

ABSTRACT

EVALUATING MOTOR PERFORMANCE OF TRAINABLE MENTALLY HANDICAPPED BOYS AND GIRLS, AGES EIGHT THROUGH TWENTY-ONE

By

David Allen Fuller

The two basic purposes of this study were:

1. To establish the utility of a test battery for evaluating the motor performance of a sample of trainable retardates, ages eight through twenty-one.
2. To select specific environmental and organic factors which appear to produce differential effects on performance of the motor tasks in the test battery.

The eighty-eight subjects who provided data for this study were enrolled in school programs for the trainable mentally retarded, in one of the two cities of Lansing, or East Lansing, Michigan.

An evaluation of individual motor performance was obtained with a fourteen-item motor test battery, which included seven gross motor fitness tasks and seven basic

game skills. The tests included several motor tasks selected from the literature, and some new tests devised especially for the stated purposes of this study.

Eight factors were selected for investigation: the two environmental factors of type of activity program, and parent education level; and the six organic factors of age, sex, IQ, dominance, etiology, and growth. Each of the selected factors was chosen on the basis that it had been considered a possible influence on motor performance, in studies with normal, educable, or trainable groups.

Data collected for each subject was recorded on individual CDC 3600 computer cards, and the one-way analysis of variance with unequal number of replications permitted (UNEQ1 routine) was used in the data analysis. If the F ratio showed overall significance within the .05 level, the Scheffé test was used to determine which pairs of category means were significantly different.

Results of the study indicate that the test battery used with this sample is a useful instrument for evaluating motor performance levels of trainable retardates, ages eight through twenty-one. The exclusion of the arm hang test, and modification of the catching tasks would be recommended as possible adaptations of the battery used. Further investigation of the squat thrust, ball shooting, catching a ball on the bounce, and batting tests as to reliability with trainable subjects, would be prerequisite to the retention of these items in the test battery.

Results indicate that there are some factors which should be considered essential for certain aspects of activity programming, and for constructing TMR performance standards, or norms. In construction of standards, it appears that age is an important consideration for establishing performance levels on game skill tests, while sex and etiology are more important considerations for categorizing gross motor fitness performance levels. Further work is required before final conclusions can be made regarding performance groupings, for the several factors investigated. Additional data which might be derived through multivariate analysis, will be essential for future efforts related to the construction of motor performance standards for the trainable mentally retarded.

EVALUATING MOTOR PERFORMANCE OF TRAINABLE
MENTALLY HANDICAPPED BOYS AND GIRLS,
AGES EIGHT THROUGH TWENTY-ONE

By

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DEDICATION

To Barbara and our children, for all the hours I
had to spend with this instead of with them.

To the children of Beekman Training Center, for all
that they have taught me.

To Dr. Janet A. Wessel, for her efforts toward the
provision of physical education experiences for all
handicapped children.

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CHAPTER I

INTRODUCTION

The literature of the last few years bears witness to the tremendous surge of interest related to the area of motor development of mentally handicapped children. As recently as five years ago, published material on this subject was relatively scarce. The American Association of Health, Physical Education and Recreation (AAHPER) has been among the leading influences in recent efforts to fill this vacuum of desired materials. In 1968-69, AAHPER published several guides concerned with physical activities for the mentally retarded, prepared by people experienced in the field.

Professional interest has been generated not only because of the fundamental physical and recreational benefits derived from activity programs, but also because of the extraordinary effects some programs have had on the social, emotional, and mental development of retarded children. Satiation of this prevailing interest requires much additional research, and the publication of pertinent findings.

One emergent danger in this area, is the growing tendency to consider physical movement as the panacea for problems among the retarded population.

Such comprehensive claims for motor activities, while welcomed by some, eventually may result in a back-lash in special education programs. . . . Motor activities may help some children remediate certain visual-perceptual distortions, but they are not a cure for all perceptual deficits in all children.¹

While the effects of structured activity programs may indeed demonstrate dramatic results in many instances, there remains at this time numerous "blind spots" in the total picture of motor function in mental retardation.

Several training programs (activities for perceptual-motor development, etc.) have been publicized, and some recent studies have indicated the efficacy of a few specified exercises for increasing certain gross physical abilities among retardates. Unfortunately, most of these materials provide little information on the techniques of evaluation on an individual basis, and very often, give little direction in prescribing and sequencing activities relative to individual needs.

A basic requirement in this area now is the information needed for greater understanding of the factors, both environmental and organic, which most influence certain aspects of physical development. This information

¹Bryant J. Cratty, Motor Activity and The Education of Retardates (Philadelphia: Lea & Febiger, 1969), p. 2.

could provide knowledge not only of each particular factor alone, but also of the effect of certain combinations of factors on one's motor performance. If it is possible to define the influence of such factors (or combinations), we could better explain certain related deficiencies in motor ability, and could begin to isolate the most efficient treatment (activities) for individual "motor syndromes" common among mentally handicapped children.

Research in the subject of physical activity for normal children has provided a good deal of basic data, with sufficient test norms (basically fitness items) so that the physical education teacher may compare results (evaluate programs or individual ability) of his groups with the scores of youngsters of similar ages. Only recently, have such "norms" been published (Francis and Rarick; AAHPER) for educable mentally retarded (IQ range approximately 50 to 80) children. These studies indicate that for most test items, the average educable youngster (ages eight through eighteen) scores two to four years below normal children of the same chronological age.

Many have cited these findings and similar results from their own research in reaching a conclusion that the retarded should not be placed in physical education programs with normal children: "Therefore, the implication is that the policy of placing Educable Mentally Retarded boys with their CA peers for physical education is open to

serious question if the assumption underlying the program is that the two groups' motor performance is comparable."²

Such research generalizations should not be used as an excuse to separate normal and retarded children, in one of the few school areas where they could perform together. This type of general conclusion--based on averages of group performance--fails to consider these important points:

1. In any group of educables, there are several who may be as capable or better in physical ability than some of their normal peers.
2. Retarded children who have been denied regular physical activity and who score very low on fitness tests, have improved dramatically with structured physical education programming.
(Many into the normal range, upon retesting.)
3. Perhaps the greatest oversight--the retarded group would not perform as a group, but as individuals within the normal physical education class. By mixing normals and retardates to form equal teams, an instructor could insure that some of the retarded children would naturally be on the winning side, too!

²Wayne L. Sengstock, "Physical Fitness of Mentally Retarded Boys," The Research Quarterly, 37:113-120, 1966.

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Most important, physical education class offers one of the few social situations where the retarded child can interact with and be accepted as an individual by his more intellectually capable peers:

The class organized for work in the three R's and other scholastic work need not be kept intact for athletic, social, mechanical, artistic and other pursuits. . . . Membership not only in one group--as often happens for the several years of a grammar school career--but with many groups would perhaps . . . build a finer foundation for effective participation in the many sided activities with all varieties of people which life in a democracy demands.³

In the last decade, many new programs have been instituted for more severely retarded or "trainable" children. The trainable individual is considered less capable than the educable retardate and more capable than the "custodial" (severe-profound retardation) individual. The trainable retardate (TMR) may be further described using the three criteria of development, education, and prognosis:

Development. His general developmental progress is at a rate of one-third to one-half of a normal child, with an intelligence quotient (as determined by test) roughly between thirty and fifty.

Education. While he is incapable of being educated through ordinary classroom procedures, the trainable

³Arthur I. Gates, "The Nature and Educational Significance of Physical Status and of Mental, Physiological, Social and Emotional Maturity," The J. of Educational Psychology, 15:358, 1924.

[illegible]

child can benefit from training carried out in a special school program designed to further his social adjustment and develop his potential for performing useful tasks in a home or sheltered environment.

Prognosis. Indicates that, while he may never be academically educable, with adequate training, his potentialities of self-care and economic usefulness may be developed for community living under family supervision.

Although their need for physical activity has been widely recognized and a variety of activity programs utilized, there remains one great deficiency--the availability of adequate norms (derived from a trainable sample). Studies done with large samples of educable children have shown the inadequacy of regular norms for judging the motor abilities of retardates. Likewise, it would be unrealistic to apply educable norms to TMR samples:

In view of the confusion which exists because of differences in results of several individual studies, it seems advisable to examine studies of the motor proficiency of normal, severely retarded, and moderately retarded groups. This will permit some general conclusions about relationships which exist within these groups, as well as between them.⁴

While research indicates that intelligence does not appear closely related to motor ability in the normal population, the studies done with educable level retardates does show a correlation between these variables. It seems

⁴Leslie Malpass, "Motor Skills in Mental Deficiency," Handbook of Mental Deficiency, ed. by N. R. Ellis (New York: McGraw-Hill Book Company, 1963), p. 620.

logical that this relationship between intelligence and physical ability would continue (or increase) in more severely retarded groups. In fact, a basic premise of this study is the idea that the specific effects of certain organic (intelligence, etc.) and/or environmental factors would be more related to motor performance in a group of trainable retardates than in higher functioning retarded, or normal children. In testing this theory, the trainable level individual is most appropriate, because he can generally perform selected motor tasks at a measurable level, whereas lower functioning (severe to profound) retardates could not.

Most studies done with mentally retarded subjects use a single measure of motor performance to differentiate among retardates, or between retardates and normals, through a correlation with some particular factor. (In many cases, it is the specified factor which is considered primary, and the motor performance is used only to quantify its effect.) Unfortunately, the evaluation of motor performance is usually limited to one item (i.e. rotary pursuit, balance, etc.), and relationships found in this single measurement may not hold for the same individuals when evaluated in many other motor skills.

If one hopes to generalize test scores in terms of motor performance, it seems reasonable that a variety of motor tasks should be examined. Following this line of

reasoning, it would also be more valuable to consider the effects of several organic and environmental factors with the experimental sample, if one wished to examine the influence of each factor upon selected motor tasks.

It appears that this kind of approach is not only the most reasonable, but is also most imperative in the area of physical education for the mentally retarded. For it is only through the insights which may be gained through such studies that the changes necessary for more effective educational programming will be realized.

Purpose of the Study

This study serves two basic objectives:

1. To establish the utility of a test battery for evaluating the motor performance of a sample of trainable retardates, ages eight through twenty-one.
2. To select specific environmental and organic factors which appear to produce differential effects on performance of the motor tasks in the test battery.

Importance of the Study

One important function of this study would be the translation of findings into suggestions relative to physical activity programming for the trainable mentally retarded. In addition, this study could provide some guidelines for the testing of similar population groups,

by those who wish to contribute to the development of adequate motor performance standards for the TMR.

The motor performance test battery used in this study would also be of value for evaluating progress of trainable individuals on these specific motor tasks, for the purpose of justifying the inclusion of physical education programs in the TMR curriculum:

The need for normative data . . . in the field of special education is critical. If local boards of education . . . are to be expected to continue supporting and improving services and facilities for exceptional children, administrators must be able to provide reliable data as justification for expanded programs and expenditures.⁵

Information relative to the influence of certain organic or environmental factors may be used as the basis for further study. For example, only those factors which appear most constructive or most detrimental to motor performance would be selected for further analyses. The most essential outcome of this study is its contribution to the continued development of procedures for modifying educational programming.

In recent years, great strides have been made in promoting and developing better community programs for trainable children. Many workers have become aware of the value of physical activity for these youngsters and are

⁵G. Orville Johnson and Harriet Blank, Exceptional Children Research Review (Washington, D.C.: The Council for Exceptional Children, 1968), p. 312.

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most eager to learn more concerning this important aspect of total development.

Limitations of the Study

The basic aim of the study was to construct a battery which could be used to evaluate motor performance levels of trainable retardates. This was to be accomplished by investigating many different motor tasks and a large number of factors which might effect motor performance. This was considered an essential step in determining which of these variables may be worthy of additional research.

The sample was restricted to all eligible trainable children in the immediate geographical area of Lansing and East Lansing. This restriction of total sample size proved to be a limiting factor, in that the small number of subjects in many categories effectively reduced significant results, and also restricted the possibilities of statistical analysis. Use of multivariate analysis, for determining the interaction effects of several factors, would be a more valuable technique in this type of study, when more adequate sampling procedures are feasible.

The high degree of variance which is common among retardates at this level, coincidental with small numbers of subjects for some categories, also limited significant results.

The low reliability of some motor tasks included in the test battery was another limitation. Most involved game skill items, which were chosen as representative of a variety of basic sports skills, and retained because no other adequate tests of this type could be found in the literature.

Definition of Terms

To avoid the confusion of interpretation which exists in much of the terminology associated with many aspects of motor evaluation and performance, the following definitions will apply to terms used in this study.

Development is regarded as some increase in skill or degree of complexity in a function. Progressive achievement of more difficult motor patterns is a form of development.

Motor capacity is considered the total potentiality a child possesses for performing a motor act.

Motor performance implies the "doing" of something, may refer to the quality of movement.

Motor ability is the extent to which the motor capacity is expressed in some measurable form (achievement).

Gross motor fitness tasks involve the use of the large muscle groups and generally entail movement of the

whole body. Many physical fitness test items would be in this category.

A motor skill may be described as an activity involving body movement which is dependent on training or learning, and may be improved through physical repetition.

CHAPTER II

REVIEW OF RELATED LITERATURE

This review of related literature will discuss the following aspects of mental retardation: incidence and classification; etiology; care and treatment; trends in programming; motor performance; factors affecting performance; and motor evaluation.

Incidence and Classification

In our society, mental retardation may be most simply defined as a subnormal level of general intellectual functioning. While he may be lacking intellectually, the retarded individual still has the same requirements as the average person. These include such basic needs as: love; acceptance (as is--with limitations); achievement (some measure of success); doing for others (to feel needed); to create (doing something himself); discipline; and to have identity (to be known as an individual, capable of enjoying life and giving enjoyment to others).

Historically, the determination of mental retardation has alternated between measured intelligence and adaptive behavior. While IQ score should not be the sole

determinant, most authorities would agree that anyone with a score below 70 would experience significant problems adapting to many aspects of our social environment. There are presently some six million of the U.S. population who could be defined as mentally retarded. This figure has been determined on the basis of 3 per cent (of total population) falling within the retarded range of intelligence.

Through the years, there has evolved a number of classification systems for mental retardation. Often, the form of classification reflected a direct relationship to some particular profession. For example, the medical approach attempted to classify mental retardation relative to clinical types or etiology, the psychologists by intelligence level, the educators by terms related to learning ability, etc. The older classifications based on levels of retardation which included such terms as "moron," "imbecile," and "idiot" have been generally replaced by the terms "mild," "moderate," "severe," and "profound." With the growing stress on special programs in recent years, the "educational" classification (educable, trainable, and dependent) has become one of the most popular in current literature.

Using the incidence figure of 3 per cent, one could estimate that of approximately 4.5 million children born every year, 135,000 will be considered mentally retarded. Of this number: about 117,000 (2.6 per cent)

TABLE 1.--Levels of Mental Retardation.

Retardation Level	IQ Range Stanford-Binet	Range S-D Value	Educational Classification	Percentage Total MR
Borderline	68-83	-1.01 to -2.00	Educable	89.0
Mild	52-67	-2.01 to -3.00	Educable	
Moderate	36-51	-3.01 to -4.00	Trainable	9.5
Severe	20-35	-4.01 to -5.00	Trainable	
Profound	Below 20	-5.00	Dependent	1.5

Modified from: Alfred Baumeister, Mental Retardation (Chicago, Ill.: Aldine Publishing Company, 1967), p. 10.

would be mildly retarded (educable); about 13,500 (0.3 per cent) would suffer moderate retardation (trainable); and approximately 4,500 (0.1 per cent) would be severe to profoundly (dependent) retarded. In a report by the President's Committee⁶ the mentally retarded population was classified: 89 per cent--mild, 6 per cent--moderate, 3.5 per cent--severe, and 1.5 per cent--profound.

Kirk has estimated that in an average community, the prevalence of mental retardation for every 1,000 children (school-age) will approximate 25 educable, 4 trainable, and 1 totally dependent.⁷ Kirk defines these categories in functional terms, as follows:

The Educable mentally retarded child is one, who because of slow mental development, is unable to profit to any great degree from the programs of the regular schools, but who has these potentialities for development: (1) minimum educability in reading, writing, spelling, arithmetic, and so forth; (2) capacity for social adjustment to a point where he can get along independently in the community; and (3) minimum occupational adequacy such that he can later support himself partially or totally at a marginal level.

The trainable mentally retarded child is defined as a child who is so subnormal in intelligence that he is unable to profit from the program of classes for educable mentally retarded children, but who has potentialities in three areas: (1) learning self-care in activities such as eating, dressing, undressing, toileting, and sleeping; (2) learning to adjust in the home or neighborhood, though not to the total

⁶President's Committee on Mental Retardation, MR 67 (Washington, D.C.: U.S. Government Printing Office, 1967), p. 1.

⁷Samuel A. Kirk, Educating Exceptional Children (Boston: Houghton Mifflin Company, 1962), p. 102.

community; and (3) learning economic usefulness in the home, a sheltered workshop, or an institution.

The totally dependent mentally retarded child is one who, because of markedly subnormal intelligence, is unable to be trained in self-care, socialization, or economic usefulness, and who needs continuing help in taking care of his personal needs. Such a child requires almost complete supervision throughout his life since he is unable to survive without help.⁸

Etiology

Literally hundreds of specific causes of mental retardation have been identified. Many attempts at classification have been based on etiological considerations ("endogenous--exogenous," "familial," etc.). Kirk⁹ has suggested general relationships between etiological and educational categories:

The defect in a totally dependent mentally retarded child almost always has an acquired organic or genetic cause. . . . The cause of much retardation at the trainable level is also organic. . . . In classes for trainable children, for example, it has been found that one-third of the enrollment consists of mongoloid children, approximately another one-third consists of brain-injured children, and the other third is usually of unknown etiology. The educable mentally retarded group consists of children of mixed etiologies. A small proportion may have a diagnosis of organic pathology, such as minimal brain injury. The majority, however, show biological variation (the lower end of the scale of intelligence) or cultural factors causing the retardation, or a combination of heredity and sub-cultural environments.

From a text by Hutt and Gibby¹⁰ the following information is part of a table which lists by etiology

⁸Ibid., p. 86.

⁹Ibid., p. 101.

¹⁰Max L. Hutt and Robert Gibby, The Mentally Retarded Child (Boston: Allyn and Bacon, Inc., 1958), p. 118.

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diagnosed first admission of mental defectives to eighty-nine public institutions in the United States (1949):

<u>Diagnosis</u>	<u>Per cent</u>
Familial	30.7
Undifferentiated	24.8
Mongolism	11.1
Post Traumatic	6.2
Developmental cranial anomalies	6.2
Post-infectious	5.5
Congenital spastic paralysis	5.4
Other	10.1

In the 1967 report of the President's Committee on Mental Retardation, a chart shows that a total of 25 per cent of all mental retardation (United States) is caused by organic (genetic, unknown prenatal, tumors, metabolic, trauma, intoxication, infection) problems. The other 75 per cent of all retardation was attributed to socio-environmental factors (generally produced in low income, disadvantaged areas.)¹¹

Care and Treatment

In most early cultures, the mentally deficient individual was considered a definite social liability, and abandonment or death was often the prescribed form of treatment for such children. As the human family became

¹¹President's Committee on Mental Retardation, p. 1.

more "civilized," the retarded were allowed to survive-- usually through a life of public ridicule or continual confinement.

One of the early breakthroughs in the treatment of the mentally retarded occurred in France about 1800, when a physician named Jean Itard attempted to teach social and language skills to a severely retarded boy. His pupil, called the "Wild Boy of Aveyron," was approximately seventeen years old at that time. He had been captured by some hunters and had evidently been living for some time in a savage-like condition in the woods of that part of France.

Although Itard's work resulted in "failure" (he did not succeed in teaching the boy to speak), the widespread publicity surrounding it served to stir up considerable interest in the problem of mental retardation. From the time of Itard's experiment, up to the present, there have evolved many changes in the opinions towards, and acceptance of, public responsibility for the care and education of our mentally retarded children.

Itard's work was followed up in Europe by Edward Seguin, who established a "School for Idiots" in Paris, in 1837. Seguin migrated to the United States in 1848, and pioneered the education of the mentally retarded in this country. Others of this era who served to orient the public to this problem, were: Charles Billard and William Little, with information on brain damage in the newborn;

Down, and his description of mongolism; Gesell, who established standards for normal child development; and, probably of the greatest consequence, the Binet and Simon tests--to determine mental growth rate (established the concept of IQ).

With greater public recognition of the problem, came the founding of several important organizations during the succeeding years. Many parent groups have been influential in the progress towards better treatment and facilities in the area of mental retardation. Operating throughout the United States, is the American Association on Mental Deficiency. This organization was established in 1876, and is composed of physicians, psychologists, and educators. The National Association for Retarded Children has established chapters in cities all over the United States, to help educate the public and the parents of retarded children. In recent years, the Joseph P. Kennedy Jr. Foundation has provided financial support for various projects (research, scholarships, Special Olympics, etc.) which provide direct benefits to our retarded population.

