record forms. She concluded that the Frostig visual perceptual tests totals showed significant relationships with the Metropolitan Readiness Test Score, and the Reading achievement tests at the .01 level, on both a pre-reading, and a reading level.[25]

Hepburn and Donnely, reported correlations between the subtests, of the Frostig test, and Goodenough Draw-A-Man Test, ranging from .48 to .57. When compared to the relationship achieved by completing the correlations between the subtests, and the Keystone Ready-to-Read Telebinocular,

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[24] Allen, R. M., Jones, W., and Haupt, T. D., "Note of Caution for the Research Use of the Frostig Test with Mentally Retarded Children," Perceptual and Motor Skills, 21, 1965, pp. 237-238.

[25] Sprague, Ruth Hamilton, <u>Learning Difficulties of First Grade Children Diagnosed by the Frostig Visual-Perceptual Tests: A Factor Analytic Study</u>., Wayne State University, 1963, Detroit, Michigan.

very similar relationships were observed. This study included 52 boys and 60 girls aged 4 years, 11 months to 6 years, 5 months, from four schools in a Canadian city of 75,000 population. Mean scores on the test items suggested that the sample might be representative of a larger population, with regard to factors of intelligence, readiness skills, and perceptual skills.[26]

The use of the Frostig test with mentally retarded children, particularly young retarded children, is generally absent from the literature. Frostig evidently expected this, and states in her final standardization:

> More research will be needed before we will be able to distinguish the patterns of visual perceptual disturbance due to brain damage from those due to developmental lag, or to any other reason.[27]

C. GROSS AND FINE MOTOR ACTIVITIES OF THE RETARDED

Most investigators have found that the mentally retarded are generally inferior to normal children in motor skills performance. Reviews by Stein[28] and Malpass[29] both completed in 1963 confirm this view. This disability is not necessarily an entity, however, as Malpass points out:

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[26]Hepburn, Andrew W., Donnely, Frank, "Psychometric Identification of Kindergarten Children with Visual Perceptual Impairments," Exceptional Children, 34:8, 1968, pp. 708-709.

[27]Frostig, Marianne, Lefever, Welty, and Whittlesey, J. R. B., Administration and Scoring Manual, Marianne Frostig Developmental Test of Visual Perception, Palo Alto, Calif., Consulting Psychologists Press, 1964, p. 6.

[28]Stein, J. U., "Motor Function and Physical Fitness of the Mentally Retarded: A Critical Review," Rehabilitation Literature, 24:8, 1963, pp. 230-242.

> Results of these studies do not demonstrate that these individuals cannot learn to perform as well as normals. As has been already pointed out, many do. The clear implication is that the moderately retarded may be able to improve their comparatively lower motor skills, but more stimulation and better training methods, probably over a longer period of time are required.[30]

The above thinking is supported by such as Piaget,[31] or Strauss and Kephart,[32] who would indicate that perhaps the earliest learning is based on motor learning. The child develops through a systematic integration of mass centralized movements into separate reflex movements. It is the integration of these with the environment, which enables the child to perform a variety of motor experiments which form the basis for his conceptual relationships.

The motor experiences, involve movement through space and the capability to control motor responses. These become generalized movement patterns suggested by Kephart to fall into four classifications: (1) Balance, with the force of gravity as a zero point for all spatial relationships, (2) Contact patterns which involve the manipulation of objects, (3) Locomotion involving the exploration of space, and (4) Propulsion and receipt involving the interception of objects in space, and their propulsion, or impartment of movement to them through the motor acts of the child.[33]

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[30] Ibid., p. 625.

[31] Piaget, op. cit.

[32] Strauss, A. A., & Kephart, N. C., Psychopathology and Education of the Brain Injured Child. Vol. II. Progress in Theory and Clinic, New York: Grune and Stratton, 1955.

[33] Kephart, Newell C., "Perceptual-Motor Aspects of Learning Disabilities," Exceptional Children, 31:4, 1964, pp. 201-206.

Early studies supported this view of relating intelligence to motor performance. Farmer[34] was among the first to call attention to this, in 1927, he pointed out that scores on intelligence measures and motor performance batteries were closely related in young children. He explained this by the fact that many intelligence test items for young children are essentially motor tasks. It was his opinion that only the more intelligent younger children could comprehend the requirement in the motor task, and that it was only as the child advanced in age that the motor tests became more independent of intelligence.

Seashore[35] studied the relationship between gross and fine motor performance, and the comparison of fine motor performance to athletic ability. He used a sample of 100 college freshmen men, and presented a battery consisting of coordination items rather than strength. He found that the correlations between gross and fine motor performances to be low, with a median "r" of about +.35. He concluded that a significant relationship did not exist between the movements requiring finer adjustments and movements of a gross nature, such as found in athletic activities.

Most investigations relating motor abilities to intelligence have been completed using subjects that fell within a normal or above normal range of intelligence. These studies suggest that there is practially no relationship between intelligence and motor ability. Jack, as an example,

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[34]Farmer, Eric, "A Group Factor in Century-Motor Tests," British Journal of Psychology, 17, 1927, pp. 327-342.

[35]Seashore, Harold, "The Relationship of Fine and Gross Motor Abilities," Psychological Bulletin, 38, 1941, pp. 608-609.

found no significant relationship between the Rogers' Physical Fitness Index and intelligence.[36] Ray,[37] Johnson,[38] and Brace[39] came to the same general conclusions.

When dealing with the lower spectrum of intelligence, however, there exists an obvious clinically observable difference between motor performance, and that observed within the normal intelligence range. The relationship between degrees of motor performance, mental age, chronological age, or intelligent quotients are not defined, and were the central issues within this investigation. Particularly absent from the literature are definitive studies dealing with either low chronological ages, or low mental abilities.

A further consideration in motor performance of the retarded remains a much unsolved problem in all areas of skill assessment psychological as well as motor; the fundamental question of whether the performance represents basal skill of the individual, or is the result of a learning process. This problem has been dealt with as it concerns the retarded by several investigators.

Several studies have shown that there appears to be no evidence of

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[36]Jack, H. K., "The Relationship of Certain Sociological Factors to Physical Fitness Index Tests in Specific Rural Environments," Research Quarterly, 6, 1935, p. 252.

[37]Ray, H. C., "Inter-relationships of Physical and Mental Abilities and Achievement of High School Boys," Research Quarterly, 11, 1940, p. 129.

[38]Johnson, G. B., "A Study of the Relationship that Exists Between Physical Skill as Measured, and the General Intelligence of College Students," Research Quarterly, 13, 1942, p. 57.

[39]Brace, D. K., Measuring Motor Ability, New York: Barnes, 1927.

a low-I.Q. deficit in motor learning. Johnson and Blake, matched older retardates with mental age equal normal school children, and had the subjects perform a card sorting task, where 32 cards were sorted into four different boxes according to the geometric design on the card. The retarded performed better than the mental age mates on all five trials, but the learning curves of both groups were parallel. Both sets of curves leveled after the third trials suggesting that a factor of speed, possibly a function of chronological age, was responsible for the retardates' superior performance.[40]

Ellis and Sloan compared the rotary pursuit data collected on normal children by Ammons, Alprin and Ammons, with that collected on retardates with mean mental ages of 6.3 and 9.4 years, using normal children between eight and nine years of age for the comparison. The Ammons, et. al., data falls just between the two curves for the retarded, again confirming the lack of a low-I.Q. deficit, when learning rate is the concern.[41]

Other evidence suggests a definite relationship between mental age and task difficulty. Ellis and Sloan, discovered performances that were noticeably inferior among the retarded subjects when a 60 r.p.m. rotor was used as compared to a 30 r.p.m. performance.[42] Annett substituted peg board work for that of the rotary pursuit, and found that the performance curves for different I.Q. groups diverged as the tasks became

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[40]Johnson, G. O., and Blake, K.A., Learning Performance of Retarded and Normal Children, Syracuse, Syracuse University Press, 1960.

[41]Ellis, N.R., and Sloan, W., "Rotary Pursuit Performance as a Function of Mental Age," Perceptual and Motor Skills, 7, 1957, pp. 267-270

[42]Ibid, p. 269.

relatively more difficult. Lower-I.Q. subjects experienced more difficulties as the tasks became increasingly difficult. Annett's study group consisted of seventy-two male retardates from sixteen to twenty-one years of age, which were divided into three distinct I.Q. groups: 60 and over, 40-59, and below 40. The lowest group exhibited the poorest performance as the tasks became more difficult, or more clearly, there was a significant interaction between intelligence and task difficulty.[43]

Other studies present moderate relationships between motor abilities and mental proficiency. Heath, in 1942, used the Vineland Railwalking Test, with 53 familial, and 40 nonfamilial retardates, with a chronological age span of 18.0 years to 21.3 years, and a mean mental age of 8.5 years as measured by the 1916 version of the Stanford-Binet. He reported an "r" of .62 between the Vineland and the Binet for the familial group, and an "r" of .23 for the nonfamilial.[44]

Heath replicated the study in 1953, using slightly more subjects, and with the mean ages at the approximate same places. The second study groups had mean mental ages of 8.1, and coefficients of .57, and .15 were determined.[45]

Dr. Edgar Doll sponsored the first translation of the Oseretsky Scale of Motor Development in 1946. The Oseretsky was constructed in a

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[43]Annett, J., "The Information Capacity of Young Mental Defectives in an Assembly Task," Journal of Mental Science, 103, 1957, pp. 621-631

[44]Heath, S. R., Jr., "Railwalking Performance as Related to Mental Age and Etiological Types," American Journal of Psychology, 55, 1942, pp. 240-247.

[45]Heath, S. R., Jr., "The Relations of Railwalking and Other Motor Performances of Mental Defectives to Mental Age and Etiological Types," The Training School Bulletin, 50, 1953, pp. 110-127.