Trends in Programming

Most of the treatment for the moderately and severely retarded in this country through the first half of this century was based on early institutionalization. The first institution for the education of mentally retarded in the United States was established in

Massachusetts in 1848. While these first institutions were founded for the purpose of establishing special educational programs, there was soon a prevailing rationale of confinement--rather than treatment--as conditions of overcrowding, understaffing, and underfinancing existed in most of them. These basic problems have continued to plague most of our large institutions and some of the resultant inadequacies have been vividly described in a recent publication by Blatt and Kaplan.¹²

As a result of conditions just reviewed and also because of many philosophical revisions in education, most of the training-education of the retardate has shifted from the institution to the public or private school. There have been a variety of class-type organizations used or suggested for educating the EMR child. Most prevalent among these are the following: segregated, departmentalized special schools; homogeneous classes; special classes; ungraded special classes; modified special classes (placing mentally retarded with children who are "educationally" retarded, behavior problems, etc.); itinerant teacher; and special class integrated with the rest of the school.

There are many things to be said for and against using any one of these organizational methods exclusively.

¹²Burton Blatt and Fred Kaplan, Christmas in Purgatory (Boston: Allyn and Bacon, 1966).

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In most cases, a community will be better equipped to use one of these class-types more effectively than the others, and it is installed on this basis. One of the continuing controversies in class organization, is between those favoring special segregated classes for the educable retarded, and those favoring integration into the regular classes. A two year study¹³ determined that mentally retarded children make better grades when they are taught in regular classes rather than in special classes, but that they are better adapted socially in the special classes. It appears that some workable combination of both types would be the best answer.

Public programs for the trainable retardate have been forced to follow a much longer, uphill road to acceptance. Many educators resisted parent efforts for TMR programs on the basis that they were by definition "uneducable," and therefore, should not be considered the responsibility of public schools. Reynolds¹⁴ discussed the area of public responsibility for these children:

Between the levels of responsibility well established in the schools, mainly for those with relatively mild handicaps, and programs operated by other public agencies, such as mental hospitals . . . is a zone of indefiniteness in public responsibility. Trainable

¹³ Viola Cassidy and Jeanette Stanton, "School Placement of the Mentally Retarded," School & Society (September, 1959), p. 366.

¹⁴ Maynard C. Reynolds, "A Framework for Considering Some Issues in Special Education," Exceptional Children, 28 (1962), 369.

retarded children . . . fall in this 'in-between' zone of responsibility. . . . Problems of the 'in-between' children will need to be solved by even closer cooperation among agencies of many types. The trainable retarded, for example, often present life-long dependency problems. It is futile to think about responsibility for these children in terms of 'education versus welfare.' They need health, welfare, and educational services--not just one or another. The challenge in this field, as in many others, is to establish new and effective inter-agency community programs.

The trainable child, because of the severity of his handicap, was offered no public (school) program until a few years ago. Parents of these children were generally given the "choice" of constant care in the home or institutionalization. In fact, several years ago, the commonest form of advice given to parents by their physicians was institutional placement at the earliest possible date. Those parents who did not want to commit their children gradually sought out others in the community and formed parent groups. Many started their own day programs, as no other public agency would accept such a task, and there was no legal provision for "uneducable" children in existence. As parent groups grew and became more potent social forces, some schools began to provide special rooms for trainable children.

The real spurt to this movement came through the organization of parents of TMR children and their insistence that some service be provided. The only service that was readily available fifteen years ago was the public schools. No other agency offered its services nor was there any other agency established which could meet the demands of these parents and their

children. The various departments of welfare provided institutional care but no community resources.¹⁵

Probably the only real valuable function these early "special" rooms served was the respite given parents for a few hours a day--from the routine of constant supervision. These children were typically isolated from other school areas (recreational, etc.), and supervised by adults with little or no special training. It was impossible to promote any significant development in such situations where many essential services were not made available for these retardates. In many of the special classes, a maximum age limitation of sixteen was enforced (the "legal" age for compulsory school attendance!). Thus, while some progress was being made in the acceptance of public responsibility for these children, it was becoming quite evident that the "special class" route for TMRs was grossly inadequate.

. . . the public school is not the agency to assume responsibility for the TMR child. Such an agency must be one that is capable of following the child from the nursery to the grave. It must be flexible enough to offer financial help on the one hand and to offer trained guidance and counseling on the other. It must be in a position to receive reports from hospitals and pediatricians concerning the probable identification of the retarded child and to act immediately to contact the family. It must be able to set up and operate preschools and coordinate the services so that the continuity in preschool, training program, and vocational adjustment is not broken. It must have the

¹⁵ William Tisdall and J. W. Moss, "A Total Program for the Severely Mentally Retarded," Exceptional Children, 28 (1962), 358.

facilities to set up and operate workshop programs which will be beneficial for the child and for the community. There is no single agency in existence today that can initiate such a program.¹⁶

Tisdall's description of program needs for the moderately and severely mentally retarded provided a most accurate prophecy of the direction they would take toward fulfillment in the approximately eight years since then. Several new community centers for trainable children have been established in many states. These centers are constructed especially for retardates at this level, and are staffed by personnel who are well qualified to work with the TMR. In many of these programs, several agencies work cooperatively--to provide many essential services under one roof. While trainable retardates will always have limited learning abilities, the emphasis on more functional programming reflects the growing recognition that they do possess much more potential than was previously credited them.

Community day centers seem to be providing the happy alternative to institutionalization. Whereas the national figures¹⁷ show an increase in number of residents in public institutions for the mentally retarded during the years 1963 through 1967 (from a total of 176,000 to

¹⁶Tisdall, "A Total Program for the Severely Mentally Retarded," p. 361.

¹⁷President's Committee on Mental Retardation, MR 68 (Washington, D.C.: U.S. Government Printing Office, 1968).

193,000), figures from Michigan (with several new training centers for TMR) have shown decreases in admissions.

Many retarded do not require traditional 24-hour institutional care. Development of alternative services--such as day care training centers--has demonstrated that demand for expensive 24-hour residential services can be reduced.

During the last ten years, the state has experienced substantial growth in general population. Despite this the number of commitments to MR institutions has declined. From 1967 to 1969, for example, commitments dropped nearly 30 per cent. Only 629 commitments were recorded in 1968; they had averaged nearly 1,000 per year for the previous ten-year period. This reduction is related to the increased availability of alternative services.¹⁸

Along with the tremendous advantages in programming which the community center provides in comparison to institutional care, the cost to the taxpayer is also considerably cheaper per individual. "The cost of maintaining them in the community [day care center], about \$750.00 per year, was below the expected institutional costs of approximately \$1,800.00 per year."¹⁹ Although the comprehensive day care center is still somewhat of a rarity, new or additional classes for TMR children are being supported in many communities. While the growth of special education classes for EMRs has been impressive (nearly doubled, 1963--1967), the total of classes for

¹⁸ Michigan Department of Mental Health Publication, Michigan Mental Retardation Facts (Lansing, Michigan, October, 1969).

¹⁹ M. J. Appell, C. M. Williams, and K. N. Fishell, "A Day Care Center Training Program for Retarded Children; A Description and Analysis," The Training School Bulletin, 62 (February, 1966), 156.

trainables has increased even more significantly. The following listing of special education classes for the mentally retarded is a modified version of a similar chart from a recent Government publication.²⁰

Level		1963	1964	1965	1966	1967
EMR	No. of Classes	22,500	26,415	31,277	36,851	43,525
	No. of Pupils	363,000	406,000	459,442	519,422	587,722
TMR	No. of Classes	2,500	3,490	4,678	6,329	8,522
	No. of Pupils	30,000	40,035	52,341	68,322	89,252

Along with increased class provisions for the TMR, other promising trends are emerging:

1. Legal requirements. More states are passing mandatory legislation relative to programs for trainable retardates.
2. Emphasis on earlier treatment and services. There are many communities providing preschool classes for TMR children.

²⁰President's Committee on Mental Retardation (1967), p. 5.

3. Extension of maximum age for public schooling.

The upper limit of twenty-one years is likely to be raised to age twenty-five.

4. More opportunities in sheltered workshop programs for older retardates.

The future of the mentally retarded looks much brighter than ever before. Continued psychological, medical, and educational research of the problem promises that additional advances are forthcoming. As the public becomes more aware of what can be accomplished with the mentally handicapped, resistance to financial responsibility for needed educational provisions should diminish.

Motor Performance

The growth of professional interest in this area has promulgated an increasing number of research publications during the last few years. Most of the initial studies on this subject attempted to show relationships between intellectual and motor abilities. It became apparent that little or no relationship existed between these variables within the normal range of intelligence. In a summary of related research, Ismail²¹ states: "After reviewing the literature one would be likely to conclude that the relationships between intellectual performance

²¹A. H. Ismail and J. Gruber, Motor Aptitude and Intellectual Performance (Columbus, Ohio: Charles E. Merrill Books, 1967), p. 33.

and items measuring physical growth, strength, speed, and power were low and in some cases non-existent."

Such a relationship does seem to exist, however, as the intellectual level falls below the range of "normalcy." Sloan used an adaptation of the Oseretsky Test of Motor Proficiency to evaluate performance of 20 normal (IQ range, 90-110) and 20 mentally retarded (IQ range, 45-70) subjects. His results led to the conclusion that motor proficiency is related to intelligence, and that ". . . an adequate evaluation of adaptive capacity should include not only estimates of intelligence but of motor proficiency and social maturity as well."²²

Following Sloan's work, numerous investigators have compared physical performances of normal and retarded groups, and results have supported his conclusion. Many have based their research on one particular type of physical performance.

Cantor and Stacey used the Purdue Pegboard to obtain a measure of manipulative dexterity and found that two groups of normal subjects performed better than the group of retardates (175 subjects, ages 14 through 18): "These results do not support the generally held contention

²²William Sloan, "Motor Proficiency and Intelligence," American Journal of Mental Deficiency, 55 (1951), 405.

that little or no relationship exists between intelligence and manipulative dexterity."²³

In a study which compared proprioception among normal and EMR boys, it was found that the retarded subjects were poorer in a task (balance) requiring integration of stimuli from both the vestibular and kinesthetic senses.²⁴

In an investigation of reaction time, Jones and Burton found ". . . that reaction times tend to be longer in groups of subjects of low intelligence than in groups of subjects of normal intelligence and matched chronological age."²⁵ In another reaction time comparison, Berkson and Baumeister²⁶ reported that in addition to being poorer on this task, the mentally retarded group also demonstrated greater variability (both between and within individuals) in scores.

²³Gordon Cantor and C. Stacey, "Manipulative Dexterity In Mental Defectives," American J. of Ment. Defic., 56 (1951), 408.

²⁴David Auxter, "Proprioception Among Intellectually Typical and Differentially Diagnosed Educable Mentally Retarded Boys," Perceptual and Motor Skills, 27:751-56, 1965.

²⁵David Jones and A. L. Benton, "Reaction Time and Mental Age in Normal and Retarded Children," American Journal of Mental Deficiency, 78 (July, 1968), 146.

²⁶Gershon Berkson and A. Baumeister, "Reaction Time Variability of Mental Defectives and Normals," American Journal of Mental Deficiency, 72 (September, 1967), 265.

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Auxter²⁷ used a test of grip strength (administered over 20-second trials) to compare muscular fatigue in normal and retarded children. His results significantly favored the normals over three (etiological) mentally retarded groups.

Comparative studies have also been done where administration of several motor items was done, in an effort to show variability between normal and retarded groups.

Kuleinski used a battery of twenty-two tumbling exercises to compare the performance of three groups (superior, normal, subnormal intelligence) of fifth and sixth grade boys and girls. He reported that ". . . group comparisons show a significant degree of learning by the superior groups over the normal and subnormal groups, marked superiority of the normal groups over the subnormal groups, and a high degree of superiority of the superior groups over the subnormal groups."²⁸

Turnquist and Marxolf²⁹ administered the Lincoln Adaptation of the Oseretsky Test to similar groups (boys

²⁷David Auxter, "Muscular Fatigue of Mentally Retarded Children," The Training School Bulletin, 63:5-10 (May, 1966).

²⁸Louis Kuleinski, "The Relation of Intelligence to the Learning of Fundamental Muscular Skills," Research Quarterly, 16 (1945), 276.

²⁹Donald Turnquist and S. Marxolf, "Motor Abilities Of Mentally Retarded Youth," J. of Health Physical Education and Recreation, 25:43-44 (March, 1954).

and girls in each, average age of thirteen years) of normal and retarded youngsters. While based on results from a limited sample (eleven subjects in each group), it was suggested that the mentally retarded do have deficiencies when compared to those of average intelligence--using this measure of motor ability.

Using the AAHPER (American Association of Health, Physical Education and Recreation) battery of seven items to test a large sample of EMR children, Francis and Rarick found that while general patterns of change by age were similar to those of normal children, the retarded were less capable in all tasks.

Direct quantitative comparisons between the motor proficiency scores of the mentally retarded and published data on normal children . . . [show] . . . that with the mentally retarded children studied, the means of both boys and girls on most measures were two to four years behind the published age norms of normal children. Furthermore, the discrepancy between the normal and the mentally retarded tended to increase with each advancing age level.³⁰

Howe³¹ tested a normal group of boys and girls (chronological age range, six to twelve) and a group of retarded children (matched with respect to chronological age, socio-economic background and sex), to compare their

³⁰R. Francis and G. L. Rarick, "Motor Characteristics of the Mentally Retarded," Amer. J. of Ment. Defic., 63 (1959), 810.

³¹Clifford Howe, "A Comparison of Motor Skills of Mentally Retarded and Normal Children," Exceptional Children, 25:352-54 (1959).

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performances on a variety of motor tasks. He used eleven tests, which were "selected to represent a variety of types of motor abilities." The results showed the normal boys to be significantly superior to the retarded boys on each of the eleven tasks. The normal girls were superior in all tasks also--significantly so in nine of the eleven items. One of the tasks which clearly differentiated between the normal and retarded groups was balancing on one foot. Howe found this specific inferiority of performance surprising, since the retarded children he had selected were supposed to be familial (had no known brain damage), in regards to etiology.

Rarick, Widdop, and Broadhead³² used an adapted (three of the seven items were modified) form of the AAHPER Youth Physical Fitness Test to measure performance of a national sample (over 4,000) of educable boys and girls, ages eight to eighteen years. It was determined through test results that performance levels of EMR boys and girls are well below published standards for normal children on all comparable tests. One of the essential purposes of this study was to establish motor norms for educable children--since those for normals are obviously inappropriate.

³²G. L. Rarick, J. H. Widdop, and G. D. Broadhead, "The Physical Fitness and Motor Performance of Educable Mentally Retarded Children," Exceptional Children, 36:509-19 (March, 1970).

Just as normal standards are unsuitable for EMR groups, so are the EMR norms inappropriate for trainable children. To date, published normative data on the motor performance of trainables is extremely limited. Rarick³³ observed that trainable children in the age range seven to twelve years showed substantial retardation in manual strength, manual dexterity, striking, throwing, and running performance. He also noted that the motor abilities of mongoloids were more deficient than those of familial TMRs.

Brown³⁴ evaluated the performance of thirty-eight trainable children on the Kraus-Weber Test (minimum muscular fitness). Results of this evaluation indicated that: the trainable group was seriously deficient in muscular fitness in comparison with four groups of normal children; the trainable group was not considered deficient in flexibility as compared with normal groups; the trainable girls tended to be more muscularly fit and had better flexibility than the TMR boys; and the lower back test item caused the greatest percentage of failure for the trainable children.

³³G. L. Rarick, "Motor Characteristics of the Mental Retardate," University of Wisconsin. (Mimeographed Paper.)

³⁴Joe Brown, "Comparative Performance of Trainable Mentally Retarded on the Kraus-Weber Test," The Research Quarterly, 38:348-54 (1967).

In an investigation of the circulorespiratory endurance of trainable boys, Campbell³⁵ tested three age groups (12-14, 15-17, 18-20 years old) on the 25 yard dash, the 300 yard run, and the standing broad jump. The test data was used to obtain "endurance quotients"--by formula, based on an individual's 300 yard run time divided by his extended 25 yard dash time. It was concluded on the basis of the technique used, that the circulorespiratory endurance of institutionalized TMR males does not vary by age levels (the three groups were similar relative to "endurance quotient" scores).

The level of physical development (growth) was investigated by Brown³⁶ as to possible influence on physical fitness scores. Nine fitness tests were given to 30 TMR boys (10 to 17 years old) who had been classified into two groups (upper or lower), based on developmental ratios obtained with the Wetzel Grid. A comparison of the performance of the two groups on the nine fitness items indicated that there was no significant group differences on any of the tests. On the basis of this data, it was concluded that the level of physical development did not

³⁵Donald Campbell, "Circulorespiratory Endurance of Three Age Groups of Institutionalized Trainable Mentally Retarded Males," The Training School Bulletin, 66:60-65, (August, 1969).

³⁶Joe Brown, "Ratio of Physical Development As A Factor In Performance of Retarded Boys on Physical Fitness," The Training School Bulletin, 65:7-11, (May, 1968).

significantly affect performance of this sample of TMR boys. (While differences were not significant, it is interesting to note that the "upper" group had better average scores on all nine tests.)

There have been several studies done which used motor tasks for comparing the performances of retarded and normal groups equated on the basis of intellectual level (mental age) rather than chronological age. The theoretical basis for this practice is the idea that if motor performance is related to mental ability, it should be more equitable to compare retarded groups with normals of similar mental age (MA), rather than matching by chronological age (CA). Research based on this MA-CA concept of group matching has generally shown that this is not an effective technique.

Sengstock³⁷ administered the AAHPER Youth Fitness Test Battery to three groups of boys--one group of EMRs and two normal groups. The retarded group was matched by chronological age to one group and by mental age to a younger group of normal boys. Results showed that the normal CA group was significantly superior to the EMR group on all seven tests, and the EMR boys scored significantly better than the younger (MA matched) boys on five of the seven items. In other words, the retarded group scored

³⁷Wayne L. Sengstock, "Physical Fitness of Mentally Retarded Boys," The Research Quarterly, 37:113-120, (1966).

about midway between the two normal groups on this test battery.

Another investigator has commented on the idea of comparing performances of retardates to "matched" groups of normals:

. . . the inequity of comparing the motor performance of mentally retarded children on the basis of either chronological age or mental age. The former gives a mixed advantage to normal children since in an equivalent time span the normal child profits much more from experience than does the retarded child. The latter gives the advantage to the retarded since it places the normal child at a disadvantage in terms of physical size and development.³⁸

One of the essential considerations in the interpretation of performance levels for groups of retardates is the element of prior experience--in the specific skills involved. Since there is a certain mental involvement in any physical activity, the retarded child would be at a disadvantage in the early stages of learning a motor skill, based on his comparative capacity to conceptualize necessary physical adjustments.

The existence of this "mental practice" influence has been studied by several researchers. Clark³⁹ equated two groups of normal boys on the basis of arm strength, intelligence, and basketball experience--prior to testing

³⁸Rarick, "Motor Characteristics of the Mental Retardate."

³⁹Verdelle L. Clark, "Effect of Mental Practice on the Development of a Certain Motor Skill," Research Quarterly, 31:560-69 (December, 1960).

skill in the one hand foul shot. Each of the two groups (physical practice group, mental practice group) met for fourteen days--one to physically practice the foul shooting and the other to mentally practice for similar periods of time. At the end of this period, both groups were re-tested. On the basis of prior basketball experience, results were reported for three subgroups (varsity, junior varsity, novice). Physical practice resulted in average gains of 16 per cent for varsity, 24 per cent for junior varsity, and 44 per cent for novice boys. Most interesting, were the gains reported for the group that had only practiced mentally for the two weeks between testing: average gains of 15 per cent for varsity; 23 per cent for the junior varsity; and 26 per cent for novice groups!

Along with the interaction of mental and physical abilities demonstrated in the study just reviewed, the influence of prior experience is reflected in the results, in that the least experienced (novice groups) showed the greatest improvement during the practice period. Several other investigators, on the basis of research with retarded subjects, have supported this idea of experiential influence:

. . . while the initial ability of imbeciles on many tasks is exceedingly low, they may achieve much higher levels of performance with extended (time) training. While average performance never equaled that of the higher IQ group, the low IQ group did show much greater

improvement and 'closed' the gap which existed between group scores on initial performances.⁴⁰

Rate of improvement in rotary pursuit performance was greater for M.R. Ss than for normals. . . . Seems . . . that the retardates were inferior in the initial stages of the task due to inappropriate postural and attentive adjustments which are indirectly but crucially linked with performance.⁴¹

The importance of utilizing multiple-trial criteria in assessing the motor educability of mental defectives seems obvious. Novel situations demanding unique motor performance in single-trial learning sessions may affect mental defectives more than normal.⁴²

. . . the findings of this study suggest that . . . the manipulative performance ability of retardates on initial trial does not represent ultimate level which can be achieved through practice, that retardates may be capable of learning manual dexterity tasks to a level competitive with normal persons, and that there is reasonable basis for expectation that using IQ, initial performance scores, and rate of improvement with practice, efficient predictors of motor skill performance may be developed.⁴³

Another important consideration in evaluating performance of retarded individuals relates to the area of motivation. This factor effects performance at any

⁴⁰ Sol Gordon, "The Rate of Improvement of Adult Imbeciles on a Manual Dexterity Task as Compared With High Grade Defectives," Proceedings of the London Conference on the Scientific Study of Mental Deficiency, ed. by B. W. Richards (May & Baker, Ltd. Dagenham, England, 1962), p. 587-92.