Binet fashion, organized by age levels from 4 to 16 years. The test was constructed around six subtests at each age level, which Oseretsky claimed measured: general static coordination, motor speed, dynamic manual coordination, simultaneous voluntary movements, and asynkinesia, or preciseness of movement. Oseretsky constructed his test battery through the clinical observation of a large number of normal and abnormal children, with the final selection of items based upon their ability to discriminate between normal, and neurological and motor deficiency. Sloan introduced The Lincoln adaptation of the Oseretsky in 1948, with a stated purpose of making the original items of the Oseretsky more usable with American subjects, and the scoring procedures show a greater conformity to prevailing test practices.[46]

Sloan used a sample of 20 institutionalized retarded children, with a mean chronological age of 10, and 1937 Stanford-Binet scores of a mean of 54 for the males, and 56 for the females to which he administered the 1948 Lincoln-Oseretsky. He reported an F-ratio of 5.30, that was significant at α=.01. On all six subtests the retarded children were consistently inferior when compared to a normal sample.[47]

Sloan revised the Lincoln-Oseretsky in 1955, reducing the number of items from 85 to 36. His subjects included 380 males and 369 females between the ages of six and 14 years, with approximately 40 in each age grouping. Reliability was expressed in terms of a split-half reliability

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[46] Sloan, William, "The Lincoln-Oseretsky Motor Development Scale," Genetic Psychology Monographs, 51, 1955, p. 188.

[47] Sloan, William, "Motor Proficiency and Intelligence," American Journal of Mental Deficiency, 55, 1951, 00. 394-406.

technique. Coefficients range from .93 to .78 for both the male and female population, with an exceptional "r" of .59 for the 14 year old female grouping, a departure Sloan did not explain. An odd-even technique was used for the males and females yielding coefficients of .96, and .97, respectively. A sample of 109 of the subjects were retested after one year, and with age partialed out a test-retest coefficient of .70 was obtained. Sloan speculates that this is quite high for a one year interval, and that if classic test-retest interval were used, the coefficient would probably be much higher.[48]

Rabin used the above version of the Lincoln-Oseretsky with a sample of 60 institutionalized, familial retardates, ranging in age from 10 to 14 years, and intelligence scores ranging from 40 to 69. Rabin found motor proficiency to have a significant relationship to chronological age, but contrary to Sloan's results he did not find a relationship of significance with intelligence.[49]

Malpass compared a normal sample with a grouping of institutional, educable mental retardates, and a grouping of public school educable retarded. He found a significant difference between the retarded groups and the normal group on the Oseretsky test, but reported no difference between the institutionalized and non-institutionalized subjects. He reported

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[48]Sloan, William, "The Lincoln-Oseretsky Motor Development Scale," Genetic Psychology Monographs, 51, 1955, pp. 197-198.

[49]Rabin, H. M., "The Relationship of Age, Intelligence and Sex to Motor Proficiency in Mental Defectives," American Journal of Mental Deficiency, 62, pp. 507-516.

correlations between the Oseretsky and Wechsler Intelligence Scale for Children to be .44 both in institutionalized and public school groups.[50]

Distefano, Ellis and Sloan used the Oseretsky, the Vineland Railwalking Test and The Minnesota Rate of Manipulation Test in 1958 using 76 institutionalized retarded. The sample was composed of 40 males with a mean chronological age of 19 years, and a mental age mean of 9.9 years, and 36 females with a mean chronological age of 22 years, and a mental age mean of 9.1 years. Correlations between mental age scores and the Oseretsky were .40 for the males, and .58 for the females. Railwalking correlated with mental age at .04 for the males and .32 for the females. Correlations for the phases of the Minnesota test were (1) Turning, .41 males, .45 females, (2) Placement, .38 males, .37 females, (3) Handsteadiness, .16 males, .05 females, (4) Strength of Grip, .03 males, .26 females.[51]

Elkin, and Friedman reviewed the existing tests of motor abilities with the feasibility of tests ability to discriminate the development of the retarded for assignment to differential training programs. The study sample was composed of thirty males and eleven females, ranging from 6 to 25 years in age, with intelligence quotients from 18 to 76, with a mean of 43. Twenty of the subjects were unable to complete at least one of the eight tests given. Results suggested that chronological age appears to be

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[50]Malpass, L. F., "Motor Proficiency in Institutionalized and Non-institutionalized Retarded Children and Normal Children," American Journal of Mental Deficiency, 64, pp. 1012-1015.

[51]Distefano, M. K., Jr., Ellis, N. and Sloan, W., "Motor Proficiency in Mental Defectives," Perceptual and Motor Skills, 8, 1958, pp. 231-234.

related to static strength and manual dexterity, and intelligence quotient to gross bodily equilibrium and arm-hand steadiness.[52]

Francis and Rarick studied 284 mentally retarded children in the public schools of Madison and Milwaukee Wisconsin. A battery of 11 motor tests was given to all subjects and observations were made on age and sex trends for each skill tested. They concluded:

> The findings of the study clearly demonstrated that intelligence as measured by standardized intelligence tests was positively correlated with most of the motor performance tests. However, the coefficients were generally low and of approximately the same order as other investigators have reported with normal children.
>
> In conclusion, it can be stated that the mentally retarded children included in this investigation were markedly inferior to normal children in all motor performance tests and that with advancing age the deviations from the normal tended to become greater...The great differences in motor proficiency between the normal and the mentally retarded, as demonstrated here, clearly shows that the degree of motor retardation of these children is perhaps greater than had been previously supposed.[53]

Oliver completed a study in 1958, in England, administering the Iowa Revision of the Brace Test, the Metheny modification of the Johnson Skill Test, and the Indiana Motor Fitness Test to adolescent mentally retarded boys. These tests generally measure gross motor performance, with limited fine motor tasks. Following a ten week program of light to vigorous exercisc, the tests were repeated as were re-evaluation of intelligence.

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[52]Elkin, Edwin, H., and Friedman, Erwin, Development of Basic Motor Abilities Test for Retardates: A Feasibility Study, Final Report, Jewish Foundation for Retarded Children, Monograph No. 67-1, Washington, D. C., February, 1967.

[53]Francis, R. J., and Rarick, G. L., "Motor Characteristics of the Mentally Retarded," American Journal of Mental Deficiency, 63, 1959, p. 811.

The results indicated significant improvement in both physical and mental abilities, which Oliver attributes to improved physical condition, improved social adjustment, and successful experiences. However, in addition to the physical education activities the experimental group was taught English and numbers each day, leaving unsupported an assumption of increase in mental ability through physical education activity alone.[54]

Corder in a 1966 article reported on changes in itellectual development, social status, and physical development as the result of a structured body development program, that ran one hour per day for twenty school days. He divided his sample into a control group, an officials group (Hawthorne control) and a training group. The officials group attended the sessions with the training group, but performed record keeping tasks for the training group. Corder's results supported the hypothesis that the physical education program would cause significant gains in intellectual development and physical fitness. Prediction of greater gain in the area of social status by the training and officials group over the control group, however, was not supported.[55]

Carter theorized that perhaps the low scores obtained by the mentally retarded on physical fitness measures might be the result of a lack of opportunity to develop abilities similar to deficiencies observed in

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[54]Oliver, J. N., "The Effects of Physical Conditioning Exercises and Activities on the Mental Characteristics of Educationally Subnormal Boys," British Journal of Educational Psychology, 28, 1958, pp. 155-165.

[55]Corder, W. O., "Effects of Physical Education on the Intellectual, Physical, and Social Development of Educable Mentally Retarded Boys," Exceptional Children, 32, 1966, pp. 357-364.

these children in linguistic abilities. Carter's sample was comprised of 44 educable mentally retarded boys. A survey investigation was completed in 1966 to determine the comparison of physical fitness test scores between a grouping from this sample who had participated in a daily physical education program, and a grouping that had not participated. Both groups were individually administered the American Association of Health, Physical Education, and Recreation Youth Fitness Test. The control group (18 boys who had participated) was superior in all items, except the 50 yard dash, and the pull-ups, when compared to the experimental group (26 boys not in a program).

Stage two of the program consisted of having the experimental group participate for twelve weeks, and comparing their scores to those achieved initially by the control group. Not a single significant difference was obtained. Carter also noted that the variability of the group tended to increase as the boys were given an opportunity to develop in accordance with their abilities.[56] He concluded:

> ...that educable retarded boys frequently score low on tests of physical ability due to lack of opportunity to participate in physical education programs, and that physical fitness of the retarded can be enhanced through a general physical education program in a manner congruent with the enhancement of linguistic ability by placing children in a language development program.[57]

Sengstock completed an analysis of the physical fitness of mentally retarded boys that agree with Carter's 1966 findings. He administered the

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[56]Carter, John L., "Effects of a Physical Education Program Upon the Physical Fitness of Educable Mentally Retarded Boys," TAHPER Journal, 38:2, 1970, p. 4, p. 33.

[57]Ibid., p. 33.

same test to two groups of normal children, one matched on chronological age (old normal) and the other matched on mental age (young normal). Mental ages for the retarded sample ran between 72 and 144 months. Chronological ages for this sample were between 120 and 180 months. Mental age for the old normal sample was between 108 and 198 months. Chronological age for the young normal group was between 60 and 160 months. The old normal group of boys was significantly superior to the mentally retarded group on all seven test areas. The retarded group was superior to the retarded sample on five of the seven test areas.[58]

A very limited sample, carefully biased as the ten most awkward educationally subnormal boys (Stanford-Binet I.Q. range 51-73), chronological aged 9-10 years were selected by Keogh and Oliver. These boys were participants in a physical performance test consisting of a standing broad jump, a 50 foot hop for time, a beam balance, a beam walk, a hopping task, and a finger-foot tapping task. They were compared with other educational subnormals, judged not to be as awkward, and a group of other school boys. The awkward subnormal boys scored below the other groups in every area of performance. This group was then given six sessions, of only 15 minutes duration, of training tasks designed to enhance their performance. These sessions were spaced over a three week period. This limited amount of work produced what was termed quite clear success in the case of five boys, some

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[58]Sengstock, Wayne L., "Physical Fitness of Mentally Retarded Boys," The Research Quarterly, 37:1, 1966, pp. 113-120.

progress with two boys, and little progress with the three remaining boys. Keogh and Oliver concluded that:

> The results from the instruction sessions were encouraging, particularly in light of the severity of the awkwardness of the boys. Oliver previously had achieved considerable success with a group of ESN boys who were given vigorous and intense physical activity. In the present study, a more extreme problem was faced with a smaller number of boys for a limited period of instruction. It would seem that the potential for these boys is not as limited as many people might believe.[59]

The Perceptual-Motor Survey is a battery designed by Roach and Kaphart to allow the observance of a broad spectrum of perceptual motor behavior within a structured circumstance. It is not designed as a diagnostic instrument but rather as a behavioral overview. Items within the survey were selected with the following specifications for inclusion: "it must, (1) tap some perceptual-motor area, (2) be easy to administer and require a minimum of special equipment, (3) be representative of behavior familiar to all children, (4) have scoring criteria simple enough and clear enough that a minimum amount of training would be necessary for administration, and (5) not be overstructured so that it elicits a specific learned response."[60]

The Perceptual-Motor Survey was administered to a sample of 200 non-retarded children, grades one through four. It was analyzed with re-

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[59] Koegh, Jack, F., and Oliver, James N., "A Clinical Study of Physically Awkward Educationally Subnormal Boys," The Research Quarterly, 39:2, 1968, pp. 301-307.

[60] Roach, Eugene G., and Kephart, Newell C., _The Purdue Perceptual-Motor Survey_, Columbus, Ohio: Charles E. Merrill Books, Inc., 1966, p. 11.

spect to grade level, socio-economic status, and sex. A second clinical group of 97 non-achievers was identified and matched with the normative sample on grade level and age.

An analysis of homogeneity of variance was made to determine if there were significant differences between grade levels. Only five items were found to differ significantly, while three of the larger differences were associated with first graders. Differences in socio-economic groups occurred between the lowest group identified and the groups identified as having middle status. There were no significant differences with regard to sex.

A test-retest technique was used with thirty children randomly selected from the original sample, and reliability estimate was made using a coefficient of stability. A coefficient of .946 was determined, which represented the stability of the scoring criteria, and that of the examiners, as no examiner tested the same child in both test and retest trials.

Intercorrelations of subtest items were low, indicating that the items were probably testing distinct areas of perceptual performance with a minimum of overlap. An analysis of all 297 children's scores, using a total score of 65 as a cut-off point, resulted in 17 percent of the achievers, and 85 percent of the non-achievers falling below that point; while 83 percent of the achievers scored above 65, only 15 percent of the non-achievers scored above 65. A Pearson coefficient between teacher ratings and scores obtained on the Perceptual-Motor Survey was .654, representing a substantial relationship.[61]

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[61] Ibid., pp. 13-29.

Francis Connor and Mabel Talbot reported the results of an experimental curriculum for young retarded children, based heavily on the developmental implications of early motor experiences. The curriculum design was the result of a five year, inter-disciplinary study conducted at Teacher's College, Columbia University. Over 900 organizations were contacted in order to obtain the minimum number of children (90) that had been identified as mentally retarded, with an I.Q. of between 50 and 75, and a chronological age below 6 years and 9 months, rather dramatically pointing out the need for instrumentation that can identify the usual educable mentally retarded child prior to the time he has difficulty with the abstract and symbolic learnings of the school situation.[62]

D. THE McGUIRE-WHITE INDEX OF SOCIAL STATUS

Indexes of social status have been consistently used in research in sociology since the development of the original scale by Lloyd Warner in the 1930's. Work by Warner and his associates apparently occupies the position within the field of measurement of social status as that held within the area of intelligence assessment by the Stanford-Binet. Hollingshead, Lenski, Kaufman, Hatt, and others all completed studies using very similar techniques and rationale, with only minor modifications to fit the community, or specific problem, such as social mobility, with which they

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[62]Connor, Francis P., and Talbot, Mabel E., _An Experimental Curriculum for Young Mentally Retarded Children_, New York: Teacher's College, Columbia University, Bureau of Publications, 1964.

were concerned.[63,64]

McGuire and White used the original work by Warner, modified it to fit status characteristics of a large Texas City (San Antonio) and a smaller community within the state, and reported an index of social status based on dwelling area, house type, occupation, and source of income. McGuire reports several studies to support a shortened form of the index, basing a status determination on occupation, source of income and education. Use of this index requires only that the status parent in the family be rated on each component of the scale, the ratings multiplied by appropriate weights as predetermined by previous research, and the products summed to determine a total index score.[65,66] The total index score can then be used to place individuals within an estimated status level or used, as it was in the present study, as a continuous valued numerical indication of social class.

E. THE SLOSSON INTELLIGENCE TEST FOR CHILDREN AND ADULTS

The Slosson Intelligence Test for Children and Adults is an individually administered screening instrument. It is a very useful instrument

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[63] Warner, W. Lloyd, Meeker, Marchia, and Eells, Kenneth, Social Class in America, A Manual of Procedure for the Measurement of Social Status, Chicago: Science Research Associates, Inc. 1949.

[64] Brown, Roger, Social Psychology, New York: The Free Press, 1965, pp. 101-152.

[65] McGuire, Carson, "Family Backgrounds and Community Patterns," Marriage and Family Living, 13, 1951, pp. 160-164.

[66] McGuire, Carson, and White, George D., "The Measurement of Social Status," Research Paper in Human Development No. 3 (revised), Department of Educational Psychology, The University of Texas, March, 1955. (Mineographed.)

when applied with young mental retardates, as it has a chronological age scale range from .5 months to 27 years. The normative population consisted of 701 children from cooperative nursery schools, public, parochial and private schools, and a wide range of social agencies.

A reliability coefficient of .97 (test-retest) was reported with a two month interval. A standard error of measurement of 4.3 was determined. Validity was determined through comparison with the Stanford-Binet, Form L-M, resulting in correlations for even chronological years ranging from .90 for the age of 4 to .97 at eighteen and above. A small sample of retarded women was tested on the Stanford-Binet, Form L-M, and the Slosson Intelligence Test and an average difference in scores of only 3.6 was reported.

Infant scales are not available with the Stanford-Binet, and in order to obtain comparisons, the Cattell Infant Intelligence Scale was used with the Slosson Intelligence Scale in the evaluation of 20 infants under two years of age. A correlation of .70 was obtained.[67]

The Slosson Intelligence Test was reviewed in Psychiatric Quarterly, in 1964. They concluded:

> Teachers, social workers, doctors and others with a background in testing will find it a useful instrument in estimating intellectual capacity. Clinical psychologists could include the SIT as a screening device in a psychological evaluation...The administration of the SIT is not difficult, the scoring is simple, and the I.Q. finder which accompanies the test is convenient.[68]

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[67] Slosson, Richard L., Slosson Intelligence Test for Children and Adults, New York: Slosson Educational Publications, 1963 Edition.

[68] "Slosson Intelligence Test for Children and Adults," Psychiatric Quarterly, April, 38, 1964, p. 368.

Baumeister examined the Columbia Mental Maturity Scale, the Leiter International Performance Scale, and the Slosson Intelligence Test and concluded:

> There are more avenues for reaching the child to evaluate the level and rate of intellectual maturation with these three tests than with other group or individual tests of intelligence. These tests correlate significantly with the Revised S-B and the Wechsler Scales so that the over-all estimate of intelligence, in terms of I.Q. or M.A., will be as satisfactory as the standard test where such information is required.[69]

[69] Baumeister, Alfred A., Mental Retardation, Appraisal, Education and Rehabilitation, Chicago: Aldine Publishing Company, 1968, p. 47.

CHAPTER III

STUDY PROCEDURE

This study was concerned with the ability of selected visual-perceptual, social status, gross motor and fine motor items to predict intelligence quotient, mental age, or chronological age in a selected sample of trainable mentally retarded children. All items were administered individually and in the same order to each child. Administration of the items was accomplished over a four week period. Each item was administered to the entire sample before the next item was initiated. Chronological age was determined as that age at the close of the second week of testing.

A. POPULATION

The sample for this study consisted of 48 trainable mentally retarded children from the pre-school program of the Harris County Center for the Retarded. The sample had a mean chronological age of 81.89 months, a mean mental age of 33.69 months, and a mean intelligence quotient of 43.18. The school program of the Harris County Center is non-residential and an integral part of the Houston Independent School District. Initial composition of the sample included 56 children. A pre-screening of the records of the Harris County Center, for medical or physical abnormality, resulted in one child being dropped from the study because of severe visual incapacity. Seven additional children were eliminated from the sample because of inability to perform in any manner on the first test of gross motor ability, the forward walking beam task. Prior to final exclusion, the clinical records of these seven children were reviewed, including previous test performances, where available. In each case competent personnel had determined that the individual child was severely retarded, either exhibiting very low intelligence test scores (below 25), or performing in such a manner that only "Severe" was determined as an estimate of intelligence.

The sample was composed of children from four classes attending the morning pre-school session at the center. Class placement had been made on a space available at the time of entrance to the pre-school program. There were no designed differences between the morning and the afternoon enrollments. All testing was done as soon as possible after the opening routines of the school day.

B. TEST PROCEDURES

An attempt was made to administer an instrument developed by Keystone View Co., of Meadville, Pennsylvania, which consists of a clinical analysis of the child's visual skills through his responses to the telebinocular presentation of a series of cards measuring his abilities at both near and far point vision. Items and scoring procedures are described in Visual Analysis, by Leo Manas.[70] This instrument is widely used in optometric examination of children, and, although the standardization is not readily available, appears to have clinical acceptance. After trials with

[70] Manas, Leo, Visual Analysis, (3rd. Edition), Chicago: The Professional Press, Inc., 1965, pp. 83-141.

this instrument with well over half of the sample, it was found, however, that the judgments required by the administrator in determining from the verbal responses of the child exactly what the child was observing through the telebinocular were inadequate from the standpoint of determining a reliable score. It was concluded that children of this age, with intelligence quotient deficits within the trainable range, could not adequately describe what they were seeing on the cards. A modification of the test was attempted, in which a model of that which appeared on the card was displayed for the child and he was asked to indicate which picture on the model most resembled what he saw in the telebinocular. This modification was also unsatisfactory from the standpoint of the examiner's feeling that he was receiving information that was at all reliable. It was decided that the instrument was inappropriate for the sample, at least as administered by an individual of the investigator's experience.