⁴¹ A. A. Baumeister, "Motor Learning and Knowledge of Results," American Journal of Mental Deficiency, 70: (January, 1966), 593.

⁴² Malpass, "Motor Skills in Mental Deficiency," p. 620.

⁴³ H. Kahn and A. D. Burdett, "Interaction of Practice and Rewards on Motor Performance of Adolescent Mental Retardates," American Journal of Mental Deficiency, 72 (November, 1967), 427.

intellectual level on an individual basis, but undoubtedly becomes more important in group evaluation--as the mental level declines. Normal children generally have an "intrinsic" desire to compete and are likely to extend themselves to maximum effort. Many trainable children, however, are more responsive to physical discomfort than to the need to excel. Therefore, they are likely to be less enthusiastic in effort, and less inclined to sustain performance through physical distress--to score near their true potential on many tasks.

An inquiry into possible factors which might explain why mentally retarded boys are less able to maintain muscular performance over time, as compared to typical boys, may be examined as physiological or psychological in nature. In the absence of known physiological differences between the groups, strong consideration must be given to the presence of psychological factors as a contributing cause affecting the mentally retarded children's ability to withstand muscular fatigue . . . it might be that the retarded children lack, to a greater degree than typical children, the ability to work past the initial stages of discomfort of fatigue which prevents them from more nearly approaching their physiological limits.⁴⁴

Motor Tests

A review of research related to motor evaluation of the mentally retarded reveals that the kinds of test batteries or individual tasks which have been used to measure motor performance are quite variable. Whether an investigator uses a single task, a few selected items, or

⁴⁴Auxter, "Muscular Fatigue of Mentally Retarded Children," p. 10.

some form of developmental scales seems to depend upon how he personally defines the term "motor performance."

Several studies of motor ability in retardates have been done where the evaluation is limited to a single motor performance task. Cantor and Stacey (1951) used the Purdue Pegboard to measure manipulative dexterity of a group of retardates (fourteen to eighteen years old). Health (1942) and Auxter (1964) used tests of dynamic equilibrium to evaluate the gross (body) balance of educable mentally retarded samples.

Examples of research where a test battery was administered to retardates are the studies of Sloan (1951), Turnquist and Marzolf (1954), and Malpass (1963), all of which used the Lincoln Adaptation of the Oseretsky Test of Motor Proficiency. The Lincoln-Oseretsky has some definite drawbacks as to its applicability with retardates, in that it is time consuming to administer, lacks scoring objectivity (scorers must be specially trained), and numerous items require a certain degree of mental ability for performance.

In a study by Distefano, Ellis and Sloan (1958), combinations of tests were used, including the Lincoln-Oseretsky, Heath Rail-Walking, Hand Steadiness, and Hand-Dynamometer tasks.

Recent studies which have evaluated physical performance in mentally retarded samples have used standardized motor achievement tests to obtain comparative

data. Francis and Rarick (1960) measured static strength (four dynamometric tasks); running speed (30- and 35-yard dash); power (vertical jump, standing broad jump, ball throw for distance); balance (ten foot beam); and agility (squat thrust, agility run). Sengstock (1966) used the AAHPER Youth Fitness Test Battery to compare performances of EMR and normal boys. Rarick, Widdop and Broadhead (1970) administered the modified AAHPER Battery (flexed arm hang, situps, standing broad jump, shuttle run, 50-yard dash, softball throw for distance and 300-yard run) to a national sample of educable boys and girls, ages eight through eighteen.

For the most part, evaluation of motor performance of trainable retardates has involved tests of the physical fitness variety. Brown (1967) administered the Kraus-Weber Test to a group of TMR boys and girls to compare their minimum muscular fitness (strength and flexibility) scores with those of normal children. Fait⁴⁵ tested a sample of TMR boys and girls with a battery of six tasks: the 25-yard dash; bent arm hang; leg lifts; static balance; thrust; and the 300-yard run. Brown (1968) evaluated performance of TMR boys with nine fitness items: standing broad jump; situps; static balance; straight arm hang; 25-yard dash; back lifts; back flexibility; one-half

⁴⁵Hollis Fait, "Measuring Physical Fitness of the Mentally Retarded," University of Connecticut, 1966. (Mimeographed paper.)

burpee (squat and stand); and leg lifts. Hayden (1964) tested trainables on the straight arm hang, medicine ball throw, speed back lifts, situps, vertical jump, floor touch, back extension and 300-yard run.

No published data relative to performance levels of retardates on individual tasks in the category of game (sports) skills was found in the literature. Even for normal children, there are few "skill" batteries where norms are available. The emphasis in evaluating motor performance in normals as well as for retardates, has been through gross motor tasks related to physical fitness. Any instrument which purports to measure an individual's general motor ability should include a variety of tasks, with both "skill" and "fitness" items represented.

In choosing individual tasks for evaluating the motor ability of trainables, certain criteria should be satisfied:

1. Task simplicity. To ensure that the test is really one of physical, and not mental ability.
2. Ease of administration. Should include a demonstration, with a minimum of verbal directions.
3. Simple scoring system. Scoring should be quantitative (rather than pass-fail) and highly objective.
4. Standardization. Test conditions and equipment should be standardized as much as possible.

5. Reliability. Test items should have an acceptable reliability with TMR children.
6. Task variety. The battery should include representative items of both the basic game skills and gross motor fitness tasks.

Factors Related to Motor Performance

As one would expect, most research on this subject has been concerned with the effects of intelligence on motor performance. There have been some recent studies, however, where several factors were examined and correlated with performance scores of mentally retarded subjects. In a study by Francis and Rarick,⁴⁶ factors (independent variables) investigated included age, sex, and IQ. While the EMR children tested scored below published norms, results indicated that age and sex seem similarly related to motor ability in normal children (general performance improves with age, males score higher than females). There also appeared to be a positive (though insignificant) relationship between intelligence and physical performance in this sample.

A University of Wisconsin study (dissertation, 1967) by James Widdop⁴⁷ was done in an attempt to determine

⁴⁶Francis, "Motor Characteristics of the Mentally Retarded," pp. 798-811.

⁴⁷James H. Widdop, "The Motor Performance of Educable Mentally Retarded Children with Particular Reference to the Identification of Factors Associated with Individual

the effect of certain environmental factors on the motor performance of educable retardates. The purpose of this investigation was to examine the relationship between motor test scores of EMR boys and girls (ages eight through eighteen) and the factors of: parental occupation; parental education; family size; birth order (parity); and opportunity for physical education instruction. The motor measures used for correlation with these data were the seven tests (some modified) of the AAHPER Physical Fitness Battery. Some conclusions of the study:

1. The factors of parental occupation and parental education seem to have little, if any, relationship to physical performance of EMR children.
2. Results indicate that children from larger families perform better than those from smaller families.
3. Regarding order of birth, retardates with several older brothers and sisters tend to perform better than those with fewer older siblings.
4. Subjects with at least one hour of school physical education tend to perform slightly better than EMRs with no school physical education.

There is a critical shortage of information pertaining to the environmental and organic factors which may effect the performance of moderate and severely retarded children. This kind of data would be of great value in evaluating the motor abilities of trainable level samples. After testing a group of trainable children on the Kraus-Weber test of minimum muscular fitness, Brown⁴⁸ recommended that the children's test results ". . . should also be correlated with suspected etiology, IQ, age, and physical education opportunities."

Factors which might influence motor performance may be generally classified as "organic" or "environmental." Organic variables would include those "inborn" or constitutional factors which are part of the individual, and generally not subject to manipulation by others. Environmental factors, on the other hand, relate to extrapersonal conditions, which may vary greatly for a given individual or group. Of the factors to be reviewed--age, sex, IQ, dominance, etiology, and growth may be considered "organic," while parental education and activity program would be "environmental."

Age and Sex

In reviewing the literature in the area of motor development and performance, one finds that the effects of

⁴⁸Brown, "Ratio of Physical Development As A Factor In Performance of Retarded Boys on Physical Fitness," 354.

age and sex are often investigated and reported in the same research studies. Therefore, a discussion of these two factors together would seem more logical than to consider them separately.

The effects of these variables on the motor performance of very young children seem quite clear-cut. Chronological age is very important since the neuromuscular and perceptual motor systems are undergoing relatively rapid rates of development in the first few years. However, there seems to be little difference in performance relative to sex during this period:

It would appear that the behaviors which are developing during the first 15 months of life, whether they are motor skills or the early perceptual and adaptive forms of mental abilities, are for the most part unrelated to sex, race, birth order, geographical location, or parental ability.⁴⁹

From the ages of two to six years (preschool), differences in performance on specific tasks may be related to sex, but this is generally due to selection and practice (i.e., "boy" activities, or "girl" activities), rather than actual physical differences.

Although no distinction is generally made in the motor performance of boys and girls in most activities during infancy and early childhood because the differences are not very great, there are some events in which one sex

⁴⁹Nancy Bayley, "Comparisons of Mental and Motor Test Scores for Ages 1-15 Months by Sex, Birth Order, Race, Geographical Location, and Education of Parents," Child Development, 36 (1965), 408.

tends to exceed the performance of the other in either maturity of pattern development or in objective measure.⁵⁰

Most of the research (large samples) reporting age and sex norms are involved with upper elementary (eight-ten years old) through high school levels. In many motor items related to muscular fitness, boy-girl performances may be quite comparable up to age eleven. From this age on, however, boys begin gaining and continue to show a marked superiority through age eighteen. This performance differential may be influenced by social as well as physical factors. "Failure of girls to improve after puberty in physical performance is apparently strongly influenced by the cultural milieu."⁵¹

Hunsicker and Reiff⁵² evaluated a national sample of normal boys and girls, ages ten through seventeen, on the basis of results from over 100 participating schools. The AAHPER Youth Fitness Test was the instrument used to gather the normative data. The boys were superior on all items and this performance "gap" between boys and girls increased with age.

⁵⁰Anna Espenschade and Helen Eckert, Motor Development (Columbus, Ohio: Charles E. Merrill Books, Inc., 1967), p. 134.

⁵¹Ibid., p. 211.

⁵²Paul Hunsicker and Guy Reiff, A Survey and Comparison of Youth Fitness 1958--1965 (Ann Arbor, Mich.: The University of Michigan, 1965).

The AAHPER Test Battery (with three items modified) was also given to a national sample of educable retarded boys and girls (ages eight to eighteen years), in an effort to establish appropriate standards for the EMR.⁵³ Results of this study indicate that changes in performance relative to chronological age follow trends similar to those of normal children (except at levels two to four years below normal). Sex differences in performance of the EMRs were also similar to those for normal children, with the boys scoring higher in all tests at each age level. One interesting difference should be pointed out, however. While the trends between normal and educable children are similar, the retarded girls do relatively better (score closer to the normal girls) than the boys, and consequently, the performance differential between retarded boys and girls is not as great in most tasks as it is between normal boys and girls.

A similar trend is evident in the results of a study by DiStefano, Ellis and Sloan--where several kinds of motor tests were used to measure proficiency in mentally retarded subjects. "The males were more proficient than the females on all tests, but only the difference in

⁵³Rarick, "The Physical Fitness and Motor Performance of Educable Mentally Retarded Children."

rail-walking performance was significant."⁵⁴ This reduction of male superiority in motor performance might be expected to diminish still further with more severely retarded samples. A study involving trainable and educable level retardates by Candland and Manning⁵⁵ offers research results in support of this expectation:

Examination of the relation between sex and performance revealed that the males perform at a consistently higher level on motor tasks than do females. It was also noted that, in general, the effects of the sex difference tend to decrease as the degree or severity of retardation increases. In other words, there is a clearer differentiation between the performance of the sexes in the subjects with the higher IQ levels.

The rate of improvement and the highest attainment level (peak) of motor performance also seem to be related to the factors of age and sex. In addition, the specific task (test item) could also be a most important consideration. In the aforementioned study⁵⁶ of normal children it was found that the mean test scores for girls generally improved between ages ten and seventeen for the shuttle run, standing broad jump, and softball throw. However, there was little or no improvement in the girls mean scores in the 50-yard dash, flexed arm hang, sit-ups, and the

⁵⁴Michael DiStefano, N. R. Ellis, and W. Sloan, "Motor Proficiency in Mental Defectives," Perceptual and Motor Skills, 8 (1958), 234.

⁵⁵Douglas Candland and Sidney Manning, "Elementary Learning Patterns in Mental Retardates," The Train, Sch. Bull., 63 (1966), 93.

⁵⁶Hunsicker, A Survey and Comparison of Youth Fitness 1958-1965.

600-yard run (i.e., performance "leveled" off at age ten). In contrast, the boys' average scores generally showed continual improvement from ages ten through seventeen, for each of the seven test items.

The explanation for the early (chronological) leveling of performance for girls on these fitness tests is probably related to physical changes in puberty, the prevailing social (mental) attitudes, and the relative lack of practice on these particular items. The attitudinal effect may be largely responsible for the differences noted in comparing normal girls performance with that of EMR girls on the same tasks.⁵⁷ (In that the retarded girls would be less influenced by social restrictions.) It seems that the educable girls continue improving (through age fifteen) on some of these tests where the normal girls "level off" much (age ten or eleven) sooner.

It may be inferred from a review of published results that chronological age, relative to changes (peaks) in performance for retardates, is somewhat different than for normal children. From a study which used seventy-six mentally retarded subjects with an age range of nine to thirty-two years, it was reported that: "In a group which may be presumed to have passed the chronological 'peak'

⁵⁷Rarick, "The Physical Fitness and Motor Performance of Educable Mentally Retarded Children."

for both motor and mental maturation, no significant relationship was found between CA and motor scores."⁵⁸ Malpass noted an increase of performance level in gross motor skills with chronological age, until about age sixteen, when there is a plateau in the curve:

It is not accidental that most research dealing with motor proficiency in mental defectives has been conducted with children between the ages of six and sixteen. Maturation of most motor skills is completed by age sixteen, and no significant changes in motor proficiency have been reported after this age.⁵⁹

There is some evidence to the contrary, however. In a recent study by Campbell,⁶⁰ three age groups (12--14, 15--17, and 18--20 years) of trainable subjects (138 males) were tested on three fitness items. His results indicate that strength continued to increase beyond the sixteen year level for that sample:

The results of the standing broad jump would establish that the strength of the skeletal muscles is greatest for the oldest age group. This fact is reflected in the less time required to perform the 300-yard run and the 25-yard run.

In concluding this review of the influence of the factors of age and sex on motor performance, an important point should be emphasized. It may be noted that most of

⁵⁸ DiStefano, "Motor Proficiency in Mental Defectives," p. 234.

⁵⁹ Malpass, "Motor Skills in Mental Deficiency," p. 621.

⁶⁰ Campbell, "Circulorespiratory Endurance of Three Age Groups of Institutionalized Trainable Mentally Retarded Males," p. 63.

the research reviewed was concerned with motor tasks related to fitness rather than motor skills. It is quite possible that these two categories of motor tasks may reveal very different patterns of development when correlated with the factors in question. Espenschade summarized data, for example, which shows peak proficiency in championship (sports) performance in the age range of twenty-two to thirty-five years. She differentiates performance levels according to the type of task:

In general, peak proficiency is attained at an earlier age in those activities requiring strength, speed, and endurance, whereas championship performance is more common at the later ages in relatively less vigorous activities where experience is also a factor.⁶¹

IQ

In the light of available evidence, it may be explicitly stated that there is a definite interaction between the mental and physical aspects of development. Kephart⁶² describes the human learning process as one of perceptual-motor development. He feels that the separation of perceptual and motor activities is impossible as they are interdependent in a functional system, and that movement is the foundation of learning.

The early motor or muscular responses of the child, which are the earliest behavioral responses of the

⁶¹Espenschade, Motor Development, p. 233.

⁶²Newell C. Kephart, The Slow Learner In The Classroom (Columbus, Ohio: C. E. Merrill, 1960), p. 35.

human organism, represent the beginnings of a long process of development and learning. Through these first motor explorations, the child begins to find out about himself and the world around him, and his motor experimentation and his motor learnings become the foundation upon which such knowledge is built.

Zuk has stated that this aspect of development is also operational for mentally retarded individuals: "Perception and learning are not independent phenomena but travel hand-in-hand in the development of normal as well as deviant intelligence."⁶³ A recent study⁶⁴ which attempted to compare the performance of normal and EMR boys on pattern copying and pattern walking tasks showed the retardates to be poorer in this type of perceptual-motor development. (They could not translate or organize the appropriate sequence of motor responses--walking--to the visual organization of space.)

There have been several attempts to predict intelligence from an individual's early motor progress (infant development scales). Most of these studies have been done with normal children and results have proved generally insignificant. One recent study which did report some significant findings was done with a sample of children

⁶³G. H. Zuk, "Perceptual Processes in Normal Development, Brain-Injury and Mental Retardation," American Journal of Mental Deficiency, 63 (September, 1958), 259.

⁶⁴Barbara Keogh and Jack Keogh, "Pattern Copying and Pattern Walking Performance of Normal and Educationally Subnormal Boys," American Journal of Mental Deficiency, 71:1009-13 (May, 1967).

suspected of being mentally retarded. The subjects were tested at regular intervals from infancy through age six or seven. Scores of early developmental quotients (DQ), obtained on the children at one and two years of age were not valid for predicting future IQ. It was found, however, that there was predictive value as the children became a little older:

Reliability of prediction based upon DQ shows a steady increase with age and offered a valuable source of IQ estimate by the time the child was three to four years of age. This seemed to be true for children with cerebral palsy, congenital anomalies, Down's Syndrome (mongolism) and hypothyroidism.⁶⁵

Even in work with the severely retarded, MacAndrew and Edgerton⁶⁶ have found the IQ (Stanford-Binet measure) to be "remarkably stable over time." They also considered an IQ measure of value in determining social capabilities at this level. "Even within a homogeneous population of institutionalized male retardates who fall in the lower range of 'those labeled idiot or imbecile,' IQ is positively related to capacity for competent conduct."

In discussing the effects of IQ, an important consideration is related to the difference between motor learning and motor performance. The latter refers to test

⁶⁵Karol Fishler, B. Graliker, and R. Koch, "The Predictability of Intelligence With Gesell Developmental Scales in Mentally Retarded Infants and Young Children," American Journal of Mental Deficiency, 69 (1965), 524.

⁶⁶C. MacAndrew and R. Edgerton, "I.Q. and the Social Competence of the Profoundly Retarded," American Journal of Mental Deficiency, 69 (1964), 390.

score (proficiency), while motor learning refers to the ability to acquire skill in a new task. In a study dealing with normal boys, Henry and Nelson⁶⁷ found that the motor learning ability had more affect on a younger (ten years old) group's scores than on the older (fifteen years old). Humphries and Shephard⁶⁸ found that the learning of a perceptual-motor skill was related to age for their sample of normal children--five to nine years old. (The oldest subjects made the most matches and fewest errors.)

Ability to learn gross motor tasks is not related to the factors of age or sex in the same way that performance seems to be. In a study of motor learning and performance in two balance tasks, Bachman found that the "rate of learning in large muscle skills is independent of age and sex over the range six to twenty-six years."⁶⁹ He also found that the performance curves were very different for the two tasks through the same age (puberty) ranges. This finding reinforces the idea of task

⁶⁷F. Henry and G. Nelson, "Age Differences and Inter-relationships Between Skill and Learning in Gross Motor Performance of Ten-and-Fifteen-Year-Old Boys," Research Quarterly, 27:162-75 (May, 1956).

⁶⁸M. Humphries and A. Shephard, "Age and Training In The Development of A Perceptual-Motor Skill," Percept. & Mot. Skills, 9:3-11 (1959).

⁶⁹John Bachman, "Motor Learning and Performance as Related to Age and Sex in Two Measures of Balance Coordination," Research Quarterly, 32 (May, 1961), 136.

specificity in considering the effects of any factor on performance. (One should not generalize the results from one task as "motor performance.")

Kuleinski's study provides some evidence of a direct relationship between motor learning ability and IQ.⁷⁰ One can readily understand how a deficiency in motor learning ability could have a depressing effect on motor performance.

It appears reasonable to assume that retardates' poor initial performance on motor skills tasks is a function of slowness in learning a novel task, that performance may be improved through learning, and that conditions affecting such learning may be specified.⁷¹

Accepting the idea that IQ determines motor learning ability, this function must necessarily become more restricted as level of retardation increases. This would help explain why the retarded score low on initial testing and why their performances improve relatively faster than normal, with practice.

From the time of Sloan's published confirmation of a positive relationship between a retarded individual's physical performance and his measured intelligence in 1951, there have been many other studies--similar both in design and conclusion. As in Sloan's study, those of Sengstock, Malpass, Cantor and Stacey, Brace, and Turnquist and

⁷⁰Kuleisnki, "The Relation of Intelligence to the Learning of Fundamental Muscular Skills."

⁷¹Kahn, "Interaction of Practice and Rewards on Motor Performance of Adolescent Mental Retardates," p. 422.

Marzolf demonstrated a relationship between intelligence and motor performance by comparing retarded children with groups of normal children.

A more meaningful approach would be to show the effects of IQ within a particular level of intellectual functioning rather than between two distinct groups. Francis and Rarick⁷² noted a low but positive correlation of IQ with most of the motor performance tests in their study with educable retardates. In a dissertation study of the motor performance of EMR boys and girls, Widdop categorized the subjects into high and low IQ levels, and found the high IQ groups (boys and girls) to be significantly better on almost all test items. "With educable mentally retarded children, IQ had a positive relationship with performance on the physical test items."⁷³ In other studies which involved only mentally retarded subjects, Black and Davis, and Distefano, Ellis, and Sloan found significant correlations between intelligence and most motor tasks performed.

There is presently a lack of data which might show the effects of intelligence on performance within the

⁷²R. Francis and G. L. Rarick, Motor Characteristics of the Mentally Retarded (Washington, D.C.: U.S. Government Printing Office, Cooperative Research Monograph No. 1, 1960).

⁷³Widdop, "The Motor Performance of Educable Mentally Retarded Children . . .," p. 157.

trainable range of retardation. Many have observed a common lack of motor ability at this level, on a subjective basis only.

The measurement of motor ability in severely retarded persons is hampered by their lack of responsiveness to directions. There are very few reliable objective studies of the motor performance of such groups. Many clinical observations have been made about their general motor capabilities and, as has already been noted, there is agreement that those people with IQs roughly below 50 demonstrate considerably less motor proficiency than those in the moderately retarded and normal classifications.⁷⁴

One would predict that the relationship between intelligence and motor performance should increase as the IQ level decreases. Cratty⁷⁵ comments on this relationship:

The IQ scores of trainable retardates when compared to their motor ability scores usually elicit higher correlations than when the same scores obtained from educable retardates and from normal children are contrasted. The reasons for these higher correlations on the part of children with lower intellectual endowments are probably at least two-fold. These children have not been able to profit from the variety of experiences to which they have been exposed as are normal children. . . . At the same time, the IQ of children with poor intellectual-verbal competencies are generally assessed primarily by measuring their perceptual-motor attributes, as indeed these measures are the only ones obtainable from such children.

One of the most important criteria in choosing test items for evaluating retarded groups--especially at the TMR level--should be task simplicity. Since intelligence is so

⁷⁴Malpass, "Motor Skills in Mental Deficiency," p. 624.

⁷⁵Cratty, Motor Activity and The Education of Retardates, p. 3.

limited, the motor task has to be very evident for these children. If a motor item requires mental interpretation (for these children), the results would be more a measure of relative intelligence than of motor ability.

Parental Education

Parent educational level could be a factor in the development of TMR children in that certain environmental conditions may be dependent upon this variable. The more highly educated parents, for example, are more likely to have an advantage in occupational and intellectual status. They are also likely to have fewer children, which allows more individual attention for the retarded child. This possibility of environmental enrichment during infancy and early childhood could have substantial bearing on the retarded child's relative mental and physical progress.

. . . perceptual experience plays a crucial role in psychological development prior to the perfection of sensori-motor skills and before the consequences of active responses can have an important learning effect. Thus it is not surprising that the richness of the environment and the extent of the young infant's opportunities for perceptual contact with people seem to influence development.⁷⁶

. . . findings suggest that an early adverse environment (assessed by highly reliable objective criteria) has a crippling effect on mental development. When the young person is withdrawn from these circumstances,

⁷⁶Robert Franz, "The Crucial Early Influence: Mother Love or Environmental Stimulation?," American Journal of Orthopsychiatry, 36 (1966), p. 331.

the retardation begins to fade and IQ increments thus occur.⁷⁷

Mental retardation in several children of the same parents is not an uncommon finding. Such familial defect is usually sociocultural and the deficiencies may be due to an impoverished environment and lack of learning opportunities which affect all the siblings.⁷⁸

Dennis and Najarian⁷⁹ investigated the development of children in an institution in Beirut, Lebanon. For these children (generally illegitimate), all forms of adult-child interaction were at a minimum because the facility was seriously understaffed (child-adult ratio, about 10 to 1). The children were admitted shortly after birth and remained until six years of age. Opportunity to develop infant skills was restricted since the children spent most of the time lying in cribs. Data obtained with the Catell Infant Scale showed a mean score of 100 at the two-month old level and a mean of 63 for the three to twelve month old infants. This drop in mean score reflects a retardation in physical development due to environmental restrictions.

⁷⁷A. D. B. Clarke and A. M. Clarke, "Pseudo-Feeble-mindedness--Some Implications," American Journal of Mental Deficiency, 59 (1955), 508.

⁷⁸Helen Wortis, E. Jedrysek, and J. Wortis, "Unreported Defect In the Siblings of Retarded Children," American Journal of Mental Deficiency, 72 (November, 1967), 391.

⁷⁹Wayne Dennis and Pergrouhi Najarian, "Infant Development Under Environmental Handicap," Psychological Monographs, 71, No. 7.

Of course, level of education tells nothing of how the retarded child is accepted by his parents. In many cases, there is evidence of rejection or over-protection of the child--on the part of one, or both parents. Such psychological problems, if of sufficient magnitude, could materially affect the child's emotional, physical, or mental adjustment and progress. While the child from a smaller family may have an advantage regarding environmental stimulation (interpersonal contact, etc.) and reflect this in comparative verbal ability, he is often "protected" to the point which increases his dependency and inhibits possible physical development.

Motor activities, for example, may be more helpful to the retarded child from the family high on the economic scale, who has been over-protected and has been denied movement experiences. On the other hand, the child from the less privileged communities may lack verbal-linguistic stimulation, but he may function in a superior way in motor tasks, because his environment has forced him to find his own forms of play.⁸⁰

Most of the research in this area would lead one to conclude that there is a relationship between parental intelligence (education) and the incidence of children classified as educable mentally retarded. Kirk⁸¹ described this level retardate "to be found more frequently in

⁸⁰Cratty, Motor Activity and The Education of Retardates, p. 3.

⁸¹Samuel Kirk, "Experiments In the Early Training of the Mentally Retarded," American Journal of Mental Deficiency, 56 (1952), 694.

families of low socio-economic, intellectual, and educational levels." Wakefield⁸² also found that the parents of EMR children were significantly lower than the general population in intelligence, level of schooling, family income, and cost of family housing. This relationship does not hold true for parents of trainable level children, however. For the severely involved, most of the retardation is related to trauma (brain injury) or genetic (mongolism, etc.) problems, which may be equally possible at any parental (socioeconomic) level.

A study⁸³ which investigated social status differences among parents of educable and trainable retardates found a trend of lower status level related to higher level retardation (of children) to be maintained in various measures of socioeconomic status, including parental education. Gibson studied a group of mongoloid children and determined that the test intelligence of home reared mongoloids is related to paternal educational attainment level. "If educational level can be accepted as a useful index of paternal intelligence level, than a reliable

⁸²Robert Wakefield, "An Investigation of the Family Backgrounds of Educable Mentally Retarded Children in Special Classes," Exceptional Children, 31:143-46 (1964).

⁸³G. Solomons, B. Cushna, E. Opitz, M. Greene, "An Investigation of Social Status Differences Among Educable and Trainable Children," American Journal of Mental Deficiency, 71:207-12 (1966).

connection seems to obtain between parental and mongoloid intelligence."⁸⁴

There is very little research available which has investigated the relationship of parental education to motor performance of their children. In a study of normal children, Bayley and Jones⁸⁵ found that while father's education showed no relation to children's scores, there was a trend of positive correlation between motor scores and mother's education--approaching a peak between the ages of one to three years. In a correlation between parental education and motor performance scores of educable retardates on the AAHPER Fitness Battery, Widdop⁸⁶ found that there was no clearly defined pattern of relationship. Since there is a much wider distribution of parent education levels for the TMR than for the educable, it would be interesting to see if similar results are obtained for a trainable sample.

⁸⁴David Gibson, "Intelligence In the Mongoloid and His Parent," American Journal of Mental Deficiency, 71 (1967), 1016.

⁸⁵Nancy Bayley and Harold Jones, "Environmental Correlates of Mental and Motor Development: A Cumulative Study From Infancy to Six Years," Child Development, 8:329-41 (1937).

⁸⁶Widdop, "The Motor Performance of Educable Mentally Retarded Children . . .," p. 133.

Activity Program

One of the most important aspects of the handicapped child's developmental potential has only recently been given the attention of special educators. In the last few years, increasing interest has been focused on this area and most administrators have become aware of the essential nature of a structured program in a curriculum for the mentally retarded. Inclusion of planned developmental activities not only helps fulfill one of the basic needs (movement) of all children, but also provides the dual benefits of individual attainment (success at one's ability level) and a "natural" learning process for teaching many mental concepts to the retardate.

Most of the initial interest in this area was sparked through published material which emphasized motor activity for the remediation of specific handicapping conditions. Of these treatment regimens, probably the best known to special educators are the programs of Kephart, and Doman and Delacato. The "Perceptual-Motor Theory" of learning has been developed by Newell Kephart⁸⁷ and stresses the complete perceptual-motor development of the retarded child. His theory explains learning difficulties as the result of a breakdown in the child's perceptual-motor development. Such a breakdown is considered the outcome of

⁸⁷Kephart, The Slow Learner In The Classroom.

an incomplete integration of present and past stimuli, and lack of complete feedback from the muscles to the brain--to compensate for errors in perception. Kephart considers the accumulation of motor information as prerequisite to all other perceptual-motor skills. His treatment procedures are purported to improve environmental orientation and include activities for gross motor control, eye-hand coordination, temporoal-spatial translation, and form perception. Specific tasks include chalkboard activities, drawing or copying, balance (board, beam, or trampoline) activities, form puzzles and pegboards, and body image ("Angels in the Snow," etc.) activities.

Kephart's program has several basic limitations regarding its utility in special education on a large scale. The program does not include an adequate evaluative technique (to define specific individual needs), and it also lacks research verification of its value in improving perceptual-motor difficulties. The basic unstructured nature of the treatment is probably the most limiting factor, however. A lack of specified, sequenced activities makes professional application on a large scale almost impossible.

The Doman-Delacato⁸⁸ program of "patterning" is based on the concept of "neurological organization."

⁸⁸Carl H. Delacato, The Treatment and Prevention of Reading Problems (The Neuro-Psychological Approach) (Springfield, Ill.: Charles C. Thomas, 1959).

According to this theory, a normal child progresses through an uninterrupted continuum of ontogenetic development--each higher stage dependent upon a more sophisticated central nervous system (brain) level. If a child "skips" any of the ontogenetic stages (crawling, creeping, etc.), Domand and Delacato would expect incomplete development of the central nervous system, with eventual difficulties in such functions as speech, reading, etc. They also recommend this technique for brain injured individuals on the basis that pathways through the central nervous system can be retrained and that unused or new brain cells may become functional. In some cases, patterns of passive movement are imposed on the individual by several people working together. This is a daily regimen which sometimes requires the services of over 100 people per child (several treatments each day, seven days a week). Other techniques sometimes used include: sensory stimulation; rebreathing of expired air (plastic face mask); restriction of fluid intake; and activities for establishing uniform hemispheric dominance (extensive use of unilateral hand, eye, and foot).

While this treatment program has publicized some amazing results, it has of late come under increasing attack by many professionals.⁸⁹ Many of the techniques

⁸⁹Roger D. Freeman, "Controversy Over 'Patterning' as a Treatment for Brain Damage in Children," The Journal of The American Medical Association, 202:385-88 (October, 1967).

have not been adequately verified and some of the procedures for evaluating individual progress are suspect. A recent opportunity for an extensive and objective study of the program was turned down by Doman, which has served to reinforce opposition to the treatment. Although the value of either the Kephart or Doman-Delacato motor (remedial) programs may be questioned by many, they have served the purpose of emphasizing the relationship between the physical and mental aspects of development and the need to provide movement experiences for the atypical child.

There have been several studies done where retardates have demonstrated improved physical performance following regular participation in a physical education program. Lillie reported results on the application of an experimental preschool motor development program (period of five months). He tested three groups: an experimental (special program); a kindergarten group; and a home group. All three groups consisted of preschool, culturally deprived, mentally retarded children. At the conclusion of this research, Lillie found no significant differences in gross motor development among the groups. However, results did show the experimental group to be significantly better than the control groups on evaluation of fine motor development. He suggested that the "investigation of gross motor and fine motor proficiencies as separate

entities appears to have much value for diagnostic remediation of motor deficiencies."⁹⁰

An investigation of a national sample of EMR boys and girls⁹¹ attempted to determine the relationship between the motor performance of these children and the extent of their physical education program. Comparisons were made of the test scores (AAHPER Youth Fitness Battery) of those retardates who had no planned physical education program with those who had sixty minutes or more (per week) of scheduled physical education.

The results showed that the level of performance of the boys in 58 of 77 tests (7 tests at 11 age levels) was higher for those who had 60 minutes or more per week of physical education than those with no regular programs. The same was true for girls on 54 of the 77 tests. There were significant differences at the 5 per cent level on 24 test items for the boys and on 17 test items for the girls. While these results do not establish causal relationships, there was a tendency for retarded children who had the benefits of as little as one hour weekly of physical education to perform better on selected physical skills than those without instruction.

Solomon and Pangle⁹² completed a research project in which an experimental group of EMR boys were involved

⁹⁰David L. Lillie, "The Effects of Motor Development Lessons on Mentally Retarded Children," American Journal of Mental Deficiency, 72 (May, 1968), 807.

⁹¹G. L. Rarick, J. Widdop, and G. Broadhead, "Environmental Factors Associated With The Motor Performance and Physical Fitness of Educable Mentally Retarded Children," University of Wisconsin, June, 1967, p. 16. (Mimeographed report.)

⁹²Amiel Solomon and Roy Pangle, "Demonstrating Physical Fitness Improvement in the EMR," Exceptional Children, 34 (November, 1967), 179.

in an eight week program of planned physical education activities. On the basis of pre- and post-tests (measures of physical fitness), the experimental group showed significant improvement. A follow-up test of the group was administered six weeks after the conclusion of the experimental program, and showed that gains (fitness) had remained significant over this period:

Results of this investigation indicate that physical fitness of educable retarded boys can be improved through planned and systematic physical education experiences. Moreover, this improvement is apparently not a spurious gain, but can be demonstrated following a six week post experiment interval. The importance of these findings, it is thought, lies not so much in the demonstrated improvement, but rather in the extent of improvement. As the data indicate, subjects in this study evidenced the capability of performing equally as well as--and in some instances superior to--their CA nonretarded comparison group on four measures of physical fitness.

There have been some reports which indicate that the more severely retarded can also show improved physical performance through participation in a regularly scheduled activity program. In a program of physical fitness (pullups, pushups, situps, springups, and back bridges) for a group of older (seventeen to thirty-five years old) males in a state institution for the mentally retarded, Lawthorne⁹³ reported a substantial improvement in fitness.

⁹³Wayne T. Lawhorne, "Physical Fitness for the Mentally Retarded: A Reality," Training School Bulletin, 63:45-48 (1966).

Hayden⁹⁴ has reported significant improvements in strength and endurance of a trainable level group of boys and girls through participation in a program stressing the development of organic fitness.

In addition to physical improvements, participation in structured activity programs has been credited with eliciting other developmental gains in mental retardates. The idea that regular physical activity might effect favorable changes in social and intellectual development has proved especially intriguing to those working with the mentally retarded. It is apparent that such changes are possible through an activity program on the basis that: the physical involvement directly effects central nervous system functioning; the "successes" possible in a carefully administered activity program may serve to motivate a child toward additional achievement; and one's self-image, or confidence may be enhanced and a "carry-over" effect might be evident in other interpersonal situations.

Several writers have observed that unacceptable social behavior is commonly associated with mental retardation. One investigation of the personality differences between EMR and normal children reported that there is a measurable general pattern of personality (less socially acceptable) common to EMR children, and the divergency

⁹⁴Frank J. Hayden, Physical Fitness for the Mentally Retarded (Ontario, Canada: University of Western Ontario, 1964).

from normal personality pattern increases as level of intelligence decreases.⁹⁵

Smith and Hurst⁹⁶ investigated the relationship between physical ability and peer acceptance (a social ability factor) of educable and trainable retardates and reported the results of the study in support of the hypothesis "that motor ability, as defined in this study, plays a significant role in peer acceptance, as defined, for these children."

Weiner discussed the social benefits of recreational play activities on mentally retarded boys:

The program has contributed specifically to our goal of socialization (or 'civilization') through its consistent demonstration of the practical necessity for regulation of conduct, particularly in the swimming pool and on the playground; through reinforcement of general instruction and supervision . . . through . . . acquaintance with numerous activities going on . . . and through companionship with the children and with a reliable adult.⁹⁷

⁹⁵R. Porter, J. Collins, and M. McIver, "A Comparative Investigation of the Personality of Educable Mentally Retarded Children and Those of a Norm Group of Children," Exceptional Children, 31:457-63 (1965).

⁹⁶J. Smith and J. Hurst, "The Relationship of Motor Abilities and Peer Acceptance of Mentally Retarded Children," American Journal of Mental Deficiency, 66 (1961), 84.

⁹⁷Bluma Weiner, "Play and Recreation Activities of Young Mentally Retarded Boys in a Residential Pre-Academic Program," American Journal of Mental Deficiency, 57 (1953), 599.

Several others have stressed the positive influence a physical activity program may exert on the social development of mental retardates:

. . . appropriately developed physical activities will increase tolerance, will offer acceptable emotional outlets, will give self-confidence, and will help the mental retardate in establishing himself as an individual and a member of the group.⁹⁸

Physical education and related activities satisfy many of these needs by siphoning off damned-up tensions in wholesome and socially acceptable ways. If satisfied in opposite ways, neurotic or delinquent behavior may be the result.⁹⁹

Physical education and music seem closest, and interestingly enough, probably most essential in the lives of children who are mentally retarded, and who seem so often to have concomitant physical disabilities of varying degrees. It is around physical education and music that learnings in social competency can most easily be integrated with these children.¹⁰⁰

Some reports have been published which indicate that the achievement potential of retardates may be more adequately realized as a result of participation in an activity program. Beck¹⁰¹ considered the physical

⁹⁸Delores Geddes, "A Physical Educator's View of Social Aspects of Physical Activity for the Mentally Retarded," The Mentally Retarded, 6 (1970), 110.

⁹⁹Charles Cowell, "The Contributions of Physical Activity to Social Development," Research Quarterly, 31 (1960), 293.

¹⁰⁰Harry Dubin, "Some Observations On the Place of Physical Education and A Health Program In Building A Program For the Mentally Retarded Child," American Journal of Mental Deficiency, 59 (1954), 12.

¹⁰¹Harry Beck, "Present Status of Physical Education in Special Classes for the Educable Mentally

education program as a possible means to better mental health for some children, especially if they can be taught to excel in some particular activity. He further stated that "Since the educable mentally handicapped are obviously not going to make a living with their wits, it becomes increasingly important that they learn to use their hands and bodies as efficiently as possible."

Ismail and Gruber¹⁰² used three IQ levels (above average, average, and below average) to form groups (three experimental, three control) for a study purporting to measure relationships between physical and mental performance. Three experimental groups (one at each IQ level) were involved in a special physical education program for one year. This program included calisthenics, gymnastics, track and field events, games and relays, rhythmic and balance activities. While they found no particular changes on IQ scores, the results did show differences in academic achievement scores--in favor of the three experimental groups.

The statistically significant increase in academic achievement of the experimental group came as a slight surprise since the program was conducted for one year duration which is relatively short. It is our opinion that the effects of a quality physical education program on intellectual achievement will be much

Handicapped," American Journal of Mental Deficiency, 61 (1956), 120.

¹⁰²Ismail, Motor Aptitude and Intellectual Performance, p. 190.

greater over a longer period of time. . . . This may be due to the fact that the experimental group is exposed constantly to a better physical education program and thus develops and achieves a better neurological basis for learning through two approaches, namely the classroom and the gymnasium programs.

Participation in a structured activity program has also been credited as a determinant in the improved mental functioning of some retardates. Oliver¹⁰³ did a study in England which involved two groups of institutionalized mentally retarded boys (ages twelve to fifteen years). While one group (control) continued on with its regular program (included two periods of physical education per week and daily games after school), the other (experimental) group of boys was placed on a special program. During the ten-week research period the schedule for the experimental group eliminated all academic classes (except arithmetic and English) and replaced them with physical activities, including daily gym time; remedial (individual) activities; fitness exercises; and recreational games. Following the ten weeks of experimental programming, the two groups were re-evaluated. Results showed the experimental group to be significantly improved in all measures of physical performance. There were also significant changes in emotional and personality adjustment, and there were significant IQ

¹⁰³J. N. Oliver, "The Effect of Physical Conditioning Exercises and Activities on the Mental Characteristics of Educationally Subnormal Boys," British Journal of Educational Psychology, 28:155-65 (June, 1958).

increases in 25 per cent of the experimental group. There were no significant improvements in IQ noted for boys in the control group.

In another study,¹⁰⁴ an experimental group of EMR boys was given an intensive twenty day physical education program. A second EMR group met with research "officials" during this period but were not involved in the activity program. A third group of boys served as "controls" with no special changes in their regular routine during the experimental period. Final results indicated that the experimental (activity) group made significant IQ score gains (Full Scale and Verbal Scale--WISC) over the control group. On a physical fitness battery, the experimental group also made significant gain scores over the other two groups.

The evidence afforded by the studies just reviewed emphasizes the interrelation between physical and mental processes, and opens the possibility of "education through movement" as a most effective technique for teaching the mentally retarded.