The following procedures were followed in administering the test items described below:

1. Gross Motor Testing, consisted of selected items from An Experimental Curriculum for Young Mentally Retarded Children,[71] and the Purdue Perceptual Motor Survey,[72] with some modifications.

Items administered from the Purdue Survey included:

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[71] Connor, Frances, and Talbot, Mabel E., An Experimental Curriculum for Young Mentally Retarded Children, New York: Teacher's College Columbia University, Bureau of Publications, 1964.

[72] Roach, Eugene G., and Kephart, Newell C., The Purdue Perceptual-Motor Survey, Columbus, Ohio: Charles E. Merrill Books, Inc., 1966.

a) Walking Board. Administrative instructions are:

> The child walks on the four inch flat surface of the board as he would walk on a fence rail. Be sure the child has plenty of room to use his arms in balancing without touching a wall, a chair or other objects. Position the child on the floor at one end of the board. Tell him, "Get up on the board and walk to the other end." When he has come to the far end of the board, say, "Now, walk it backward." When he has walked across the board again, say, "Now, walk it sidewise." When he has walked sidewise in one direction, say, "Now, come back sidewise." Be sure he faces in the same direction as before so that in walking back he uses the opposite foot to lead. Many children will turn 180 degrees so that in the second sidewise task they use the same lead foot that they used in the first sidewise task.[73]

In this task, and in all other tasks in the gross motor testing, a child that was unable to perform with the first set of instructions was given two additional approaches to the task being presented. These parallel suggestions by Roach and Kephart. The first is verbal description of the task with suggestions for its completion. The second, and final, structuring of the task is demonstration of the required response by the examiner.

b) Jumping and Hopping. Administrative instructions are:

> Task A (Both Feet) Instruct the child: "Place both feet together. Jump one step forward..."
>
> Task B (Right Foot) Instruct child: "Stand on your right foot with your left foot off the floor. Jump one step forward without putting your left foot down..."

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[73]Roach, Op.Cit., p. 29.

> Task C (Left Foot) Same as Task B except that the child hops on his left foot, keeping the right off the floor..."
>
> Task D (Skip) Place the child at one side of the room with as much space as possible directly in front of him. Instruct him: "Skip across the room." Make sure the child has enough room to achieve good free rhythmic movement...
>
> Task E (Hop 1/1) Say to the child: "I want you to hop once on the right foot, then once on the left, once on the right, then on the left, etc." If he stops, say, "Keep going." If he pauses markedly between each hop, say, "Can you go faster?" If he moves forward as in running or walking, say, "Stay in one place and keep hopping." He should sustain this performance for at least thirty seconds.
>
> Task F (Hop 2/2) Same as Task E, except that the child is instructed to hop twice on the right foot and then twice on the left foot...
>
> Task G (Hop 2/1) Say to the child: "Now hop twice with your right foot and once with your left." If he spontaneously begins two with left and one with the right, reverse the order of G and H in the presentation.
>
> Task H (Hop 1/2) Same as Task G except that the child is instructed to hop twice on the left foot and once on the right.[74]

The skipping task was modified slightly and scored as two separate tasks. The initial performance was administered as described above. A second performance was then required, in which the child was instructed to start the skipping routine on the foot opposite the one which he spontaneously had used.

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[74] Ibid., pp. 33-34.

An additional hopping task was also included. This task was also included. This task was administered as was task A, with the exception that the child was instructed to remain in the same location rather than hop forward.

These tasks, basically Purdue Perceptual Motor Survey items, with the above described modifications generated fourteen separate scoring points.

Rather than a standard form of administration, the Experimental Curriculum for Young Mentally Retarded Children suggests observation of various behaviors and presents a description of levels of performance for each skill observed. Two basic areas were selected from this curriculum. They were: (1) locomotor activities to include an informally presented running task, a walking task, and a stair climbing task, and (2) a series of eye-hand large muscle coordination type activities, including throwing and catching both a large ball (10 inch playground) and a small ball (tennis). Throwing motions were observed inboth an overhand and an underhand task.

These two areas resulted in an additional nine scoring points. Scores for the total twenty-three items were determined using the following technique:

A score of 1 was given if the child exhibited no evidence of ability to perform the required task after the first presentation, and continued to exhibit this lack of ability after the task had been clarified using the techniques of further verbalization and demonstration.

A score of 2 was given if the child exhibited a minimal ability to perform the task, that is, performed functionally with some evidence of control.

A score of 3 was given if the child displayed a sureness in the movement, evidenced good control, but either required additional aid in understanding what was required, or only performed at this level after one or more abortive attempts.

A score of 4 was given when the child made the appropriate response on the first attempt, evidenced good control, and displayed a minimum of awkward, or abortive movements.

2. Fine Motor Testing, consisted of selected items from the Lincoln-Oseretsky Motor Development Scale, as described by Sloan in 1955.[75] Administration and scoring were completed using the techniques standardized by Sloan. The items selected for use as fine motor evaluators all featured control rather than movement as their salient characteristic. Included in this selection were:

a) Touching Nose: a task where the child stretches his hands wide to the side and attempts to accurately touch the nose with alternate forefingers.

b) Touching Fingertips: the child touches the fingertips of each hand with the thumb, in succession, beginning with the little finger.

c) Finger Movement: the subject joins his right index finger with the pad of the left thumb, and proceeds to transcribe

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[75]Sloan, William, "The Lincoln-Oseretsky Motor Development Scale," Genetic Psychology Monographs, 51, 1955, pp. 183-252.

an arc until the opposite thumb and index finger makes contact. When the movement is understood, the subject is asked to do it for 10 seconds with the eyes open, and then with the eyes closed.

d) Closing and Opening the Hands: a task where the subject is rated on his ability to alternately open and close the extended hands.

e) Tapping: an item where the child makes as many dots as possible, within a fifteen second time trial, using ordinary pencil and paper, without gross movements of the arm.

f) Cutting a Circle: the child is asked to cut out with blunt scissors a heavily drawn circle.

g) Putting Coins in a Box: the child places up to 20 coins in a small box as rapidly as possible during a fifteen second trial.

h) Balancing a Rod Vertically: the child attempts to balance a wooden rod vertically on the extended index finger for a brief period.

i) Balancing a Rod Horizontally: a ten second balance of the rod horizontally on the extended index finger, without the aid of the other hand.

j) Making Dots: the child taps simultaneously on two sheets of blank paper with a pencil in each hand for a fifteen second time period.

All items were administered and scored as closely as possible to the instructions contained in Sloan's initial publication of the revision of the Lincoln-Oseretsky Scale in Genetic Psychology Monographs.[76]

3. The Marianne Frostig Developmental Test of Visual Perception was the third instrument employed. It was individually administered according to the instructions contained in the 1964 manual.[77] In each of the five test areas administration proceeded only as far as the level recommended for nursery school children. These included:

a) Test One, Eye Motor Coordination, Items 1-4.

b) Test Two, Figure Ground, Items 1-4.

c) Test Three, Constancy of Shape, Items 1-2.

d) Test Four, Position in Space, Items 1-4.

e) Test Five, Spatial Relationships, Items 1-4.

These items were scored according to the instructions in the manual, but no attempt was made to convert them to perceptual quotients or scale scores for chronological age groups.

4. The McGuire-White Index of Social Status short form was calculated using the records available from the files of Harris County Center for the Retarded. The short form of this index includes three weighted scales, scored on a 1-7 basis, with the lowest score representing a higher

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[76] Ibid., pp. 205-238.

[77] Frostig, Marianne, Lefever, Welty, and Whittlesey, John R. B., Administration and Scoring Manual for the Marianne Frostig Developmental Test of Visual Perception, Palo Alto, California: Consulting Psychologists Press, 1964.

level of status. Occupation is the first category, source of income the second, and educational attainment the third. The index is calculated on the male parent, or the significant adult in the family in the absence of the male parent. The results of the weighted scale calculations are then summed to indicate the social status position. Procedures for this calculation are contained in a research paper presented by Carson McGuire and George White.[78]

5. The Slosson Intelligence Scale for Children and Adults was the final item administered to the sample. Instructions for this instrument are contained in a 1963 manual published by Richard L. Slosson.[79]

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[78]McGuire, Carson, and White, George D., "The Measurement of Social Status," Research Paper in Human Development No. 3 (revised), Department of Educational Psychology, The University of Texas, March, 1955. (Mimeographed.)

[79]Slosson, Richard L., The Slosson Intelligence Test for Children and Adults, East Aurora, New York: Slosson Educational Publications, 1963.

CHAPTER IV

ANALYSIS OF THE DATA

The primary problem of this study was to determine whether a series of predictors (social class, visual-perceptual scores, gross motor performance, and fine motor performance) would generate multiple correlation coefficients sufficiently high as to have practical application in the identification of a criterion of intelligence quotient in young mentally retarded children. The predictive capability was further analyzed as it related to criteria of mental age, and chronological age with these children.

Prior to determination of the multiple coefficient the data was examined to determine the relationship that existed between the individual variables and each criterion. Data analysis was accomplished in the following manner:

A. STATEMENT OF HYPOTHESES

The primary hypotheses of this study were:

1. Scores obtained on the measures of social status, visual-perception, gross motor performance, and fine motor performance will, through the use of multiple correlation techniques, predict a criterion of intelligence quotient.

2. Scores obtained on the measures of social status, visual-perception, gross motor performance, and fine motor performance will, through the use of multiple correlation techniques, predict a criterion of mental age.

3. Scores obtained on the measures of social status, visual-perception, gross motor performance, and fine motor performance will, through the use of multiple correlation techniques, predict a criterion of chronological age.

Concommitant hypotheses relating the individual predictors to the criteria were stated. They were:

1. There is a significant relationship between scores obtained on the measure of intelligence quotient and scores obtained on the measure of social status.

2. There is a significant relationship between the scores obtained on the measure of intelligence quotient and scores obtained on the measure of visual-perception.

3. There is a significant relationship between scores obtained on the measure of intelligence quotient and scores obtained on the measure of gross motor performance.

4. There is a significant relationship between the scores obtained on the measure of intelligence quotient and scores obtained on the measure of fine motor performance.

5. There is a significant relationship between the scores obtained on the measure of mental age and the scores obtained on the measure of social status.

6. There is a significant relationship between the scores obtained on the measure of mental age and the scores obtained on the measure of visual-perception.

7. There is a significant relationship between the scores obtained on the measure of mental age and the scores obtained on the measure of gross motor performance.

8. There is a significant relationship between the scores obtained on the measure of mental age and the scores obtained on the measure of fine motor performance.

9. There is a significant relationship between the chronological age of the child and the scores obtained on the measure of social status.

10. There is a significant relationship between the chronological age of the child and the scores obtained on the measure of visual-perception.

11. There is a significant relationship between the chronological age of the child and the scores obtained on the measure of gross motor performance.

12. There is a significant relationship between the chronological age of the child and the scores obtained on the measure of fine motor performance.

B. PRELIMINARY TREATMENT OF THE DATA

Prior to the determination of the estimate of the criteria through multiple correlation technique, or the determination of the significance of the individual variables, some preliminary data treatment was necessary. The data in raw score form is presented in Table 7, in Appendix I. Table 1 is a summary of the data in the raw score form, indicating the mean, standard deviation, median and range of the scores for each variable. Additional

TABLE I

MEANS, STANDARD DEVIATIONS, MEDIANS AND RANGES OF RAW SCORES OF THE RESEARCH VARIABLES

Variable	Mean	Standard Deviation	Median	Range
Chronological Age	81.89	32.34	71	48-168 months
Mental Age	33.69	11.39	29.5	20-70 months
Intelligence Quotient	43.18	11.01	42	20-72 months
Social Status	51.89	17.25	50.5	20-84 months
Visual-Perception	6.97	7.57	5	0-31 months
Gross Motor	39.83	15.00	34	23-81 months
Fine Motor	10.12	6.76	7.5	1-28 months

preliminary work with the data consisted of: (1) the transformation of the data from the raw score form to normal form, (2) an estimate of the reliability of the scoring technique employed for the gross motor battery, and (3) development of an inter-correlation matrix for predictor variables of the study and each of the criterion.

Transformation of the data was accomplished using a method suggested by Ferguson.[80] This method involves constructing a T-score transformation from the raw score form by first determining the standard score point represented by the raw score, multiplying this figure by 10 to yield a set of transformed scores with a standard deviation of 10, and adding a constant value of 50 to each score value, changing the origin from 0 to 50 and eliminating negative values. The resulting transformed scores for all variables are contained in Table 8, in Appendix I.

The second preliminary treatment of the data consisted of an estimate of the reliability of the scoring techniques used in determining the gross motor performance scores. A split-half technique for estimating reliability was selected. The method of determining this estimate is detailed in Ferguson.[81] The gross motor performance battery consisted of 23 items, scored on a 1-4 with the total performance represented by the summation of the individual items. The twelfth item on the test was scored identically for all 48 subjects attempting the battery (Task H). This item was dropped

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[80] Ferguson, George A., Statistical Analysis in Psychology and Education, (2nd Ed.) New York: The McGraw-Hill Book Company, 1966, pp. 262-265.

[81] Ibid., p. 378.

from the analysis of reliability as its lack of a variability in scoring could not contribute to the estimate. The scores were then divided into two halves and these were correlated. The reliability coefficient for the whole test was then estimated using the Spearman-Brown Formula. This procedure was initially performed on the raw data. The correlation coefficient between the first half of the test items and the second half was .825. The Spearman-Brown Formula estimated the reliability coefficient for the whole test to be .907. The procedure was repeated after the data had been normalized, yielding an estimated reliability coefficient of .904.

The final preliminary treatment of the data consisted of the development of a correlation matrix between the criteria and the predictor categories. This was accomplished in both the normalized form and in the raw score form, in order that the effects of converting the scores to fit the normal curve could be observed. Table 2 presents this comparison, with the raw score correlations presented in parenthesis. The coefficients generally were within the same ranges. In all except three cases the raw score form tended to estimate a coefficient that was slightly higher than that which was achieved after the data had been normalized. The exceptions were the relationships between Gross and Fine Motor performance, between Social Status and Intelligence Quotient, and between Social Status and Chronological age. The general trend towards over-estimating the relationship is that which would be expected if product-moment correlation techniques were employed using skewed, non-normalized data. It may be considered a confirmation for the necessity of converting the raw scores to a normalized form,

TABLE II

CORRELATION COEFFICIENTS CALCULATED ON RAW SCORE AND NORMALIZED DATA, BETWEEN THE CRITERIA AND PREDICTOR VARIABLES, AND BETWEEN THE PREDICTORS

	Social Status	Visual Perception	Gross Motor	Fine Motor
Intelligence Quotient	-.124(.039)	.057(.084)	.135(.184)	.201(.274)
Mental Age	.141(.162)	.631(.692)	.710(.772)	.566(625)
Chronological Age	.151(.124)	.501(537)	.486(.550)	.325(381)
Social Status	1.00	.167(213)	.219(278)	.243(.273)
Visual-Perception		1.00	.763(799)	.741(727)
Gross Motor			1.00	.733(862)
Fine Motor				1.00

Correlation coefficients in parenthesis are raw score calculations.

although later analysis done to test the hypotheses in the study (Table 3) would not have resulted in any altered decisions concerning the significance of the coefficients if they had been analyzed in raw score form.

C. HYPOTHESES TESTING

The third phase in the analysis of the data was to test the hypotheses as stated in the previous section. The concommitant hypotheses were first stated in the null form; a product moment correlation coefficient was calculated for each; a two tailed "t" test of significance performed; and the decision to accept or reject the null hypothesis was based on the results of the "t" test. Rejection of the null hypothesis indicated that the value of the correlation coefficient was not equal to zero. In the cases in which this was established the hypothesis stated in Section A was accepted.

Degrees of freedom associated with this procedure were defined as N-2, or in the case of each of the concommitant hypothesis, 46. The critical value of "t" required for significance at the .01 level is 2.704, with 40 degrees of freedom. The critical value of "t" required for significance at the .05 level is 2.021, with 40 degrees of freedom. Using the formula described by Ferguson,[82] the minimum correlation coefficient necessary for significance at the .01 level is .369. The minimum correlation coefficient necessary for significance at the .05 level of confidence is .285. Table 3

[82] Ibid., pp. 186-187.

[illegible]

[illegible] LEN CRITERION
[illegible] LATING SIGNIFICANT
[illegible] ANT HYPOTHESES

	Social Status	[illegible]al [illegible]eption	Gross Motor	Fine Motor
[illegible]	[illegible].124	[illegible]57	.135	.201
		[illegible]31**	.710**	.566**
	[illegible]	[illegible]01**	.486**	.325*

[illegible] (t-test)

presents the correlation coefficients obtained between the three criterion variables of the study and each of the predictor variables and indicates significance where appropriate.

The three primary hypotheses were tested in the following manner. A multiple regression analysis was performed using a program prepared by Biomedical Computer Programs.[83] This program, BMDO2R:

> ...computes a sequence of multiple linear regression equations in a stepwise manner. At each step one variable is added to the regression equation. The variable added is the one which makes the greatest reduction in the error sum of squares. Equivalently it is the variable with the highest partial correlation with the dependent variable on the variables which have already been added; and equivalently it is the variable which, if it were added, would have the highest F value.[84]

The "F" level for inclusion in the multiple correlation coefficient is fixed at the .01 level unless otherwise specified. The hypotheses were stated in the null form, and an "F" test for significance was determined. This procedure is described in Ferguson.[85] Tables 4, 5 and 6 contain the results of this analysis, and indicate which variable makes the most contribution to the multiple correlation coefficient.

The output from BMDO2R contains all the information necessary for testing both the concomitant and primary hypotheses. The print-out from this program is included in Appendix II.

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[83]Dixon, W. J., Biomedical Computer Programs, (Editor), Los Angeles: Health Sciences Computing Facility, Department of Preventive Medicine and Public Health School of Medicine, University of California, Revised September, 1965, pp. 233-257.

[84]Ibid., p. 233.

[85]Ferguson, Op.Cit., p. 401.

TABLE IV

MULTIPLE REGRESSION ANALYSIS OF THE CRITERION VARIABLE, INTELLIGENCE QUOTIENT

Step	Variable Added	Multiple Correlation	"R" Squared	Per Cent of Contribution
1	Fine Motor	.2006	.0402	.0402
2	Social Status	.2682	.0719	.0317
3	Visual-Perception	.3024	.0914	.0195
4	Gross Motor	.3058	.0935	.0021

Calculated "F" for "R" = .3058 is 1.09 with df_1 = 4, df_2 = 43.
"F" required for significance, .01 level = 3.80**
.05 level = 2.59*

TABLE V

MULTIPLE REGRESSION ANALYSIS OF THE CRITERION VARIABLE, MENTAL AGE

Step	Variable Added	Multiple Correlation	"R" Squared	Per Cent of Contribution
1	Gross Motor	.7101**	.5042	.5042
2	Visual-Perception	.7233**	.5231	.0189
3	Fine Motor	.7237**	.5238	.0006
4	Social Status	.7238**	.5239	.0002

Calculated "F: for "R" = .7238 is 11.8 with df_1 - 4, df_2 = 43
"F required for significance, .01 level = 3.80**
.05 level = 2.59*

TABLE VI

MULTIPLE REGRESSION ANALYSIS OF THE CRITERION VARIABLE, CHRONOLOGICAL AGE

Step	Variable Added	Multiple Correlation	"R" Squared	Per Cent of Contribution
1	Visual Perception	.5014*	.2514	.2514
2	Gross Motor	.5265**	.2772	.0258
3	Fine Motor	.5522**	.3049	.0277
4	Social Status	.5563**	.3094	.0049

Calculated "F: for "R" = .5563 is 4.78 with $df_1 = 4$, $df_2 = 43$
"F" required for significance, .01 level = 3.80**
.05 level = 2.59*

D. DISCUSSION OF THE ANALYSIS

With respect to the concommitant hypotheses the analysis of the data resulted in the following:

1. There were no significant relationships determined between any of the predictors and the criterion of intelligence quotient.