A still more refined viewpoint has slowly emerged, possibly only as recently as the last five to seven years. The aim remains to capitalize on sensory and motor traits and to teach skills that can improve social adjustment, but there is a new feature in the expectation that the appropriate planning of physical

¹⁰⁴W. O. Corder, "Effects of Physical Education on the Intellectual, Physical, and Social Development of Educable Mentally Retarded Boys," Exceptional Children, 32:357-64 (1966).

activity for the retarded can affect personal capacity for thought and action. If we raise the degree of well-being, alertness, and interest in reality and action, the individual's attention span will expand, with the result that he will have the benefit of more awareness, more associative perception, more thought. Presumably, more effective intellectual potential will rise.¹⁰⁵

Although there is much supportive evidence as to the value of regular physical education in classes for the retarded, recent reports indicate that there are widespread deficiencies in the actual implementation of activity programs. A questionnaire study by Brace¹⁰⁶ was conducted in an attempt to gather data about provisions for physical education and recreation for mentally retarded children in the United States. The following summary statements are based upon the questionnaire returns:

1. Almost 100 per cent believe that instruction in physical education and recreation can help social and emotional development in the mentally retarded.
2. Almost 90 per cent of the respondents feel that all workers with the mentally retarded should have a basic understanding of physical education and recreation.

¹⁰⁵E. Paul Benoit, "Extending the Mind Through the Body," Journal of Health Physical Education and Recreation, 37 (April, 1966), 28.

¹⁰⁶David K. Brace, "Physical Education and Recreation for Mentally Retarded Pupils in Public Schools: A National Survey," in Programing for the Mentally Retarded (Washington, D.C.: AAHPER, 1968), p. 130-31.

3. Physical education for the mentally retarded is limited in content, as indicated by the report that in 40 per cent or more of the programs, the only activities taught regularly each week are basic movements and calisthenics.
4. One-third or more of the schools never teach swimming, racket games, bowling, combatives, gymnastics or activities on apparatus, track and field, or winter activities.
5. Facilities for physical education are generally inadequate.

Through interviews with administrators and teachers in all the 241 schools involved in their study--Rarick, Widdop, and Broadhead¹⁰⁷ compiled information concerning the amount of time which is allotted for physical activity instruction. A review of this data led them to the conclusion:

It is apparent that mentally retarded children do not have the same opportunities for physical education instruction as do children of normal intelligence. Forty-five per cent have no physical education classes and less than 25 per cent of the schools have sixty minutes or more per week.

These findings raise an interesting question concerning the often quoted two to four year retardation

¹⁰⁷Rarick, "The Physical Fitness and Motor Performance of Educable Mentally Retarded Children," p. 16.

(motor) of educable retardates. A comparison of national samples of normal children on the AAHPER Fitness battery showed that the children tested in 1965 were better in all items than the normal children of similar chronological ages tested in 1958.¹⁰⁸ The suggested reason for this improvement in performance (for equivalent CA) was the fact that 1958 was the first year of testing (national) on the AAHPER test battery, and that by 1966 children had greater familiarity (physical education classes) and had more relative experience on the test items. One can readily understand how a single administration of a similar test battery on a sample of EMR children (many who have had no or little exposure to the test items) would provide data which would necessarily be a minimum (unfavorable) standard for comparison to normal children!

There has been a recent accumulation of evidence which indicates that the preschool years may be among the most critical for influencing an individual's developmental potential. Bayley's work with infants and young children prompted her to conclude: "Evidently, the period between one and four years of age is an important one in the development of mental and motor functions."¹⁰⁹ In

¹⁰⁸Hunsicker, A Survey and Comparison of Youth Fitness 1958-1965.

¹⁰⁹Bayley, "Comparisons of Mental and Motor Test Scores . . .," p. 409.

Espenschade and Eckert¹¹⁰ a discussion related to the effects of early motor training of one child from a set of twins seems to substantiate this concept. While the other (untrained) twin was able to learn more quickly and eventually perform the specific skill equally as well at a later age, there were general differences (between the boys) noted which seemed to continue throughout their lives. The twin who had been given more opportunity for motor activity (experimental training) during his first two years still possessed superior motor coordination and more assurance in performance many years after termination of the experiment. "Early training does, moreover, seem to have a very definite effect upon the individual's general 'rapport' or 'feeling' for motor activities."

The emphasis on early motor training is undoubtedly as essential (or more so) for trainable retarded children as for normals:

The importance of 'critical periods' in the development of behavior should not be overlooked. . . . In general, the periods occur at early ages and it is at these stages of development that the behavior of the profoundly retarded should be given special attention.¹¹¹

¹¹⁰Espenschade, Motor Development, p. 84.

¹¹¹John Hollis, "The Effects of Social and Non Social Stimuli on the Behavior of Profoundly Retarded Children: Part II," American Journal of Mental Deficiency, 69 (1965), 782.

In programming for TMR children, some important adaptations may be essential for producing desired progress in motor performance. One of the major difficulties with older trainables is related to the pattern of inactivity many have adjusted to--which makes them particularly resistant to sustained movement or physical stress. For these youngsters particularly, it is necessary to gradually progress to an adequate level of fitness. In fact, the experiential restrictions imposed on most trainable children makes it imperative that any type of motor task be presented in simple form initially and a gradual sequence of progression determined for subsequent presentations.

When children . . . have not learned the basic skills, instruction should start at beginners' level with adaptation made for the child's greater social and physical maturity. Sequential learning is important in Physical Education just as in other instructional areas.¹¹²

Some special motivational techniques are often helpful for increasing participatory level of the TMR. The addition of music sometimes improves group participation in active movement. Weigl¹¹³ defined "functional music" as that used "not for any aesthetic value, but for

¹¹²Sisters of St. Francis of Assissi, Physical Education Curriculum for the Mentally Handicapped (Milwaukee, Wis.: Cardinal Stritch College, 1962), p. ii.

¹¹³Vally Weigl, "Functional Music, A Therapeutic Tool In Working With The Mentally Retarded," American Journal of Mental Deficiency, 63 (1959), 676.

its effectiveness in reaching practical therapeutic goals outside of music itself." Another study reported that a combination of music and exercise may have a significant effect (positive) on the psycho-motor ability of severely retarded children:

Thus, music may act as an agent through which the focusing of attention could be increased and the controlled manipulation of music, with respect to some performance measure, may produce an increase in perceptual accuracy and performance.¹¹⁴

There are certain common deficiencies among trainables which might require particular emphasis in activity programing. For the most part, however, the same basic principles stressed in developing a good physical education program for normal children are applicable for the TMR.

The program should provide activities that are physically stimulating, socially constructive and esthetically acceptable. A program planned with these criteria in mind contributes to the child's growth in all areas--motor, social, emotional, intellectual and spiritual. Careful planning is necessary. The gym or playground must never be regarded as a refuge from the classroom.¹¹⁵

¹¹⁴W. Harrison, H. Lecrone, M. Temerlin, and W. Tronsdale, "The Effect of Music and Exercise Upon the Self-Help Skills of Non-Verbal Retardates," American Journal of Mental Deficiency, 71 (1966), 279.

¹¹⁵Julia S. Molloy, Trainable Children Curriculum and Procedures (New York: The John Day Company, 1963), p. 40.

Etiology

Literally hundreds of conditions or causes of mental retardation have been identified. Several investigators have attempted to classify mental retardates by causative factor. The following categories were among those listed in an etiological classification by Carter:¹¹⁶

1. Mental retardation due to infections (prenatal, postnatal).
2. Mental retardation associated with prenatal intoxication and allergic reactions.
3. Mental retardation second to prenatal trauma, physical agents, or intoxication.
4. Mental retardation due to injury at birth (brain damage).
5. Mental retardation associated with postnatal poisons and allergic reactions.
6. Mental retardation associated with toxins, endotoxins, and deficiencies in the postnatal period.
7. Mental retardation associated with abnormalities of metabolism.
8. Mental retardation due to postnatal injuries, vascular accidents, and anoxia.

¹¹⁶Charles H. Carter, Handbook of Mental Retardation Syndromes (Springfield, Ill.: Charles C. Thomas, 1966).

9. Mental retardation associated with abnormalities of endocrine function.
10. Mental retardation associated with diseases and conditions due to new growths and skin lesions.
11. Mental retardation associated with cranial abnormalities and other prenatal influences.
12. Mental retardation due to chromosomal or genetic causes.
13. Mental retardation due to unknown or uncertain causes.
14. Mental retardation due to functional causes (familial, environmental, etc.).

In most instances, etiological classification systems have very limited value, because of the wide range of abilities (social, intellectual, etc.) generally encountered within any one category. However, many researchers in recent years have expressed an interest in learning more about the possible relationship between etiology and physical performance in mental retardation:

Consideration of some of the etiological variables underlying motor performance in general points up many of the more specific reasons why motor disability and mental status, at least for low-grade defectives as contrasted with normals, are related.¹¹⁷

¹¹⁷Malpass, "Motor Skills in Mental Deficiency," p. 605.

This study points up the desirability of developing incisive measures of motor proficiency. Further investigation of the motor proficiency of different clinical groups is indicated.¹¹⁸

In general, the present evidence supports the hypothesis of a significant positive relationship between MA and motor proficiency. Some evidence is adduced for the importance of task complexity and possible clinical etiology as significant variables which need to be considered in investigations of this type.¹¹⁹

A study of the effects of etiology on performance--especially with TMR samples--would necessitate a limitation to a few basic categories, into which large numbers of the children could be placed. A review of studies which investigated the effects of this factor indicates that there are four common "etiological" categories: brain-injured; familial; unknown; and mongoloid.

Brain-injured. Brain damage may result from numerous causes, including: disease processes (inflammation of brain tissue); internal pressure; chemical imbalance; toxic substances; circulatory (blood) problems; and anoxia (lack of oxygen). Perhaps the most common cause of brain damage would be that resulting from physical trauma--during birth (paranatal), or later. In many cases, there will be one or more symptoms (of brain damage) present, if the injury sustained is of any import. These

¹¹⁸Sloan, "Motor Proficiency and Intelligence," 405.

¹¹⁹DiStefano, "Motor Proficiency in Mental Defectives," 234.

could include certain behavioral or motor symptoms, neurological (abnormal reflex, etc.) signs, unusual EEG pattern, or periodic seizures (petite, or gran mal). The degree of retardation and motor handicap is related to the area of the brain involved and the extent of the damage. This is the reason why this particular etiological group may be so variable--in comparison to others.

Familial. This term is used to describe retardation which is believed to be "inherited" as a result of organic deficiencies (subnormal function) in brain tissue. "Cultural" and "endogenous" are other terms that have been used to define retardates in this category. The home situation is generally very poor, and the lack of environmental stimulation may often have a negative effect on intellectual development. One would expect to find several members (parents, siblings, etc.) of the individual's family who would also be classified as mentally retarded.

Mongoloid (Down's Syndrome). A condition due to chromosomal abnormality, mongolism is a common finding among trainable level retardates. This condition seems most related to maternal age--with a peak incidence in mothers over forty years old. In this country, the incidence of mongolism is approximately 1 per 600 live births. The life expectancy of the mongoloid child has increased into normal ranges in the last fifteen years,

with the availability of drugs which effectively control many common respiratory diseases (formerly fatal to such individuals).

The average mongoloid child may be expected to function at the trainable level, but there is a wide range of abilities among these individuals, from severe retardation to dull-normal levels. There have been several cases of mongoloids who have possessed mental ability within the normal range of intelligence (average, and above).

Certain common physical stigmata are found among these children, such as: a depressed (flattened) bridge of the nose; large tongue; brachiocephalic skull shape; slanted eyes (inner epicanthal fold); abnormally shaped ears; short stature and extremities; short fingers and toes (with wide separation between first and second toes); single transverse palmer line; frequent congenital heart defects; and infantile genital organs. In addition to the presence of some or many of these physical signs, the mongoloid will have an abnormal (forty-seven, rather than forty-six) chromosome count.

Unknown. Many trainable level children have no specified condition or developmental history (pre- or postnatal) which would indicate the reason for their retardation. If there are no family members who would be considered intellectually subnormal, and there is no

indication of brain damage, these children would have to be classified in an "unknown" category--relative to etiology.

Auxter¹²⁰ found the performance of brain injured EMR boys to be significantly poorer than that of non-brain injured or undifferentiated retardates on items requiring muscular strength or endurance. Heath¹²¹ compared the rail-walking (dynamic balance) ability of brain-injured (exogenous) and endogenous groups of retardates, and found the latter category to be superior on this task.

In a study¹²² which compared performance of brain-injured (organic) and familial groups, it was reported that the familial etiology group was significantly faster on the two reaction-time tasks used. Howe's study (1959) of the motor ability of retarded children was done with a sample he considered familial in etiology (children with evidence of brain damage were excluded from the study).

¹²⁰David Auxter, "Strength and Flexibility of Differentially Diagnosed Educable Mentally Retarded Boys," Research Quarterly, 37:455-61 (January, 1967).

¹²¹Roy S. Heath, "Rail-Walking Performance as Related to Mental Age and Etiological Type Among the Mentally Retarded," American Journal of Psychology, 55:240-47 (1942).

¹²²Gerard Bensberg and Gordon Cantor, "Reaction Time in Mental Defectives With Organic and Familial Etiology," American Journal of Mental Deficiency, 62: 534-47 (1957).

Results from a study which compared tactual discrimination skills in mongoloid and non-mongoloid groups indicate that ". . . when purely motor skills are compared, with little need for conceptual understanding, the performance of mongoloid and non-mongoloid retardates is similar."¹²³ Cratty¹²⁴ describes the mongoloid's motor performance as a separate (from other TMR children) category. "The mongoloid child is the least favored motorically of all groups of retardants discussed on these pages."

Knights, Hyman and Wozony¹²⁵ compared the psychomotor abilities of familial, brain-injured, and mongoloid groups of retarded children. Results showed the mongoloid children to be poorer than the other groups on a non-visual psychomotor task. It was also determined that the brain-injured retardate does not benefit from prior tactual-kinesthetic experience as much as the familial type. It was concluded that the findings of ". . . different psychomotor abilities suggests contrasting emphasis in

¹²³R. M. Knights, B. R. Atkinson, and J. A. Hyman, "Tactual Discrimination and Motor Skills In Mongoloid and Non-Mongoloid Retardates and Normal Children," American Journal of Mental Deficiency, 71 (1967), 900.

¹²⁴B. J. Cratty, Developmental Sequences of Perceptual-Motor Tasks (Freeport, N.Y.: Educational Activities, Inc., 1967), p. 5.

¹²⁵Robert Knights, J. Hyman, M. Wozny, "Psychomotor Abilities of Familial, Brain-Injured and Mongoloid Retarded Children," American Journal of Mental Deficiency, 70 (1966), 457.

the training of psychomotor skills with these three types of retarded children."

A comparison of several etiological groups of TMR children in a variety of motor tasks could provide some interesting data. Relative strengths and deficiencies in certain types of performance could be useful in planning activity programs for these particular groups.

Although at present we do not have much evidence concerning differential procedures in educating children whose intellectual defects arise from different causes, it is possible that in the future many educational techniques will be based, at least in part, on the etiological factor.¹²⁶

Growth

Many who have worked with groups of mentally retarded children have observed a rather common occurrence of retarded physical development among this population. A study of the height and weight of mental retardates (up to age twelve, with a mean age of nine years) found a high incidence of short stature and sub-average weight among trainable children. It was further noted that: "Profoundly retarded patients . . . were shorter and lighter for their age than higher functional patients."¹²⁷

¹²⁶Samuel Kirk and G. O. Johnson, Educating the Retarded Child (Cambridge, Mass.: The Riverside Press, 1951), p. 15.

¹²⁷W. Culley, D. Jolly, and E. Mertz, "Heights and Weights of Mentally Retarded Children," American Journal of Mental Deficiency, 68 (1963), 209.

Flory¹²⁸ also suggested that the degree of physical deviation is related to the degree of mental defect.

Mental deficiency does not seem to be an isolated misfortune which centers in the brain of the persons afflicted. Factors which operate to produce a mental debility, also seem to operate to produce a general physical inferiority.

Kugel and Mohr¹²⁹ agreed that ". . . the supposition that brain defect can of itself produce physical growth retardation may be a reasonable hypothesis."

In addition to the growth measures of height and weight, Hollis¹³⁰ found that ". . . x-rays of development of the hand bones of retardates generally showed erratic and retarded growth." Another study¹³¹ of an institutionalized population of retarded males and females found that in comparison to normals, there is a delay in the appearance of secondary sex features in the mentally retarded. Kraus, Clark, and Oka¹³² reported an elevated incidence of

¹²⁸Charles Flory, "The Physical Growth of Mentally Deficient Boys," Society for Research in Child Development Monographs 1: Number 6, 1936, p. 50.

¹²⁹R. Kugel and J. Mohr, "Mental Retardation and Physical Growth," American Journal of Mental Deficiency, 68 (1963), 48.

¹³⁰Hollis, "The Effects of Social and Non Social Stimuli . . .," p. 782.

¹³¹H. Mosier, H. Grossman, and H. Dingman, "Secondary Sex Development In Mentally Deficient Individuals," Child Development, 33:273-86 (1962).

¹³²B. Kraus, G. Clark, and S. Oka, "Mental Retardation and Abnormalities of the Dentition," American Journal of Mental Deficiency, 72:905-17 (1968).

tooth deformity, while investigating an association between mental retardation and dental morphology.

After reviewing the literature on this subject one would be inclined to conclude that as the degree of retardation increases, so does the probability of concomitant physical deviation from the norm. The theoretical explanation for this apparent relationship between physical and mental development which many researchers advocate-- suggests that the central nervous system, the endocrine glands, and other systems act reciprocally in producing the total developmental condition.

The results of research on the relationship of developmental level and physical performance are somewhat contradictory. In a study done with elementary school children, Bookwalter¹³³ noted a definite relationship between growth factors (body build) and physical fitness test scores. Clarke and Harrison¹³⁴ tested boys at three age levels (9, 12, and 15 years) and compared test scores for advanced, normal, and retarded maturity (growth) groups. They found that in all instances where mean score

¹³³Karl Bookwalter, "The Relationship of Body Size and Shape to Physical Performance," Research Quarterly, 23:271-79 (1952).

¹³⁴H. Clarke and J. Harrison, "Differences in Physical and Motor Traits Between Boys of Advanced, Normal and Retarded Maturity," Research Quarterly, 33:13-25 (1962).

differences were significant, the advanced maturity group scored highest.

Others who have done similar research with elementary school children have reached different conclusions, however. Rarick and Oyster¹³⁵ reported that skeletal maturity was not an important factor in effecting the motor performance scores of their sample. Seils found ". . . little or no relationship between the gross motor skill performance of primary-grade children and their age, height, or weight."¹³⁶ In a study with three maturity groups of boys (ages ten to fourteen), Solley¹³⁷ found no significant differences between the accelerated, average, and retarded growth groups on the measures of motor coordination used.

The limited research of this factor as related to performance of retarded children also provides conflicting results. Dawson and Edwards¹³⁸ suggested that there was a relationship between growth (height and weight) and grip

¹³⁵G. L. Rarick and N. Oyster, "Physical Maturity, Muscular Strength, and Motor Performance of Young School-Age Boys," Research Quarterly, 35:523-31 (1964).

¹³⁶LeRoy Seils, "The Relationship Between Measures of Physical Growth and Gross Motor Performance of Primary-Grade School Children," Research Quarterly, 22 (1951), 259.

¹³⁷William Solley, "Ratio of Physical Development as a Factor in Motor Co-ordination of Boys Ages 10--14," Research Quarterly, 28:295-304 (1957).

¹³⁸W. Dawson and R. Edwards, "Motor Development of Retarded Children," Perceptual and Motor Skills, 21: 223-26 (1965).

strength measures for their sample of retardates. Brown¹³⁹ used the Wetzel Grid to determine developmental level of trainable boys. Two experimental groups ("upper" and "lower") were formed by dividing each individual's developmental age by his chronological age. On the basis of test scores, it was concluded that ". . . the level of physical development did not significantly effect the performance of this group of TMR boys on the nine physical fitness items."

It appears that part of the explanation for research differences connected with this factor may be related to the age level of the subjects and the growth measures used. Whatever the reason, the existence of such conflicting results in the literature makes this factor worthy of further investigation--especially with the trainable mentally retarded.

Dominance

There has been a long history of scientific interest in the uniquely human pattern of unilateral motor dominance. Many researchers have investigated the possible relationship of incomplete dominance (hand-eye) and problems in speech and reading. Recent attention on the subject of incomplete cerebral dominance has been

¹³⁹Brown, "Ratio of Physical Development As A Factor In Performance of Retarded Boys on Physical Fitness," p. 11.

aroused through the efforts of Doman and Delacato and their "patterning" techniques.

Many studies have been done in an attempt to explain the occasional occurrence of left hand dominance in a population which is so biased towards right handedness. Most researchers agree that there is little evidence of hand preference in infants through six or seven months of age. During the first year, there is a great tendency to use either hand, rather than a dominant one.

In a study of eight month old (normal) children, Cohen¹⁴⁰ found that over 40 per cent should be categorized as ambidextrous (no preference) in an evaluation of handedness. Longitudinal research has shown that there may be considerable interchangeability in individual cases through the first two years. At this time there is usually an ascendance of hand preference evident, but this stage is often followed by another increase in bilaterality, which may continue for a year or two.