2. Relationships significant at the .01 level were determined between the criterion of mental age and the predictors visual-perception, gross motor performance, and fine motor performance.

3. Relationships significant at the .01 level were determined between the criterion of chronological age and the predictors visual-perception, and gross motor performance.

4. A relationship significant at the .05 level was determined between the criterion chronological age and the predictor fine motor performance.

5. There was no significant relationship determined between any of the criterion and the predictor social status.

Based on the above concommitant hypotheses No. 1, 2, 3, 4, 5 and 9 were rejected. Concommitant hypotheses No. 6, 7, 8, 10 and 11 were accepted at the .01 level of confidence. Concommitant hypotheses No. 12 was accepted at the .05 level of confidence.

With respect to the primary hypotheses the analysis of the data resulted in the following:

Hypothesis No. 1, "Scores obtained on the measures of social status, visual-perception, gross motor performance, and fine motor performance will, through the use of multiple correlation techniques, predict a criterion of intelligence quotient" was rejected. The multiple R produced in the analysis (.3058) was not significantly different from zero.

Hypothesis No. 2, "Scores obtained on the measures of social status, visual perception, gross motor performance, and fine motor performance will, through the use of multiple correlation techniques, predict a criterion of mental age," was accepted. The multiple R produced in the analysis (.7238) was significantly different from 0 at the .01 level of confidence.

Hypothesis No. 3, "Scores obtained on the measures of social status, visual perception, gross motor performance, and fine motor performance will, through the use of multiple correlation techniques, predict a criterion of chronological age," was accepted. The multiple R produced in the analysis (.5563) was significantly different from 0 at the .01 level of confidence.

Inspection of BMDO2R revealed that the square of the coefficient .7238 equals .5239. The greater part of this predictive value was achieved by the gross motor performance score, contributing .5042 of the square of the coefficient, with only .0197 being contributed by the other predictors, in the analysis of hypothesis No. 2. A like situation occurred in the analysis of Hypothesis No. 3, in which the square of the coefficient .5563, indicated a predictive ability of only .2514, with the major portion of the prediction attributable to visual-perceptual scores. Relatively high correlations between the predictors themselves, as evident upon examination of the correlation matrix, plus their significant correlations with criterion indicate that they are perhaps measuring the same aspects of the criterion.

The absence of a relationship between social status and the criterion was an expected result. The influence of cultural deprivation is reported to be a major factor in the educable retarded, but within this trainable grouping this is not necessarily true. A further factor in controlling any differences based on social position might well have been the year long exposure to the environment of the Harris County Center. The testing phase of the study was completed at the close of the school year, and the relatively enriched environment of the center may account for lack of differences.

The Keystone Visual Skills analysis, as reported previously, was a battery of items that were evidently beyond the capability of these childdren to complete. The Marianne Frostig Developmental Test of Visual Perception may have been close to the limit of their capabilities. The raw data form of the Frostig scores presented an obviously skewed distribution, with over 31% of the sample unable to achieve scores higher than 1. These 15 children had mean chronological ages of 69.5 months, mental ages of 31 months, and intelligence quotients of 38. These are all below the total sample means, and suggest that Frostig performance may well be at the upper range of the sample's abilities. The transformation to normality was not completely successful with the Frostig scores, leaving a still skewed set of data. Following the transformation this was confirmed by performance of the Shapiro-Wilkes test for normality.[86] Critical value necessary for the W-statistic at the 5% and 1% levels were .947 and .929. Computed value was .735. Complete confidence, therefore, cannot be placed in the coefficients calculated using the Frostig scores. Ferguson suggests that the effect of correlational analysis using such distributions is to place constrant on the derived correlation.[87] It may also be that the real reason for the skewness is the error of measurement is so great that the true ability of the children is not revealed. This is supported by the lower criterion measures of the sample on the skewed portion of the Frostig curve, as was suggested when it was proposed that the test might well be exceeding the ability of the sample.

Finally, the lack of significant relationships with the criterion of intelligence was an unexpected result. The Slosson Intelligence Test for Children and Adults reports a standard error of measurement of 4.3, determined during the reliability estimation on a population with a normal range of intelligence. It might well be that on a sample such as used in this study, which had a narrowly defined range of intelligence, this standard error may be much greater. There would appear to be support for the position that factors of retardation and a much younger chronological age could contribute to the probability of a greater error of measurement. If

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[86]Shapiro, S. S., and Wilk, M. B., "An Analysis of Variance Test for Normality," Biometrika, 52, 1965, pp. 591-611.

[87]Ferguson, George A., Statistical Analysis in Psychology and Education, (second edition), New York: The McGraw-Hill Book Company, 1966, p. 129.

this is the case, correlation analysis would have been adversely affected. additional testing of the Slosson instrument at extreme ranges would seem indicated to determine its reliability under these conditions.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

This study was designed to investigate the relationships between social status, visual-perceptual performance, gross motor performance and fine motor performance in predicting a criterion of intelligence quotient, mental age or chronological age in young, trainable mental retardates. A primary interest within the study was to determine if the above relationships would determine multiple correlations of enough strength to be useful in early identification and screening programs, or in programs designed to apply limited resources where they might achieve the maximum benefit.

Intelligence quotients were determined using the Slosson Intelligence Test for Children and Adults. Mental age and chronological age were calculated using this instrument with a sample of 48 trainable retarded children attending the pre-school program of the Harris County Center for the Retarded.

Social status was determined from the McGuire-White Index of Social Status. Visual-perceptual performance was measured by the Marianne Frostig Developmental Test of Visual Perception. Gross motor performance was determined through application of selected items from the Purdue Perceptual Motor Survey and Connor's, An Experimental Curriculum for Young Mentally Retarded Children. Fine motor performance was measured by selected items from Sloan's revision of the Lincoln-Oseretsky Scales.

None of the predictor items (social status, visual-perception, gross motor scores, fine motor scores) were significantly related to intelligence quotient. There was no significant relationship between social status and any of the criterion measures (intelligence quotient, mental age, chronological age). Moderate coefficients (range .486-.710) were determined between criteria of mental age or chronological age, and the predictor variables of visual perception, gross motor or fine motor performance at the .01 level. A relatively low coefficient (.325) was determined between fine motor performance and chronological age, significant at the .05 level.

Multiple correlation coefficients were determined between the predictors and each of the criterion. A non-significant multiple R of .3058 was determined for the criterion of intelligence quotient. A significant (.01) R of .7238 was determined for the criterion of mental age. A significant (.01) R of .5563 was determined for the criterion of chronological age. The value of the square of the multiple R obtained for each of the significant relationships, .5239 and .2514, respectively, indicate the predictive ability of the coefficient.

B. CONCLUSIONS

As measured by the instruments used in this study, social status visual-perceptual performance, gross motor performance and fine motor performance were not related to intelligence quotient in the selected sample of young trainable retarded children.

Social status was not related to chronological age or mental age within the sample.

There were significant relationships between visual perceptual, gross motor, and fine motor performance scores and factors of mental age and chronological age. The relationships with the visual perceptual data were determined using a skewed distribution (see pages 61-62). This violates the assumption necessary for Pearson-Product Moment Correlation, and should be considered when referring to this relationship.

There was no relationship between a criterion of intelligence quotient and the predictor categories, as determined by multiple correlation.

There was a significant relationship between the predictors and criteria of mental age and chronological age. The relationship was not of sufficient strength to have adequate predictive ability for use as a screening instrument, or as the basis for programming in education.

C. RECOMMENDATIONS

This study, by its nature a pilot project on relatively unexplored ground, used a small sample with narrowly defined population criteria of retarded children. It is recommended that the techniques used in the study be subjected to a standardizing study to explore a much larger more diverse sample.

It is recommended that each of the predictor categories be subjected to re-evaluation as to item content, and that different combinations of items, from additional sources, be included in a factor study to determine if it is possible to achieve higher correlations than are reported.

Finally following evaluation of the content of each of the predictor categories, and hopefully elimination of those items which tend to measure identical aspects of the criteria, it is recommended that additional attempts be initiated that will determine coefficients of sufficient strength to be useful in screening or educational curriculum design.

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APPENDIX I

TABLE VII

DISTRIBUTION OF SCORES IN RAW DATA FORM

Col. 1--Identification number
Col. 2--Chronological age
Col. 3--Mental age
Col. 4--Intelligence quotient
Col. 5--Social status
Col. 6--Visual-Perception
Col. 7--First half gross motor score
Col. 8--Second half gross motor score
Col. 9--Total gross motor score
Col. 10--Fine motor score

1	2	3	4	5	6	7	8	9	10
001	66	21.5	32	51	00	11	11	23	4
002	57	25	44	20	7	19	19	39	12
003	55	23	42	55	1	11	15	27	04
004	58	33	57	52	5	14	21	36	11
005	66	25	38	58	6	17	29	47	17
006	75	32	43	58	10	18	18	37	12
007	66	33	50	24	00	12	17	30	8
008	139	58	42	40	13	28	23	52	14
009	129	26	20	20	00	12	16	29	4
010	149	52	35	80	27	33	29	63	28
011	48	22.5	47	27	3	12	15	28	10
012	87	38	44	48	3	12	13	26	05
013	130	45	35	32	4	25	20	46	11
014	48	20	42	40	7	16	21	38	16
015	73	25.5	35	60	07	11	13	25	3
016	135	29	21	71	4	13	18	32	6

TABLE VII (CONTINUED)