Handedness is fluctuating and unstable during the nursery years. However, all observers report increased preference for right-handedness during the ages of two to five.¹⁴¹

¹⁴⁰ Abraham Cohen, "Hand Preference and Developmental Status of Infants," The Journal of Genetic Psychology, 108:337-45 (1966).

¹⁴¹ Gertrude Hildreth, "The Development and Training of Hand Dominance: I. Characteristics of Handedness," Journal of Genetic Psychology, 75 (1949), 225.

Data presented by Harris¹⁴² shows an increase in the category of "strong" hand (left or right) dominance over three age groups: 7 and 8 years old, 36.6 per cent; 9 and 10 years old, 55.6 per cent; and 11 years and older, 65.4 per cent. (For the oldest group, 58.1 per cent were strong right dominant and 7.3 per cent strong left.) Belmont and Birch¹⁴³ stated that age nine may be considered a useful indicator for the existence of established hand preference. The reported incidence of left handedness varies among many investigators, but the general consensus is that approximately 7 per cent of the population would be in this category.

In those studies where eye and foot dominance were also evaluated, somewhat different (from handedness) patterns emerged. In his study, Harris (1957) found for the older (11 years, plus) group a determination of eye dominance rated 46.8 per cent in the strong right category, and 27.4 per cent in the strong left category. Foot dominance for the same age level showed 54.7 per cent in the strong right, and 17.1 per cent in the strong left groups. The data also indicates that eye and foot dominance is established earlier than hand preference (less variable across the three age levels). Belmont and

¹⁴²Albert Harris, "Lateral Dominance, Directional Confusion, and Reading Disability," Journal of Psychology, 44:283-94 (1957).

Birch¹⁴³ (1963) stated that of all findings, the one exhibiting the most clear-cut and earliest (by age six) established preference in usage is footedness.

There is general agreement that the existence of left eye dominance in our population is much higher (approximately 25 per cent) than left handedness. This would necessarily mean that there are many people who are right handed and have a dominant left eye. The fact that most of these individuals evidence no emotional, reading, speech or other problems seems to refute the theory of the normalcy of unilateral hemispheric dominance.

However, since 20 to 25 per cent of the population shows some lack of correspondence between eye and hand in sighting and many of these persons experience no confusion . . . due to 'mixed' dominance, this factor has probably been exaggerated as a cause of adjustment difficulties.¹⁴⁴

Much research has focused upon the possible determinants of dominance, and the findings remain inconclusive. The notably increased incidence of left handedness among mentally retarded groups has been reported by many workers. Gordon¹⁴⁵ tested a large sample (over

¹⁴³L. Belmont and H. Birch, "Lateral Dominance and Right-Left Awareness in Normal Children," Child Development, 34:257-70 (1963).

¹⁴⁴Hildreth, "The Development and Training of Hand Dominance: . . .," p. 275.

¹⁴⁵Hugh Gordon, "Left-Handedness and Mirror Writing, Especially Among Defective Children," Brain, 43:22-68 (1921).

4,000) of mentally retarded boys and girls (ages eight to sixteen) and found the incidence of left handedness to be 18.2 per cent. He tested a similar sample (ages four to fourteen) of normal children and found that 7.3 per cent were left handed. One explanation for the difference between normals and retardates is related to the social environment:

However, boys, who tend to be less responsive to and/or less subjected to as much social training as girls, are more often left handed than the opposite sex. Moreover, retarded children and mental defectives, who are also less responsive to social training, have twice as great an incidence of left handedness as normal children.¹⁴⁶

The environmental influence of other people on handedness seems to be another important factor. Hildreth (1949) reported that children tended to be more consistent (stronger dominance) in their use of hand for taught activities (drawing, eating with a spoon, throwing, etc.) than they were for "untrained" activities. Rife¹⁴⁷ has explained the development of handedness as a combination of heredity and environmental influence:

The inheritance of left-handedness cannot be explained solely on the basis of a single pair of genetic factors. There is considerable evidence that handedness is a graded or quantitative trait. . . . Many individuals are genotypically intermediate, that is, not strongly biased in either direction. The handedness of such individuals can easily be shifted one way or the other by environmental conditions. . . .

¹⁴⁶ Espenschade, Motor Development, p. 97.

¹⁴⁷ D. C. Rife, "Handedness, With Special Reference to Twins," Genetics, 25 (1940), 185.

Individuals genotypically strongly biased for either right- or left-handedness, would not be shifted by environmental circumstances.

In addition to these factors there is also the possibility of pathological left (or right) handedness--especially in a group of mentally retarded subjects. In these cases, a left or mixed dominance could be the result of weakness in the dominant extremity, hemiplegia, minimal brain damage, and similar conditions.

Most of the work done in this area has attempted to show a relationship between the establishment (or lack) of dominance and reading ability. While Harris (1957) found a significant relationship between the factors of reading disability and hand dominance, most studies (Coleman; Smith; Stephens; and Balow) reported that the degree of dominance does not significantly effect reading achievement.

There have been very few studies which have investigated the relationship of dominance and motor ability. Cohen (1966) found that in normal infants, developmental status is related to the (early) development of hand preference. An interesting finding was reported in a study by Paul and Markow. They involved ten retarded children in a six-month exercise program which was based on the theory of neurological organization.

The first, and what may be the most startling finding, revolves around a change in dominance which occurred at approximately two months after beginning the procedure. The group receiving the experimental

treatment started out with a ratio of 50-50 left to right handedness. Within a period of approximately three weeks all but one of the left handed group went through a mixed stage, then established their right hand as dominant. This left the group with a 90-10 per cent distribution between right and left. It should be noted that this is far closer to the right to left handed distribution in a normal population.¹⁴⁸

One would expect that the earlier dominance is established for hand skills, the more proficient an individual could become. The relatively high incidence of mixed dominance (ambidexterity) among trainable retardates then becomes an important factor in considering the performance level of these children.

Smooth team work between the two hands functioning automatically in motor performance contributes to skill. Individuals who have not achieved manual dominance are less effective or may even be handicapped in motor performance. Delay in establishing dominance is unfortunate because it leads to uncertainty, confusion, and awkwardness in motor performance.¹⁴⁹

Summary

It has been determined that approximately 3 per cent of all children born in this country may be considered mentally retarded. Of this total, the great majority (87 per cent) would be classified as mildly retarded (educable). Of the other 13 per cent, about 10 per cent

¹⁴⁸H. Paul and M. Markow, "Neurological Organization Exercises on Retarded Children With Strabismus," The Training School Bulletin, 66 (1969), 69.

¹⁴⁹Hildreth, "The Development and Training of Hand Dominance: . . .," p. 199.

would be considered trainable (the remainder would be in the totally dependent category).

While the trainable child could not profit from classes (academics) for educables, they do have potential for learning self care, social adjustment, and economic usefulness in the home or a sheltered environment.

Responsibility for the care and training of the "non-educable" child has only recently been assumed by the local school systems in most of the United States. From an emphasis on early institutionalization, there has been a gradual progression to the provision of special community centers where trainable children can profit from a daily program of essential professional services.

While studies done with normal subjects have shown no relationship between motor and mental abilities, research with educable retardates has demonstrated the existence of a slight positive correlation between these variables. Available evidence indicates that the greater the mental deficiency, the more pronounced will be the retardation in motor behavior and physical growth.

Current literature reflects an almost complete lack of data concerning the effects of organic or environmental factors upon the motor development of trainable children. From the review of related literature, the following eight factors appear to be worthy of investigation in regards to possible effect on motor performance:

age, sex, IQ, parent education, activity program, etiology, growth, and dominance.

The evaluation of motor abilities in the mentally retarded has generally involved tests of the physical fitness variety. In addition to such gross motor tasks, a test battery should include evaluation of several basic game (sports) skills. This additional information would help the teacher to more effectively plan the activity content of the physical education program for trainable retardates.

CHAPTER III

PROCEDURES

This chapter includes a review of the sample of trainable retardates used as subjects and the methodology of data collection. The battery of test items is outlined, with a summary of findings as to its reliability with TMR children. Along with the topic of testing arrangements is a description of the method for collecting and recording personal data which provided the basis for grouping the children into categories for each of the factors under consideration. The concluding segment of this chapter outlines the proposed analysis or treatment of the data to be collected.

Sample

The trainable group which provided data for this study consisted of eighty-eight subjects, ages eight through twenty-one. All the children were enrolled in one of two schools--both of which were involved exclusively in programing for the TMR. Approximately one-half of the sample was attending Community School (Lansing, Michigan),

and the rest of the subjects were enrolled at Towar School (East Lansing). All children who could perform the test items were included in the sample (88 of 92 enrolled, ages 8 through 21). Of the four who were not used in this study, three were excluded for physical reasons (two severe cases of cerebral palsy and one non-ambulatory child), and the other due to gross lack of comprehension of the test items.

Personal Data

The information needed for categorizing subjects (relative to the factors under investigation) was obtained by reviewing individual records of all eligible children. Data cards were made for each child in the study, and each was assigned a number based on alphabetical order in the sample. In addition to test scores, the data cards contained the following information:

1. Birthdate. To determine age at the time of testing. The testing month of June was considered the mid-point of a year, and birthdates from January through December were included in that year. (For example, those children born in 1960 were considered eight years old at the time of testing. The actual range was 8 years, 5 months if born in January, to 7 years, 6 months if born in December of that year.) On the basis of birthdate, subjects were placed in one of five age categories:

- a. 8 and 9 years old;
- b. 10 through 12;

- c. 13 through 15;
 - d. 16 through 18; and
 - e. 19 through 21 years old.
2. Sex. Male, or female category.
3. IQ. Based upon most recent psychological assessment. The Stanford-Binet (Form L-M) was the fundamental measure. (A few subjects had been tested with the W.I.S.C. Any other measures were not considered acceptable.) Three IQ categories were determined:
- a. High, IQ range 51--72;
 - b. Medium, IQ range 41--50; and
 - c. Low, IQ range 30--40.

One may question the IQ range of the High category, since TMRs are generally considered to be in the 30 to 50 range. Of the 23 subjects in that category, all but four had IQs below 60, and many of these were in the low fifties. The fact that all the subjects were considered functionally trainable, and enrolled in certified TMR programs at the time of testing, permits their inclusion in this study.

4. Etiology. Based upon personal records and other information in the school files, each subject was assigned to one of four categories (see Chapter II) as to possible cause of mental retardation:

- a. Familial--parents or siblings enrolled at some time in school programs for the mentally retarded;

- b. Brain Injured--based on medical records or other evidence (seizures, etc.) of brain damage;
- c. Mongolism--genetic defect sometimes termed "Down's Syndrome";
- d. Unknown--no known cause, no evidence for inclusion in one of the other categories.

Following a review of the records, there were several children for whom assignment to one of the four above categories was considered inappropriate. These six subjects were all diagnosed as microcephalic. The microcephalic individual has an extremely small head, which is usually due to a lack of brain tissue formation (especially the cerebral hemispheres). In primary microcephaly, the principal abnormality is usually mental retardation (from mild to severe), and such individuals are often well coordinated in physical performance. An additional category was provided for the benefit of these subjects:

- e. Microcephaly--abnormally small head related to subnormal development of brain tissue.

5. Activity Program (School). At the time of testing, those children at Community School had been involved in a regular physical education program (period of eight months), while those attending Towar School had no structured activity program.

6. Parent Education. The number of years total (elementary, secondary, college) for each parent was recorded. The sum of both parents' total years of education provided the child's rating for inclusion in one of two categories:

- a. High, a parent education total of 21 to 34;
- b. Low, a parent education total of 0 to 20.

7. Growth. Height in inches, weight in pounds was recorded for each subject during the test period. Using the physical growth records (boys and girls) by Meredith,¹⁵⁰ a subject was placed in one of three height categories: below average (short), average, or above average (tall), according to his chronological age. Using the subject's height, he was then given a weight classification based on his height. (For example, a child may be short for his chronological age, but of average weight for his height.) This allowed for placement in one of nine possible growth categories:

- a. Short and underweight (light)
- b. Short and average weight
- c. Short and overweight (heavy)
- d. Average and underweight (light)

¹⁵⁰H. V. Meredith and V. B. Knott, "Height Weight Interpretation Folder For Boys (For Girls)" (Washington, D.C.: National Education Association, 1967).

- e. Average and average weight
- f. Average and overweight (heavy)
- g. Tall and underweight (light)
- h. Tall and average weight
- i. Tall and overweight (heavy)

8. Dominance. During performance in certain skill tests (throwing and kicking), hand and foot (left, right, or mixed) usage was also recorded for each subject. Following completion of the test battery, a child was placed in one of four categories:

- a. Right dominant--exclusive use of right hand and right foot in single limb tasks.
- b. Mixed dominance--in a single limb task, used both (either) left and right hand (or foot) on successive attempts.
- c. Opposed dominance--use of single limb was consistent, but hand used was opposite to the foot used.
- d. Left dominant--exclusive use of the left hand or left foot in single limb tasks.

Motor Performance Test Battery

Fourteen motor performance tasks were selected to evaluate the motor ability of each trainable subject. A complete description, including equipment and administrative directions for each task may be found in the appendices. The fourteen test items are listed below under one of two

categories. Seven items purport to measure basic components of motor fitness, such as muscular strength, agility, speed of movement, endurance, and balance. The other seven items are supposed to measure basic components of game skills, such as throwing, catching, kicking, and striking.

1. Seven gross motor fitness tasks.
 - a. Straight arm hang (Hayden, 1964; Brown, 1968).
 - b. Standing broad jump (Francis and Rarick, 1960; Brown, 1968).
 - c. Sit ups (Widdop, 1967; Brown, 1968).
 - d. Balance beam (Francis and Rarick, 1960; Auxter, 1965).
 - e. Squat thrust (Francis and Rarick, 1960; Howe, 1959).
 - f. 25-yard dash (Fait, 1966; Brown, 1968; Campbell, 1969).
 - g. 300-yard run (Widdop, 1967; Hayden, 1964; Brown, 1968).
2. Seven game skill tasks.
 - a. Shooting a ball (two hands) into a barrel.
 - b. Throwing (one hand) at a target (Howe, 1959; Cratty, 1969).
 - c. Catching a ball, after one bounce (Cratty, 1969).

- d. Catching a ball, no bounce.
- e. Batting a suspended (swinging) ball.
- f. Dribbling (one hand) a ball.
- g. Kicking a ball at a target.

Some may argue that the tests listed are but crude measures of basic movement components. Nevertheless, they do include many basic abilities and skills required for successful participation in physical activities common to our culture.

Reliability of the Tests

The reliability of most of the gross motor fitness tasks have been examined in studies which included normal (Espenschade, 1940) or educable mentally retarded (Francis and Rarick, 1960) samples. There is no published study which has examined the validity and reliability of these tests for the trainable retarded.

In this study, the seven gross motor fitness items have been claimed valid for measuring certain basic motor qualities on logical grounds. These specific tests have been used by several investigators (see references cited on page 109) with EMR or trainable mentally retarded samples. Based on the test descriptions, face validity was claimed for each of the seven game skills tasks.

The fourteen test items were given to a group of twenty-five trainable mentally retarded subjects, in order to determine reliability coefficients for each motor task.

The group consisted of both male (N = 18) and female (N = 7) retardates, ages ten through twenty-one.

The method used was the test-retest technique, and the test interval was one week (seven days). Each reliability coefficient was obtained by applying the following correlation formula, as described in Edwards:¹⁵¹

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{N}}{\sqrt{[\sum X^2 - \frac{(\sum X)^2}{N}] [\sum Y^2 - \frac{(\sum Y)^2}{N}]}}$$

r = coefficient

X = raw score, first testing

Y = raw score, second testing

N = number taking test

The test-retest reliability coefficients obtained for each of the motor tasks are reported below:

<u>Task</u>	<u>Coefficient</u>
1. Straight Arm Hang	.88
2. Standing Broad Jump	.96
3. Sit Ups	.93
4. Balance Beam	.86
5. Squat Thrust	.58
6. 25-Yard Dash	.94
7. 300-Yard Run	.83

¹⁵¹Allen L. Edwards, Statistical Analysis (New York: Rinehart, 1958), p. 73.

<u>Task</u>	<u>Coefficient</u>
8. Shoot Ball in Barrel	.33
9. Throwing (Accuracy)	.73
10. Catch Ball on Bounce	.37
11. Catch Ball--No Bounce	.75
12. Batting a Suspended Ball	.41
13. Ball Dribble--One Hand	.88
14. Kicking (Accuracy)	.64

The standard of acceptable reliability for group (normal subjects) application is generally considered to be 0.75 or above. As the listed coefficients indicate, there were some test items where the reliability obtained was not at this level for the group tested.

Lower reliabilities in certain tasks might be due to the limited range of possible scores (on two items), and/or the lack of familiarity (practice) with these tests by the trainable subjects. Since these tasks do serve to give a more complete picture of basic motor skill components, they have been retained in the motor performance test battery for exploratory purposes.

Similar investigations with other samples are necessary for a conclusive determination as to the validity and reliability of these tasks with trainable subjects.

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Testing Arrangements

The tests were administered during the first two weeks of June, 1968. All testing was done by this writer, with some assistance by two graduate students (physical education). The same test equipment was used at both schools (transported for each test session).

The children were tested in class groups, so their teachers could be present during testing. An attempt was made to have each class involved in both morning and afternoon sessions during the two week period, so that the possible effect of "time of day" would be neutralized. Each test was demonstrated for the whole class prior to testing, and children then watched as classmates were tested. All tests were done indoors (cleared classroom areas) except the straight arm hang, the 25-yard dash and the 300-yard run. The tests were given in the following order for each class:

First day: 1. broad jump; 2. balance beam;
3. sit ups.

Second day: 1. catch on bounce; 2. catch-no
bounce; 3. arm hang.

Third day: 1. shoot ball; 2. ball dribble;
3. squat thrust.

Fourth day: 1. throwing; 2. batting; 3. 25-
yard dash.

Fifth day: 1. kicking; 2. 300-yard run.

Treatment of Data

Data collected for each subject in the sample was recorded on individual computer (CDC 3600) cards. The "UNEQ1" routine (one-way analysis of variance with unequal number of replications permitted) was chosen as the statistical technique which would allow maximum use of collected data.

For each of the eight factors, the analysis provided the mean score and standard deviation of each category on all fourteen motor tasks. The F statistic (level of significance at .05) was also reported for each test item. For those factors (with three or more categories) where significance level was within .05, a post hoc comparison (Scheffé method) was made in order to determine which pairs of means (categories) were significantly different for that specific motor task.

Data results are also presented in graphic form to provide a visual demonstration of variance among the categories of each factor under investigation. These graphs are constructed through implementation of standardized scores (category mean increment divided by the overall standard deviation), since the tests were scored on a variable (points, repetitions, seconds, etc.) basis. This technique allows one to visualize how categories vary (from the overall mean score) and how they compare on each test, and across all fourteen tests at once.

CHAPTER IV

RESULTS

The two basic purposes of this study were:

1. To establish the utility of a test battery for evaluating the motor performance of a sample of trainable retardates, ages eight through twenty-one.
2. To select specific environmental and organic factors which appear to produce differential effects on performance of the motor tasks in the test battery.

Results of the data analysis (each of the fourteen tests with each factor) are presented for each of the eight factors, in both tabular and graphic forms. The tables include data on: categories (factor groups), numbers of subjects, mean score, and standard deviation for each category. The F statistic is also reported for each test, and those within the .05 level of significance are marked with an asterisk. (The significance found for one or two of these factors could be due to chance.)

To facilitate comparisons, results are also presented in graphic form, showing the category variance from the overall mean, for each of the fourteen motor tasks.

Main Effects: Age

In all tests except the arm hang, the youngest group scored relatively poorly. An inspection of the graph (page 119) of this factor indicates that for most gross motor fitness items, there is relatively little variance among mean scores of the four older age groups (except for the sixteen-eighteen years old group on the two running tasks). This visual interpretation is substantiated by the fact that the .05 significance level was reached only for the 25-yard dash. The situation is quite different for the seven skill items, however, where the group variance is significant on six of the seven tasks.

The skill items seem to be more effected by age, in that the younger groups are lower and the oldest group higher for these tasks (see graph). Further evidence for this conclusion may be seen in the post hoc comparisons on those tests where a significant F ratio was found (Table 3). As this analysis shows, the comparison contributing to overall significance on most tasks is between (mean scores of) youngest and oldest age groups.

In terms of the effects of age on performance in specific tasks, the table shows that the straight arm hang

TABLE 3.--Comparison (Scheffé) of Significant F Means:
Age.