1	2	3	4	5	6	7	8	9	10
017	168	49	29	40	22	32	29	62	14
018	66	28.5	43	51	00	15	18	34	2
019	87	25	29	77	00	12	13	26	01
020	72	46	64	76	22	34	29	64	22
021	79	33	42	55	9	28	31	60	18
022	74	26.5	44	20	7	19	19	39	6
023	52	23	44	42	00	11	14	26	5
024	54	28	52	68	00	12	14	27	2
025	72	29	40	43	2	11	17	29	3
026	60	43	72	60	6	21	19	42	15
027	91	37	41	47	12	31	30	62	14
028	85	26.5	31	75	20	14	33	48	14
029	123	67	54	71	17	33	34	70	20
030	56	21.5	38	68	00	12	15	28	1
031	60	26.5	44	60	1	13	12	26	7
032	52	36	69	69	7	24	3	56	20
033	66	33	50	50	00	15	13	29	1
034	165	70	42	53	31	42	38	81	18
035	82	28.5	35	33	7	13	15	29	5
036	70	44	63	48	8	24	22	47	16
037	71	27	38	27	00	12	16	29	7
038	53	21	40	65	1	12	13	26	3

TABLE VII (CONTINUED)

1	2	3	4	5	6	7	8	9	10
039	57	27	47	73	12	18	18	37	11
040	68	30.5	45	20	2	11	13	25	5
041	108	30.5	28	84	1	19	27	47	13
042	73	32	44	27	8	13	14	28	7
043	76	33.5	44	48	2	14	16	31	6
044	69	36	52	48	15	16	24	41	16
045	61	34	56	68	1	13	14	28	4
046	59	29	49	27	11	21	21	42	8
047	145	47	32	79	7	30	22	53	21
048	76	40.5	53	57	10	36	33	72	21

TABLE VIII

DISTRIBUTION OF SCORES IN NORMALIZED FORM

Col. 1--Identification number
Col. 2--Chronological age
Col. 3--Mental age
Col. 4--Intelligence quotient
Col. 5--Social status
Col. 6--Visual-Perception
Col. 7--First half gross motor score
Col. 8--Second half gross motor score
Col. 9--Total gross motor score
Col. 10--Fine motor score

1	2	3	4	5	6	7	8	9	10
001	45.1	36.1	40.3	50.6	41.6	38.5	29.6	29.6	43.1
002	41.6	41.6	54.2	34.6	54.2	54.9	52.1	52.7	53.2
003	38.5	39.4	50.0	53.2	45.7	38.5	48.4	41.6	43.1
004	42.5	53.8	63.8	51.1	50.0	50.0	54.2	50.6	52.7
005	45.1	41.6	45.7	54.9	50.6	52.7	60.5	56.8	59.7
006	53.2	51.6	51.1	54.9	57.5	53.8	51.1	51.6	49.4
007	45.1	53.8	58.2	36.1	41.6	45.7	48.9	48.4	50.6
008	63.8	67.3	50.0	43.9	60.5	59.7	56.2	58.2	56.2
009	60.5	43.1	43.9	34.6	41.6	45.7	47.9	47.9	43.1
010	67.3	65.3	43.1	70.4	70.4	65.3	60.5	63.8	79.9
011	32.5	37.2	56.2	39.4	47.9	45.7	48.4	44.5	51.1
012	57.5	57.5	54.2	48.4	47.9	45.7	40.3	40.3	45.7
013	61.5	60.5	43.1	41.1	49.4	58.2	52.7	54.9	52.7
014	32.5	29.6	50.0	43.9	54.2	52.1	54.2	52.1	58.9
015	52.1	42.5	43.1	56.8	54.2	38.5	40.3	34.6	40.3

TABLE VIII (CONTINUED)

1	2	3	4	5	6	7	8	9	10
016	62.3	49.4	32.5	61.5	49.4	48.4	51.1	49.4	47.4
017	79.9	63.8	37.2	43.9	67.3	62.3	60.5	62.3	56.2
018	45.1	47.9	51.1	50.6	41.6	51.1	51.1	50.0	37.2
019	57.5	41.6	37.2	67.3	41.6	45.7	40.3	40.3	34.6
020	51.1	61.5	67.3	65.3	67.3	67.3	60.5	65.3	70.4
021	54.9	53.8	50.0	53.2	56.2	59.7	63.8	60.5	61.5
022	52.7	45.1	43.9	45.7	49.4	45.7	47.9	47.9	47.4
023	36.1	39.4	54.2	44.5	41.6	38.5	43.1	40.3	45.7
024	38.5	46.8	58.9	58.9	41.6	45.7	43.1	41.6	37.2
025	51.1	49.4	46.8	45.1	46.8	38.5	48.4	47.9	40.3
026	44.5	58.9	79.9	56.8	50.6	56.2	52.1	54.2	56.8
027	58.2	56.8	47.4	46.3	59.7	61.5	61.5	62.3	56.2
028	56.4	45.1	38.5	63.8	63.8	50.0	67.3	57.5	56.2
029	59.7	70.4	61.5	61.5	62.3	65.3	70.4	67.3	63.8
030	40.3	36.1	45.7	58.9	41.6	45.7	48.4	44.5	34.6
031	44.5	45.1	54.2	56.8	45.7	48.4	36.1	40.3	49.4
032	36.1	56.2	70.4	60.2	54.2	57.5	63.8	59.7	63.8
033	47.9	53.8	58.2	49.4	41.6	51.1	40.3	47.9	34.6
034	70.4	79.9	50.0	52.1	79.9	79.9	79.9	79.9	61.5
035	55.5	47.9	43.1	41.6	54.2	48.4	48.4	47.9	45.7
036	49.4	59.7	65.3	48.4	55.5	57.5	55.9	56.8	58.9
037	50.0	46.3	45.7	39.4	41.6	45.7	47.9	47.9	49.4

TABLE VIII (CONTINUED)

1	2	3	4	5	6	7	8	9	10
038	37.2	32.5	46.8	57.5	45.7	45.7	40.3	40.3	40.3
039	41.6	46.3	56.2	62.3	59.7	53.8	51.1	51.6	52.7
040	48.4	50.6	54.9	34.6	46.8	38.5	40.3	34.6	45.7
041	58.9	50.6	34.6	79.9	45.7	54.9	57.5	56.8	53.8
042	52.1	51.6	54.2	39.4	55.5	48.4	43.1	44.5	47.4
043	54.2	54.2	54.2	48.4	46.8	50.0	47.9	48.9	47.4
044	48.9	56.2	58.9	48.4	61.5	52.1	56.8	53.2	58.9
045	45.1	54.9	62.3	58.9	45.7	48.4	43.1	44.5	43.1
046	43.1	49.4	56.8	39.4	57.5	55.5	54.2	54.2	50.6
047	65.3	62.3	40.3	70.4	54.2	60.5	55.9	58.9	67.3
048	54.2	58.2	60.5	53.8	57.5	70.4	67.3	70.4	67.3

APPENDIX II

STEPWISE REGRESSION ANALYSIS OF CRITERION
OF INTELLIGENCE QUOTIENT, AND THE PREDICTORS
SOCIAL STATUS, VISUAL-PERCEPTION, GROSS
MOTOR AND FINE MOTOR PERFORMANCE

Identification of variables on the following computer print-outs: pp. 67-69.

Variable 1, Intelligence Quotient

Variable 2, Social Status

Variable 3, Visual-Perceptual Performance

Variable 4, Gross Motor Performance

Variable 5, Fine Motor Performance

```
BMD02R - STEPWISE REGRESSION - VERSION OF NOVEMBER 1, 1969
RICE UNIVERSITY RESEARCH COMPUTATION LABORATORY
PROBLEM CODE                     INTLQ
NUMBER OF CASES                     48
NUMBER OF ORIGINAL VARIABLES         5
NUMBER OF VARIABLES ADDED           -0
TOTAL NUMBER OF VARIABLES            5
NUMBER OF SUB-PROBLEMS              -0
```

CORRELATION MATRIX

VARIABLE	1	2	3	4	5
1	1.000	-0.124	0.057	0.135	0.201
2		1.000	0.167	0.219	0.243
3			1.000	0.763	0.741
4				1.000	0.773
5					1.000

VARIABLE	MEAN	STANDARD DEVIATION
1	51.36667	9.70359
2	51.62708	10.39369
3	52.02917	8.86835
4	51.19167	9.84401
5	51.35417	9.95079

```
SUB-PROBLEM     1
 DEPENDENT VARIABLE           1
 MAXIMUM NUMBER OF STEPS     10
 F-LEVEL FOR INCLUSION    0.010000
 F-LEVEL FOR DELETION     0.005000
 TOLERANCE LEVEL          0.001000
```

```
STEP NUMBER    1
VARIABLE ENTERED    5

MULTIPLE R              0.2006
STD. ERROR OF EST.      9.6092
```

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	1	178.007	178.007	1.928
RESIDUAL	46	4247.499	92.337	

VARIABLES IN EQUATION

VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT	41.32310)		
5	0.19557	0.14086	1.9278

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
2	-0.18180	0.9412	1.5382
3	-0.13909	0.4506	0.8877
4	-0.03174	0.4022	0.0454

```
STEP NUMBER    2
VARIABLE ENTERED    2

MULTIPLE R              0.2682
STD. ERROR OF EST.      9.5535
```

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	2	318.396	159.198	1.744
RESIDUAL	45	4107.110	91.269	

VARIABLES IN EQUATION

VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT	47.94192)		
2	-0.17140	0.13820	1.5382
5	0.23900	0.14435	2.7413

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
3	-0.14496	0.4505	0.9445
4	-0.02285	0.4012	0.0230

```
STEP NUMBER    3
VARIABLE ENTERED    3
```

MULTIPLE R 0.3024
STD. ERROR OF EST. 9.5594

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	3	404.703	134.901	1.476
RESIDUAL	44	4020.804	91.382	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	52.16210)						
2	-0.17394	0.13831	1.5816	4	0.04776	0.3204	0.0983
3	-0.22767	0.23427	0.9445				
5	0.39004	0.21217	3.3794				

STEP NUMBER 4
VARIABLE ENTERED 4

MULTIPLE R 0.3058
STD. ERROR OF EST. 9.6589

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	4	413.873	103.468	1.109
RESIDUAL	43	4011.633	93.294	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	52.00563)						
2	-0.17687	0.14006	1.5946				
3	-0.26495	0.26489	1.0004				
4	0.07928	0.25287	0.0983				
5	0.35477	0.24210	2.1473				