Task	Age Category	2	3	4	5 (19-21)
25-Yard	(8 & 9) 1	NS	NS	*	NS
Dash	(10-12) 2		NS	NS	NS
	(13-15) 3			NS	NS
	(16-18) 4				NS
Shoot	1	NS	NS	NS	*
Ball	2		NS	NS	NS
	3			NS	NS
	4				NS
Throwing	1	NS	*	NS	*
	2		NS	NS	NS
	3			NS	NS
	4				NS
Catch on	1	NS	*	NS	*
Bounce	2		NS	NS	NS
	3			NS	NS
	4				NS
Catch	1	NS	*	*	*
	2		NS	NS	NS
	3			NS	NS
	4				NS
Dribbling	1	NS	NS	NS	*
	2		NS	NS	*
	3			NS	NS
	4				NS
Kicking	1	*	NS	NS	*
	2		NS	NS	NS
	3			NS	NS
	4				NS

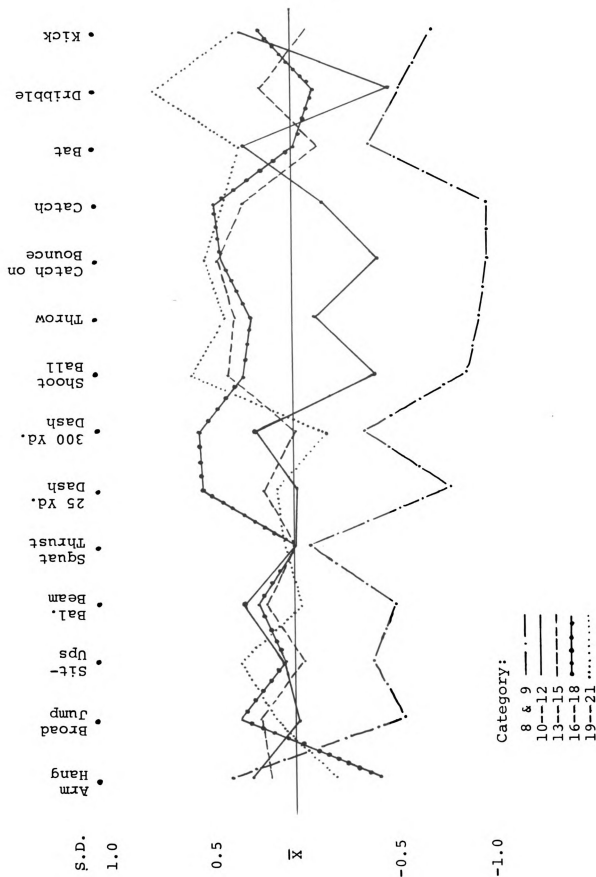


Figure 1--Age Results

TABLE 4.--Number of Subjects by Age and Sex.

Age Level	Subjects		
	Total	Male	Female
8 & 9	16	10	6
10--12	16	10	6
13--15	20	9	11
16--18	15	10	5
19--21	21	9	12
Overall	88	48	40

provides scores which are nearly inverse to age levels. The probable explanation for this would be that body weight rather than age, is most related to performance on this item. In the standing broad jump, the second oldest group (16-18 years old) had the best mean score, as they did in the 25-yard dash and the 300-yard run. There was relatively little variance in mean scores by age in the remaining fitness items for all groups but the youngest. Except for the sit ups and squat thrust tests, there was a tendency for the oldest group to score lower than the next two younger (16-18 and 13-15) groups on the fitness items.

There seemed to be a different pattern with the game skills, however, where the oldest group had the best average score on six of the seven items. This would offer some support to the concept that skill improves longer, or peaks at a later age than fitness performance, with TMRs, as well as for normals. The catch on one bounce proved to be an easier task for all age groups than the direct (air) catch item (see mean scores of tabled data). The relative lack of progressive improvement by age (through 10--18 years) level for this sample is contrary to what has been reported for normal (Hunsicker and Reiff) and educable (Rarick, Widdop and Broadhead) groups. The lack of experience with these test items could be one influence affecting this result. Other possible influences would be

the small number of subjects in the five age groups, and the male-female ratio in each.

Main Effects: Sex

Since the sexes are fairly representative at each level (Table 4), and due to the small number of subjects at some levels, it was considered appropriate to make the data analysis without regard to age (two general categories of male and female).

Once again, results show a definite relationship to the type of task involved. In all fitness items, males performed better than females--significantly so in six of the seven (all but balance) tasks. For the skill tests, however, only on the throwing task did the males perform significantly better. On several of the skill items, there was relatively little difference in mean scores, although the males had the higher average. The only test (of all fourteen) where the female mean score surpassed that of the males was in the dribbling task.

In the age range represented, for the fitness items the results of the comparisons based on the sex factor are in general agreement with findings for other (normal, EMR) samples, except that the TMR girls score relatively closer to the male test means. There is not sufficient data (published) available for comparisons (male-female) with other populations on the skill tests.

TABLE 5.--Sex Results.

Age Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Dash		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Male	46	29.80	19.35	45	29.67	12.65	46	15.20	6.60	47	7.07	4.32	46	7.02	2.12	46	6.62	1.38	44	127.32	41.15
Female	39	18.44	16.41	38	23.16	11.79	39	10.77	8.19	39	5.58	4.39	38	5.61	2.65	38	7.41	1.48	36	149.22	42.66
Overall	85	24.59	18.84	83	26.69	12.61	85	13.16	7.65	86	6.40	4.39	84	6.38	2.46	84	6.98	1.47	80	137.18	42.99
F Statistic	8.36			5.81			7.61			2.53			7.41			6.29			5.43		
Significance	.005*			.018*			.007*			.116			.008*			.014*			.022*		

Age Category	Shoot Ball			Throwing			Catch Bounce			Catch No Bounce			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Male	46	1.96	1.48	45	16.93	5.15	45	4.42	1.36	46	3.89	1.73	47	6.21	2.54	47	36.53	33.73	44	19.86	3.08
Female	40	1.73	1.24	39	13.49	6.44	39	4.21	1.59	38	3.82	1.72	39	5.23	3.46	39	41.54	34.81	39	19.10	3.54
Overall	86	1.85	1.37	84	15.33	6.00	84	4.32	1.47	84	3.86	1.72	86	5.77	3.01	86	38.80	34.11	83	19.51	3.31
F Statistic	0.61			7.42			0.46			0.04			2.30			0.46			1.10		
Significance	.437			.008*			.502			.842			.133			.501			.298		

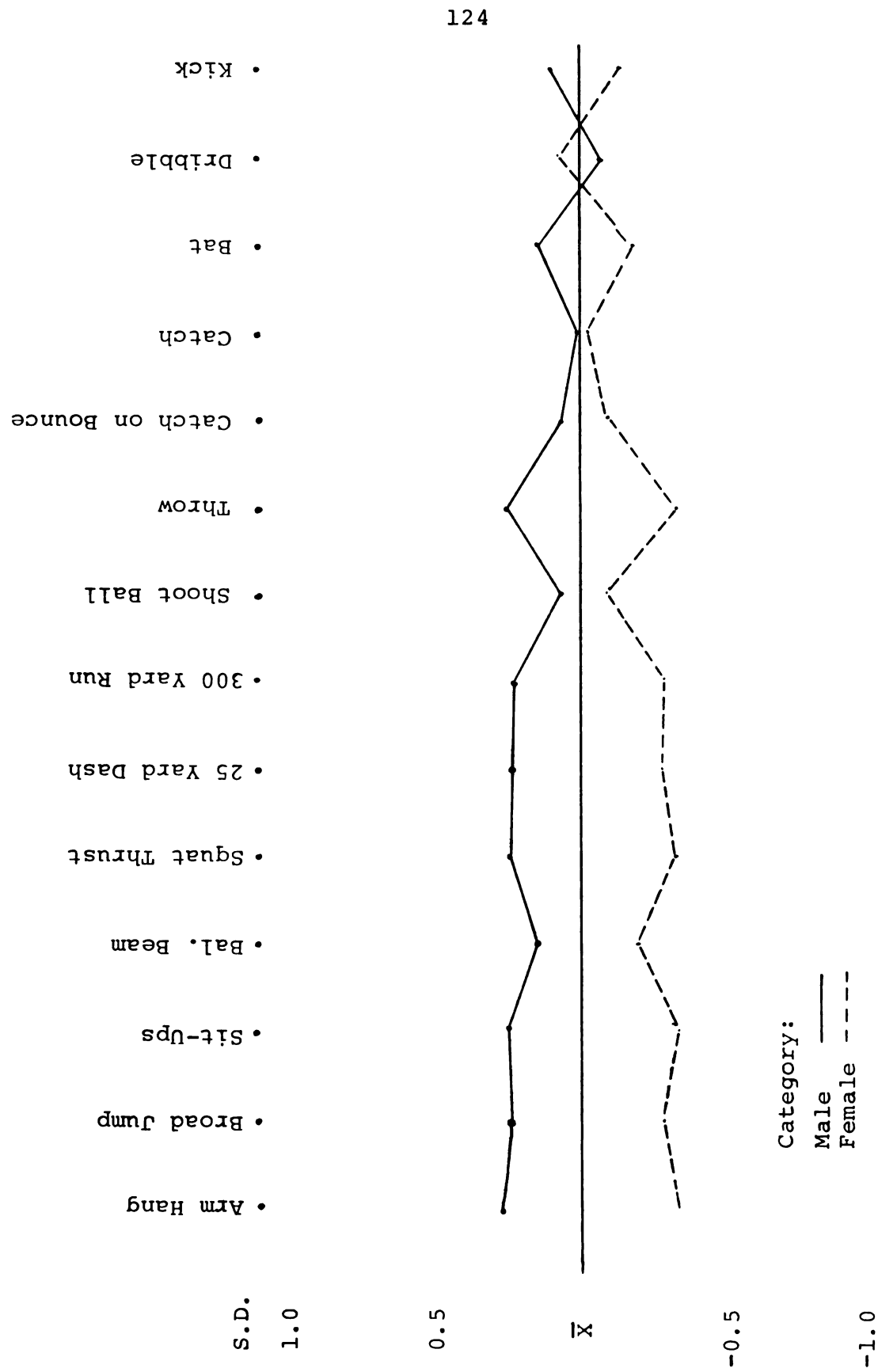


Figure 2.--Sex Results

TABLE 6.--Comparison of Mean Scores on Three Fitness Tasks for Normal, Educable, and Trainable Samples.

Task	Sex	Sample	Age Range	Scores			
				Low Mean	High Mean	Overall Mean	Individual Range
Standing Broad Jump (inches)	Male	Normal	10-17	60	80	. .	. .
		EMR TMR	8-18 8-21	40 ..	76 ..	. . 29.67	. . 6--56
	Female	Normal	10-17	55	64	. .	. .
		EMR TMR	8-18 8-21	35 ..	58 ..	. . 23.16	. . 2--48
300-Yard Run (sec.)	Male	EMR TMR	8-18 8-21	95 ..	58 ..	. . 127.32	. . 195--65
		EMR TMR	8-18 8-21	100 ..	79 ..	. . 149.22	. . 240--85
	Male	EMR TMR	8-18 8-21	16 ..	29 ..	. . 15.20	. . 0--29
		EMR TMR	8-18 8-21	13 ..	20 ..	. . 10.77	. . 0--39

Data for Normal and EMR modified from: G. L. Rarick, J. Widdop and G. Broadhead, "The Physical Fitness and Motor Performance of Educable Mentally Retarded Children," Exceptional Children, 36 (1970), 509-19.

Results show that performance on comparable items indicates a considerably poorer level of ability in trainable, as compared to EMR subjects. Relative ability levels on the skill items cannot be determined at this time, since such data is not available. While direct (age) comparisons are not possible, Table 6 does give a general idea of performance level on comparable (scoring, etc.) motor tasks by normal, educable and trainable samples.

Main Effects: IQ

The results based on the three IQ groups are presented on pages 127 and 128. The medium IQ (range 41-50) group performed better than the high (range 51-72) and low (range 30-40) categories on all fourteen test items. The difference reached the level of significance on two tests (standing broad jump, and balance beam). The Scheffé procedure showed that the significant mean differences on both those tests were between medium and low IQ categories.

It also appears for this factor that the type of performance (fitness or skill) is related to the extent of group differences (dispersion). The graph indicates that there was much less variance (mean scores) among the three groups on the skill tasks than on the fitness items. Another difference involving the type of task, is the relative position (mean) of the three groups. In the

TABLE 7.--IQ Results.

IQ Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Dash		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
High (51-72)	23	23.04	16.85	22	28.86	12.65	22	13.14	6.96	21	6.29	4.51	23	6.30	2.03	23	6.74	1.45	22	138.14	41.64
Med. (41-50)	38	29.45	21.37	38	29.47	12.70	37	14.73	8.09	39	7.72	4.20	37	6.97	2.51	35	6.70	1.43	35	126.00	41.18
Low (30-40)	23	18.30	14.74	22	20.05	10.44	25	10.88	7.45	25	4.62	4.02	23	5.52	2.66	25	7.53	1.45	22	151.36	43.52
Overall	84	24.64	18.94	82	26.78	12.66	84	13.17	7.70	85	6.45	4.38	83	6.39	2.48	83	6.96	1.47	79	136.44	42.76
F Statistic		2.70			4.65			1.91			4.11			2.54			2.77			2.44	
Significance		.073			.012*			.155			.020*			.085			.069			.089	

IQ Category	Shoot Ball			Throwing			Catch Bounce			Catch No Bounce			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
High	22	1.41	1.14	22	13.77	6.88	23	4.04	1.66	23	3.70	1.74	23	5.65	3.08	23	38.96	35.95	22	19.55	2.52
Med.	38	2.11	1.43	36	16.06	5.52	36	4.53	1.25	36	4.11	1.65	38	5.95	3.16	38	44.71	34.24	35	19.83	3.66
Low	25	1.76	1.36	25	15.28	5.64	24	4.25	1.59	24	3.58	1.82	24	5.58	2.87	24	30.79	31.59	25	18.84	3.37
Overall	85	1.82	1.36	83	15.22	5.94	83	4.31	1.47	83	3.84	1.72	85	5.76	3.03	85	39.22	34.09	82	19.45	3.29
F Statistic		1.92			1.01			0.79			0.79			.125			1.23			.665	
Significance		.154			.369			.459			.457			.882			.297			.517	

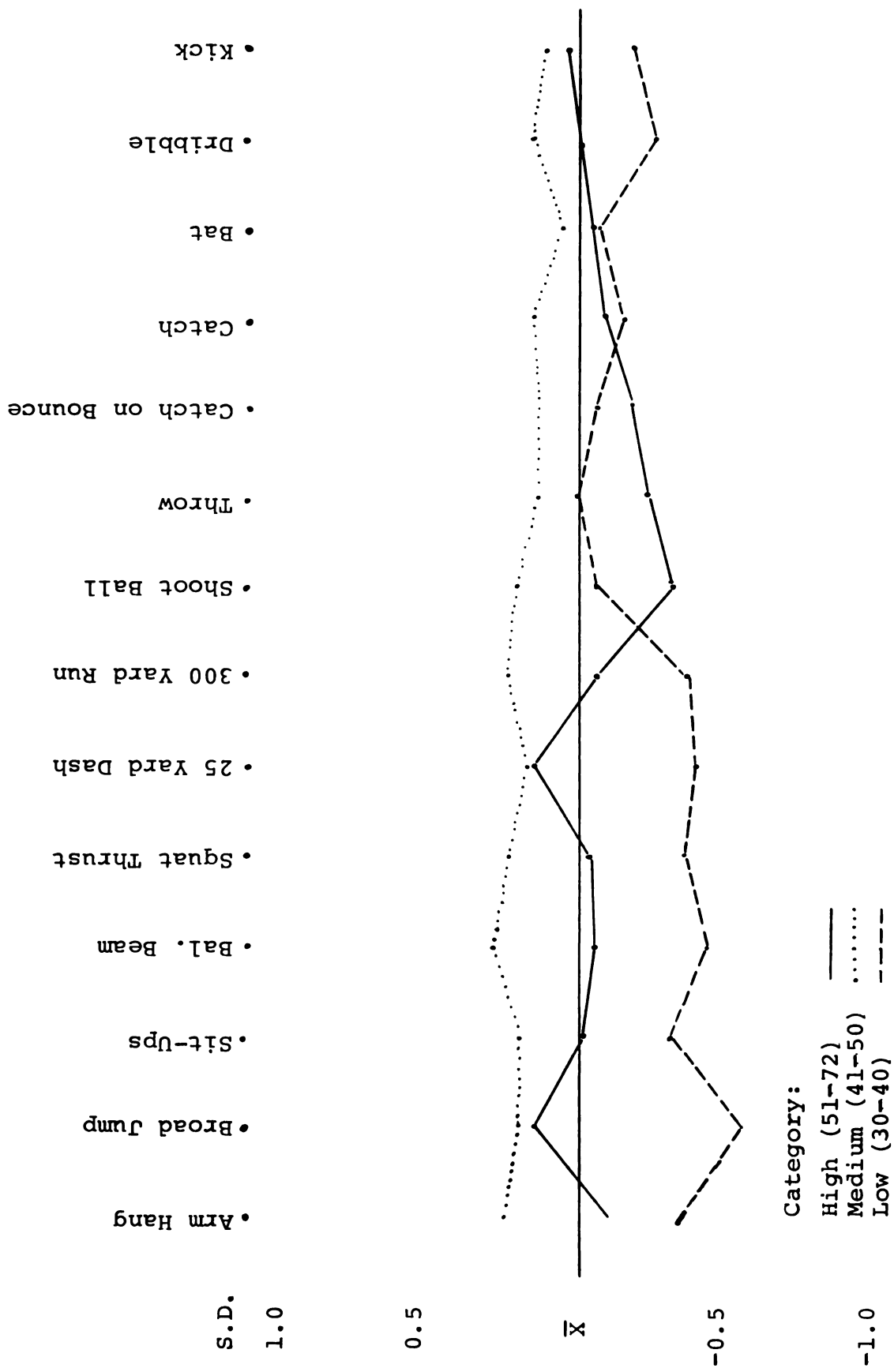


Figure 3.---IQ Results

TABLE 8.--Factor Relationships--Number of Subjects in IQ Categories Relative to Age Level and Etiology.

Age Level	Subjects in IQ Category					
	High		Medium		Low	
8 & 9	6		8		2	
10--12	5		8		3	
13--15	5		9		5	
16--18	2		8		5	
19--21	5		6		10	
Total	23		39		25	

Etiology	High		Medium		Low	
	N	%	N	%	N	%
Brain Inj.	7	30.45	5	12.80	9	36.0
Familial	4	17.40	16	40.96	2	8.0
Mongoloid	1	4.35	6	15.36	8	32.0
Unknown	9	39.15	8	20.48	6	24.0
Microceph.	2	8.70	4	10.24	0	0.0

seven fitness tests, for example, the high IQ group means are always below those of the medium and well above these of the low IQ group. For the skill items, however, the high group drops below the low group on three of the seven items.

In attempting to explain the pattern demonstrated in the graphed results, some consideration of possible interaction of other factors is in order. It would seem that age would not be an important factor, since the three IQ categories are relatively evenly represented in all five age levels (Table 8).

There does appear to be some interrelationship with the etiological factor, however. The medium IQ group has a much higher percentage of the familial type, and a relatively smaller proportion of the brain injured than the high IQ group. As results by etiology show, this would tend to enhance the total group (medium IQ) scores. In addition to the intellectual disadvantage, the low IQ group is also comparatively high (percentage) in brain injured and mongoloid subjects, and very deficient in familial representation, which would tend to depress the overall (category mean) scores.

Main Effects: Etiology

Results based on this factor indicate that etiology of retardation may be an important consideration for

many types of motor performance, especially those generally involved in fitness testing.

The microcephalic group was well above the overall mean on most test items but did drop below on the 300-yard run and some of the skill tasks. One of the subjects in this category was a dwarf, and because of the small number of subjects in the group, this individual's low scores (on those particular tests) depressed the group mean.

The most consistent (above the overall mean on all fourteen tests) and capable (highest mean on six items) of the etiological categories was the familial group.

The unknown etiology category generally scored below the familial and microcephalic groups and above the brain injured and mongoloid categories. As the graph shows, the pattern for this category is one of proximity to (above and below) the overall mean--across the entire test battery.

The brain injured and mongoloid categories were notably poorer on this test battery. The mongoloid group was especially deficient in the fitness items, while performing somewhat better on most skill items. The pattern for the brain injured group was somewhat the opposite.

These results would tend to support the idea of programing for certain kinds of etiological groups among trainable samples. As the post hoc (Scheffé) comparison shows (Table 10), on the four gross motor tasks examined,

TABLE 9.--Etiology Results.

Etiology Category	Arm Hang		Broad Jump		Sit Ups		Balance Beam		Squat Thrust		25-Yard Dash		300-Yard Run	
	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄
Unknown	22	19.95	22	28.41	23	13.61	22	6.16	22	6.55	22	6.69	20	122.60
Familial	22	29.23	21	29.48	20	14.20	22	8.09	21	6.62	20	6.39	20	117.95
Brain Inj.	19	22.42	19	23.84	20	10.05	20	5.13	19	5.95	21	7.34	19	147.16
Mongoloid	16	20.75	15	19.60	16	13.50	16	4.66	16	5.75	15	7.85	15	168.80
Microceph.	6	41.67	6	37.33	6	17.50	6	9.92	6	8.00	6	6.53	6	139.17
Overall	85	24.59	83	26.69	85	13.16	86	6.40	84	6.38	84	6.98	80	137.18
F Statistic		2.26		3.15		1.46		3.14		1.14		3.08		4.56
Significance		.070		.019*		.223		.019*		.345		.021*		.002*

Etiology Category	Shoot Ball		Throwing		Catch Bounce		Catch No Bounce		Batting		Dribbling		Kicking	
	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄
Unknown	22	1.73	23	14.96	22	4.64	22	3.64	22	5.50	23	42.96	22	18.91
Familial	21	2.19	19	17.95	19	4.95	20	4.60	22	6.64	21	46.81	19	20.42
Brain Inj.	21	1.81	20	14.20	21	3.57	20	3.65	20	4.40	20	30.35	20	18.50
Mongoloid	16	1.50	16	14.19	16	4.25	16	3.50	16	6.00	16	24.88	16	20.25
Microceph.	6	2.17	6	15.33	6	4.00	6	3.83	6	7.50	6	60.17	6	20.17
Overall	86	1.85	84	15.33	84	4.32	84	3.86	86	5.77	86	38.80	83	19.51
F Statistic		0.71		1.26		2.80		1.29		2.16		2.03		1.29
Significance		.590		.291		.031*		.280		.080		.090		.283

TABLE 10.--Comparison (Scheffé) of Significant F Means:
Etiology.