F-LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	MULTIPLE RSQ	INCREASE IN RSQ	F VALUE TO ENTER OR REMOVE	NUMBER OF INDEPENDENT VARIABLES INCLUDED
1	5		0.2006	0.0402	0.0402	1.9278	1
2	2		0.2682	0.0719	0.0317	1.5382	2
3	3		0.3024	0.0914	0.0195	0.9445	3
4	4		0.3058	0.0935	0.0021	0.0983	4

**** TIME REQUIRED FOR THIS PROBLEM = 14 SECS. ****

STEPWISE REGRESSION ANALYSIS OF CRITERION
OF MENTAL AGE, AND THE PREDICTORS SOCIAL
STATUS, VISUAL-PERCEPTION, GROSS MOTOR AND
FINE MOTOR PERFORMANCE

Identification of variables on the following computer print-outs: pp. 71-73

Variable 1, Mental Age

Variable 2, Social Status

Variable 3, Visual-Perceptual Performance

Variable 4, Gross Motor Performance

Variable 5, Fine Motor Performance

BMD02R - STEPWISE REGRESSION - VERSION OF NOVEMBER , 1969
RICE UNIVERSITY RESEARCH COMPUTATION LABORATORY

PROBLEM CODE	MENAGE
NUMBER OF CASES	48
NUMBER OF ORIGINAL VARIABLES	5
NUMBER OF VARIABLES ADDED	-0
TOTAL NUMBER OF VARIABLES	5
NUMBER OF SUB-PROBLEMS	-0

CORRELATION MATRIX

VARIABLE	1	2	3	4	5
1	1.000	0.141	0.63[illegible]	0.710	0.566
2		1.000	0.167	0.219	0.243
3			1.000	0.763	0.741
4				1.000	0.773
5					1.000

VARIABLE	MEAN	STANDARD DEVIATION
1	50.88750	10.15582
2	51.62708	10.39369
3	52.02917	8.86835
4	51.19167	9.84401
5	51.35417	9.95079

SUB-PROBLEM 1

DEPENDENT VARIABLE	1
MAXIMUM NUMBER OF STEPS	10
F-LEVEL FOR INCLUSION	0.010000
F-LEVEL FOR DELETION	0.005000
TOLERANCE LEVEL	0.001000

STEP NUMBER 1
VARIABLE ENTERED 4

MULTIPLE R 0.7101
STD. ERROR OF EST. 7.2281

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	1	2444.328	2444.328	46.786
RESIDUAL	46	2403.284	52.245	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	13.38529)						
4	0.73259	0.10710	46.7856	2	-0.02176	0.9520	0.0213
				3	0.19533	0.4171	1.7851
				5	0.03855	0.4022	0.0670

STEP NUMBER 2
VARIABLE ENTERED 3

MULTIPLE R 0.7233
STD. ERROR OF EST. 7.1672

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	2	2536.025	1268.013	24.685
RESIDUAL	45	2311.587	51.369	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	[illegible].28343)						
3	0.24387	0.18253	1.7851	2	-0.02227	0.9520	0.0218
4	0.56485	0.16444	11.7996	5	-0.03665	0.3476	0.0592

STEP NUMBER 3
VARIABLE ENTERED 5

MULTIPLE R 0.7237
STD. ERROR OF EST. 7.2433

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	3	2539.131	846.377	16.132
RESIDUAL	44	2308.482	52.465	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	9.48135)						
3	0.26166	0.19843	1.7389	2	-0.01777	0.9366	0.0136
4	0.58685	0.18921	9.6204				
5	-0.04381	0.18008	0.0592				

STEP NUMBER 4
VARIABLE ENTERED 2

MULTIPLE R 0.7238
STD. ERROR OF EST. 7.3259

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	4	2539.860	634.965	11.831
RESIDUAL	43	2307.753	53.669	

VARIABLES IN EQUATION				VARIABLES NOT IN EQUATION			
VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE	VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
(CONSTANT	9.96155)						
2	-0.01235	0.10623	0.0136				
3	0.26356	0.20091	1.6820				
4	0.58835	0.19179	9.4106				
5	-0.04109	0.18362	0.0501				

F-LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	RSQ	INCREASE IN RSQ	F VALUE TO ENTER OR REMOVE	NUMBER OF INDEPENDENT VARIABLES INCLUDED
1	4		0.7101	0.5042	0.5042	46.7856	1
2	3		0.7233	0.5231	0.0189	1.7851	2
3	5		0.7237	0.5238	0.0006	0.0592	3
4	2		0.7238	0.5239	0.0002	0.0136	4

**** TIME REQUIRED FOR THIS PROBLEM = 7 SECS. ****

STEPWISE REGRESSION ANALYSIS OF CRITERION
OF CHRONOLOGICAL AGE, AND THE PREDICTORS
SOCIAL STATUS, VISUAL-PERCEPTION, GROSS
MOTOR AND FINE MOTOR PERFORMANCE

Identification of variables on the following computer print-outs: pp. 75-78

Variable 1, Chronological Age

Variable 3, Social Status

Variable 3, Visual-Perceptual Performance

Variable 4, Gross Motor Performance

Variable 5, Fine Motor Performance

BMD02R - STEPWISE REGRESSION - VERSION OF NOVEMBER , 1969
RICE UNIVERSITY RESEARCH COMPUTATION LABORATORY

PROBLEM CODE	CHRAGE
NUMBER OF CASES	48
NUMBER OF ORIGINAL VARIABLES	5
NUMBER OF VARIABLES ADDED	0
TOTAL NUMBER OF VARIABLES	5
NUMBER OF SUB-PROBLEMS	0

CORRELATION MATRIX

VARIABLE	1	2	3	4	5
1	1.000	0.151	0.501	0.496	[illegible]
2		1.000	0.16[illegible]	0.219	[illegible]
3			1.000	0.743	0.741
4				1.000	0.773
5					1.000

VARIABLE	MEAN	STANDARD DEVIATION
1	50.61875	10.18406
2	51.62708	10.39369
3	52.02917	8.56835
4	51.19167	9.84401
5	51.35417	9.95079

SUB-PROBLEM	1
DEPENDENT VARIABLE	1
MAXIMUM NUMBER OF STEPS	10
F-LEVEL FOR INCLUSION	0.010000
F-LEVEL FOR DELETION	0.005000
TOLERANCE LEVEL	0.001000

STEP NUMBER 1
VARIABLE ENTERED 3

MULTIPLE R 0.5014
STD. ERROR OF EST. 8.9069

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	1	1225.313	1225.313	15.445
RESIDUAL	46	3649.300	79.333	

VARIABLES IN EQUATION

VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT	20.46311)		
3	0.57575	0.14650	15.4453

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
2	0.07877	0.9719	0.2810
4	0.18561	0.4171	1.6056
5	-0.08034	0.4506	0.2924

STEP NUMBER 2
VARIABLE ENTERED 4

MULTIPLE R 0.5265
STD. ERROR OF EST. 8.8488

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	2	1351.034	675.517	8.627
RESIDUAL	45	3523.579	78.302	

VARIABLES IN EQUATION

VARIABLE	COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT	18.53695)		
3	0.35774	0.22535	2.5199
4	0.25725	0.20302	1.6056

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOLERANCE	F TO ENTER
2	0.05368	0.9520	0.1272
5	-0.19590	0.3476	1.7560

STEP NUMBER 3
VARIABLE ENTERED 5

```
MULTIPLE R              0.5522
STD. ERROR OF EST.      8.7754

ANALYSIS OF VARIANCE
                    DF     SUM OF SQUARES     MEAN SQUARE     F RATIO
     REGRESSION      3        1484.264          495.421        6.431
     RESIDUAL       44        3388.349           77.004

               VARIABLES IN EQUATION               .                    VARIABLES NOT IN EQUATION
                                                   .
  VARIABLE      COEFFICIENT  STD. ERROR  F TO REMOVE .     VARIABLE    PARTIAL CORR.     TOLERANCE     F TO ENTER
                                                   .
                                                   .
     (CONSTANT     20.14304 )                      .
     3              0.47511     0.24040     3.9060 .          2           0.08079         0.9366        0.2825
     4              0.40247     0.22923     3.0827 .
     5             -0.28911     0.21817     1.7560 .


STEP NUMBER     4
VARIABLE ENTERED     2

MULTIPLE R              0.5563
STD. ERROR OF EST.      8.8479

ANALYSIS OF VARIANCE
                    DF     SUM OF SQUARES     MEAN SQUARE     F RATIO
     REGRESSION      4        1508.382          377.095        4.817
     RESIDUAL       43        3364.232           78.284

               VARIABLES IN EQUATION               .                    VARIABLES NOT IN EQUATION
                                                   .
  VARIABLE      COEFFICIENT  STD. ERROR  F TO REMOVE .     VARIABLE    PARTIAL CORR.     TOLERANCE     F TO ENTER
                                                   .
                                                   .
     (CONSTANT     17.49814 )                      .
     2              0.06920     0.12830     0.2825 .
     3              0.48114     0.24265     3.9318 .
     4              0.39426     0.23163     2.8971 .
     5             -0.30410     0.22177     1.8802 .

F-LEVEL INSUFFICIENT FOR FURTHER COMPUTATION
```

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	RSQ	INCREASE IN RSQ	F VALUE TO ENTER OR REMOVE	NUMBER OF INDEPENDENT VARIABLES INCLUDED
1	3		0.5014	0.2514	0.2514	15.4453	1
2	4		0.5265	0.2772	0.0258	1.6056	2
3	5		0.5522	0.3049	0.0277	1.7560	3
4	2		0.5563	0.3094	0.0045	0.2825	4

```
**** TIME REQUIRED FOR THIS PROBLEM =      21 SECS.   ****

********  -EOF NO LABEL STATCRD:AMD02F /STATLIB= 1, LINE NO     7100  ****************************************************************
```