Task	Etiology Category		2	3	4	5 (Microcephalic)
Broad Jump	Unknown	1	NS	NS	NS	NS
	Familial	2		NS	NS	NS
	Brain Inj.	3			NS	NS
	Mongoloid	4				*
Balance Beam		1	NS	NS	NS	NS
		2		NS	NS	NS
		3			NS	NS
		4				*
25-Yard Dash		1	NS	NS	NS	NS
		2		NS	*	NS
		3			NS	NS
		4				NS
300-Yard Run		1	NS	NS	*	NS
		2		NS	*	NS
		3			NS	NS
		4				NS
Catch on Bounce		1	NS	*	NS	NS
		2		*	NS	NS
		3			NS	NS
		4				NS

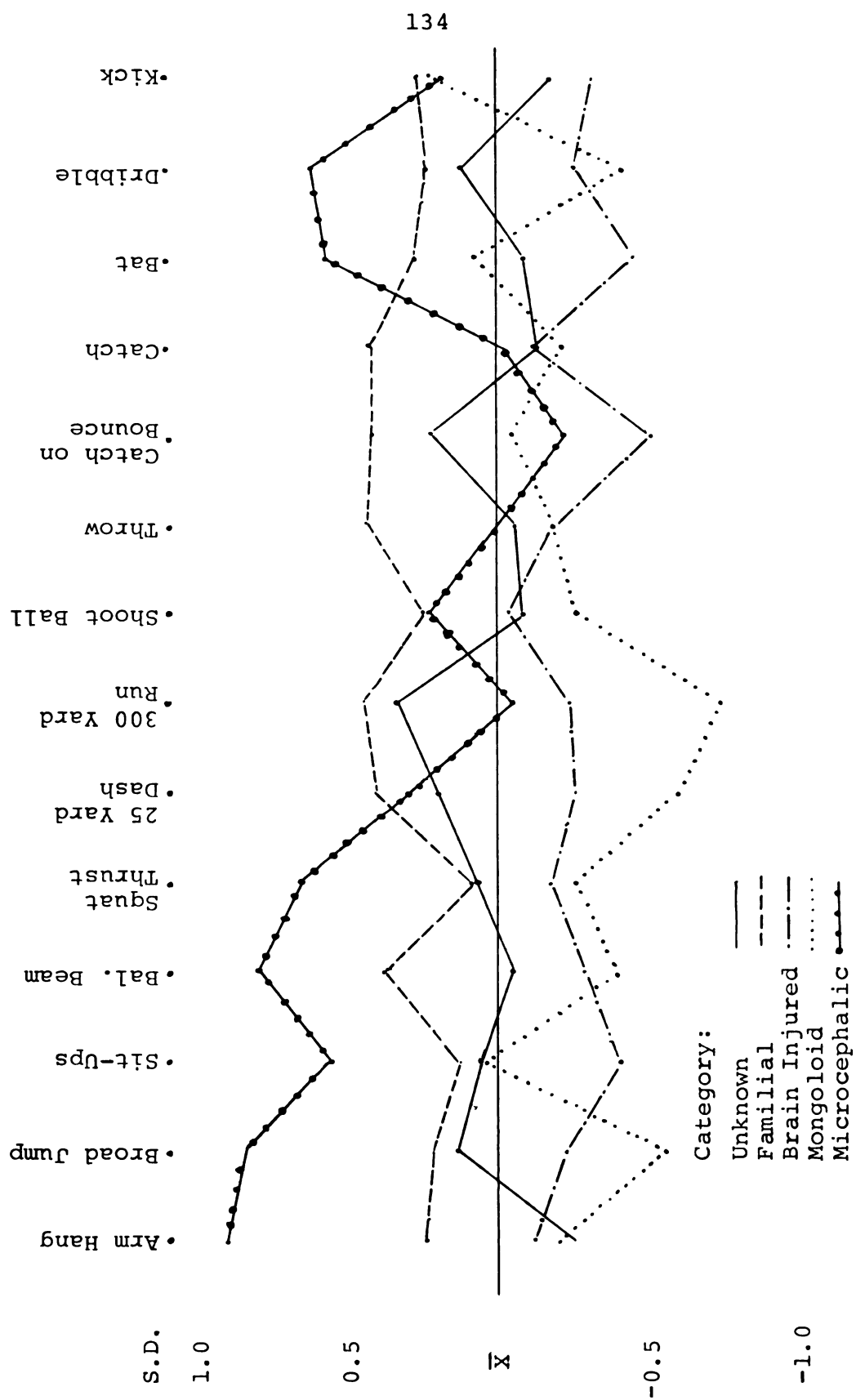


Figure 4.--Etiology Results

TABLE 11.--Etiology of Retardation and Related Sample Information.

Etiology	Unknown	Familial	Brain Injured	Mongoloid	Microcephalic
N	23	22	21	16	6
Per Cent of Sample	26.1	25.0	23.9	18.2	6.8
IQ Range	33-72	34-56	30-64	34-54	44-57
Age Level:					
8 & 9	5	3	3	3	2
10-12	3	7	4	2	0
13-15	4	5	6	3	2
16-18	3	5	4	3	0
19-21	8	2	4	5	2

the mongoloid category is consistently one of the mean pairs contributing to overall significant (F ratio) difference. For the catching task, however, it is the brain injured group (versus unknown, versus familial) which does significantly poorer.

It is evident that (for the sample tested) mongoloids especially need activities involving jumping, balance, running, and endurance, while brain injured subjects tend to be very poor in strength (jumping, sit ups) tasks and ball skills.

Main Effects: Parent Education

As the table and graph for this factor indicate, the rather interesting results were in favor (three at a significant level) of the low parent education group for all fourteen test items.

In respect to type of task, the means were generally more variable in the skill items for this factor. On three of the fitness items (arm hang, balance beam, and squat thrust) the mean scores were quite comparable, though all favored the low parent education group.

The information of Table 12 shows relationships of parent education level to other factors, and gives some insight as to possible interaction of these factors. Relative to subjects' IQ status, the low parent education group appears to have some advantage (higher percentage of high and medium IQ subjects). What may be even more

TABLE 12.--Parent Education Results.

Parent Ed. Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Dash		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
High	41	23.63	17.56	40	24.23	11.16	40	11.70	7.88	42	6.11	4.49	40	6.35	2.24	40	7.41	1.59	38	147.03	40.39
Low	43	24.67	19.63	42	28.74	13.63	44	14.48	7.38	43	6.64	4.37	43	6.37	2.70	43	6.56	1.24	41	128.68	44.25
Overall	84	24.17	18.54	82	26.54	12.62	84	13.15	7.70	85	6.38	4.41	83	6.36	2.47	83	6.97	1.48	79	137.51	43.16
F Statistic		0.06			2.68			2.78			0.31			.002			7.43			3.68	
Significance		.799			.106			.099			.581			.968			.008*			.059	

Parent Ed. Category	Shoot Ball			Throwing			Catch Bounce			Catch No Bounce			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.S.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
High	42	1.69	1.39	41	13.73	6.72	41	3.93	1.85	40	3.53	1.95	41	5.29	3.47	41	32.59	33.10	40	19.15	3.49
Low	43	2.02	1.35	42	17.00	4.80	42	4.69	0.84	43	4.14	1.44	44	6.20	2.52	44	44.68	34.76	42	19.81	3.16
Overall	85	1.86	1.37	83	15.39	6.02	83	4.31	1.47	83	3.84	1.72	85	5.76	3.03	85	38.85	34.31	82	19.49	3.32
F Statistic		1.25			6.53			5.91			2.70			1.94			2.69			0.81	
Significance		.266			.012*			.017*			.104			.167			.105			.372	

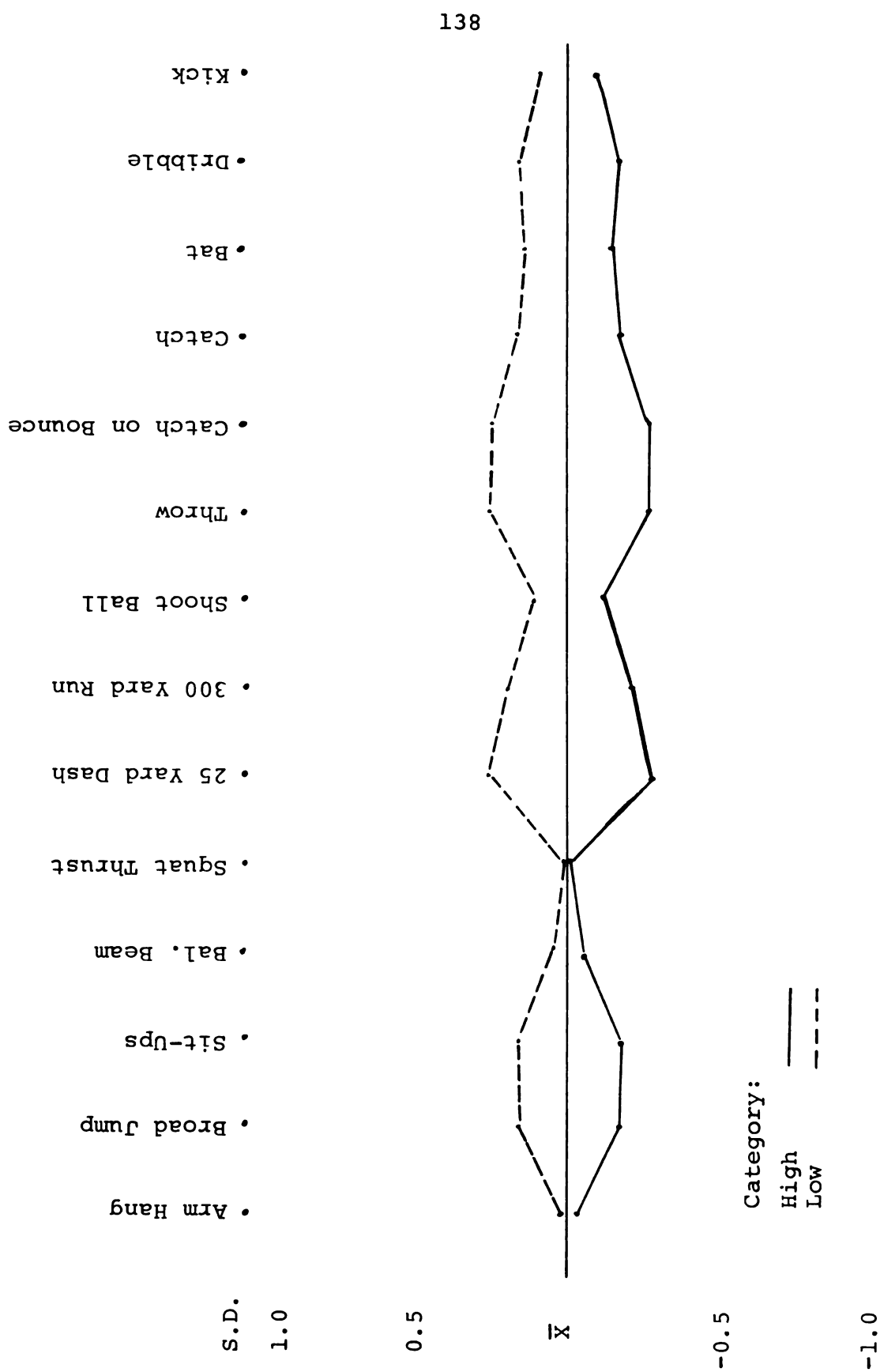


Figure 5.---Parent Education Results

TABLE 13.--Factor Relationships: Parent Education, Etiology, IQ.

Parent Education	High (21-34)		Low (0-20)	
	N	%	N	%
Etiology:				
Familial	4	9.3	18	41.0
Brain Injured	14	32.6	7	16.0
Mongoloid	11	25.5	5	11.3
Unknown	11	25.5	11	25.0
Microcephalic	3	7.0	3	6.7
IQ:				
High	10	22.7	13	31.0
Medium	19	43.3	19	45.2
Low	15	34.0	10	23.8

TABLE 14.--Comparison of Percentage Distribution in Parent Education.

Education	General Population	Parents of EMR	Parents of TMR Sample	
	%	%	N	%
4 Years College	10.0	2.4	14	9.1
1-3 Years College	10.0	1.4	20	13.0
High School	30.0	8.0	40	26.0
Grades 10-11	22.0	40.2	29	18.8
Grades 7-9	14.0	31.0	35	22.7
Less Than 7 Years	14.0	17.0	16	10.4

Percentages for general population and EMR parents from: G. L. Rarick, J. Widdop and G. Broadhead, "Environmental Factors Associated With The Motor Performance and Physical Fitness of Educable Mentally Retarded Children," University of Wisconsin, 1967. (Mimeographed report.)

important, is the etiological representation in the respective categories. The relatively high percentage of familial, and lower proportion of brain injured and mongoloid subjects found in the low parent education group would definitely enhance group scores for that category.

Another very possible explanation for category variance may be related to differences in environmental restrictions between the two groups. In other words, the subjects whose parents are more educated may be given relatively less opportunity to interact with and motorically explore their surroundings ("over-protected")--because they are mentally handicapped. In the low education group, there is a greater incidence of parental and sibling retardation, and such a condition is more "acceptable," which often means fewer environmental restrictions for the involved child. This idea seems to have some support in the specific kinds of tasks (running, catching, throwing) where differences were greatest between the groups.

Table 14 indicates that the distribution by educational level for the parents of this TMR sample is quite comparable to the distribution for the normal population. (An exception is "grades 7-9" level--a reflection of the incidence of familial retardation.) There is, however, a notable contrast when comparing these two distributions to the EMR parent education levels.

Main Effects: Dominance

There were two tasks (broad jump and sit ups) where mean differences reached the .05 level of significance. Post hoc analysis of these items showed the left dominant group to be involved (higher) in all significant comparisons (Left versus Right, Left versus Opposed for the broad jump; Left versus Opposed for the sit ups task). One of the basic reasons for the lack of other significant findings is undoubtedly related to the small numbers of subjects in some categories. The results, while not highly significant, do give one the general impression that the establishment of unilateral dominance may be an important factor in the development of game skills for trainable retardates.

The left dominant group had most of the higher mean scores. (There is an etiological consideration in these results, in that five of the six microcephalic individuals were in this category.) The right dominant group scored very close to the overall mean on all items, as the graph for this factor illustrates. (Proximity to the overall mean in this case is generally a reflection of the large number of subjects in this category, as compared to the other three.)

The mixed dominance category scored quite well on most of the fitness items (except arm hang). The picture

TABLE 15.--Dominance Results.

Dominance Category	Arm Hang		Broad Jump		Sit Ups		Balance Beam		Squat Thrust		25-Yard Dash		300-Yard Run								
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	S.D.						
Right	50	21.06	16.96	49	24.82	12.12	52	12.29	7.05	51	5.57	3.91	50	6.10	2.46	51	7.14	1.42	49	140.45	41.22
Opposed	13	28.85	20.93	12	22.17	12.53	13	10.92	8.96	13	6.38	4.60	12	6.58	2.87	13	7.49	1.76	11	130.91	38.93
Mixed	6	20.00	20.09	6	30.17	5.95	5	18.80	4.09	6	7.83	6.27	6	6.83	1.60	6	6.43	1.35	6	127.33	38.19
Left	12	30.75	21.23	12	36.58	13.56	12	17.83	8.52	12	8.92	4.89	12	6.67	2.67	12	6.16	1.20	12	139.25	59.36
Overall	81	23.67	18.61	79	26.61	12.73	82	13.28	7.77	82	6.35	4.44	80	6.31	2.48	82	7.00	1.48	78	137.91	43.29
F Statistic		1.34		3.79		3.13		3.13		0.33		2.17		0.33		2.32		0.27			
Significance		.268		.014*		.030*		.098		.802		.082		.849							

Dominance Category	Shoot Ball		Throwing		Catch Bounce		Catch No Bounce		Batting		Dribbling		Kicking								
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$	S.D.						
Right	51	1.80	1.36	52	14.85	6.05	52	4.38	1.42	51	3.78	1.79	51	5.86	2.79	51	41.47	34.19	52	19.79	2.99
Opposed	13	1.38	1.26	13	13.69	7.26	12	3.50	2.20	13	3.15	2.11	13	4.15	3.08	13	20.46	25.88	13	18.54	3.89
Mixed	6	1.83	1.17	6	16.83	6.43	6	4.50	0.84	6	4.17	1.33	6	5.50	2.59	6	32.67	32.95	6	18.33	2.34
Left	12	2.67	1.50	12	18.00	3.05	12	4.92	0.29	12	4.75	0.45	12	7.33	3.63	12	50.42	40.08	12	19.92	4.32
Overall	82	1.87	1.38	83	15.27	6.00	82	4.34	1.46	82	3.85	1.73	82	5.78	3.03	82	38.80	34.45	83	19.51	3.31
F Statistic		1.99		1.37		2.07		2.07		2.45		1.94		2.45		1.91		0.80			
Significance		.123		.259		.111		.130		.069		.135		.495							

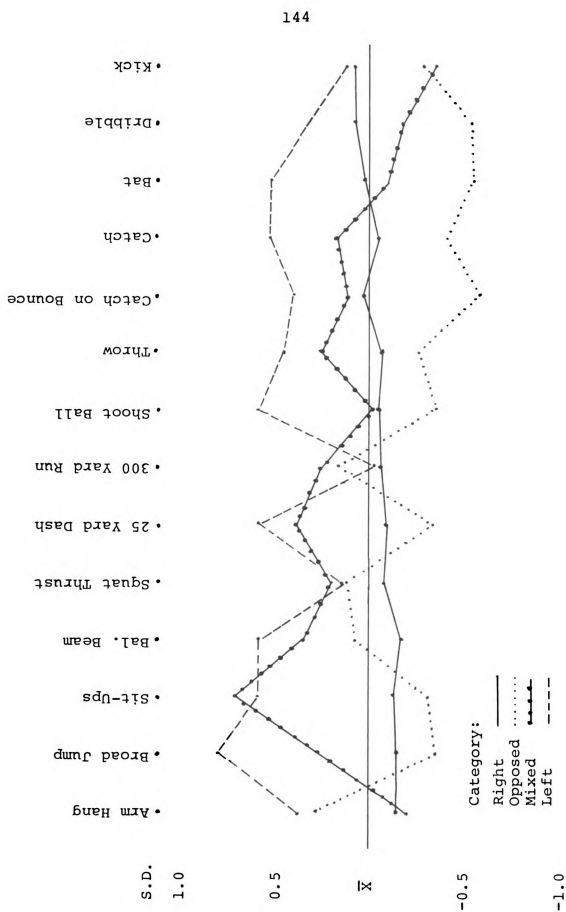


Figure 6.--Dominance Results

TABLE 16.--Dominance Categories--Number of Subjects, by Age Level.

Category:	Right		Mixed		Opposed		Left
	Right- Right	Right- Mixed	Mixed- Right	Left- Mixed	Right- Left	Left- Right	Left- Left
Age:							
8 & 9	10				3	1	
10--12	9			1	2		2
13--15	10	1		1	1	4	3
16--18	9		2			1	3
19--21	13		1	1		1	4
Total N	51		20 (lack of unilateral dominance)				12
% of Sample	61.4		24.1				14.5

changes somewhat for skill tasks, however, and scores are below the overall mean on four of the seven items.

One of the most interesting aspects in the results for this factor is the pattern for the opposed dominance group. Except for a few of the fitness tasks, this group does relatively poorly on the entire battery, and especially so on the skill tests.

As Table 16 shows, the incidence (percentage) of left dominance was approximately double that which has been reported for the normal population. One of the interesting findings in this sample was the fact that five of the six microcephalics were left dominant (the other youngster was in the opposed category). Almost one-fourth of the sample was in one of the two categories (mixed, opposed) which evidenced a lack of unilateral dominance. For the age range represented, this is much higher than would be expected, and further illustrates the need for greater emphasis in training for this development.

Main Effects: Growth

The Meredith Growth Charts (boy and girl) were used to obtain ranges in height and weight, by age (see Tables 19 and 20). To categorize subjects for this factor, the age was found on the proper (sex) table, and the subject's height was compared to the average range for his chronological age. If his height was within that range he was given an "A" for height. If his height was below

that range, he was assigned as "S" (short) and if above, a "T" (tall). After this height rating was recorded, the subject was also given a weight rating. This was done by locating the "A" column (average height range) which contained his measured height (if his height was not in the range for his chronological age, the age column closest to his C.A. is found), then moving at that level across to the weight ratings, to find if his measured weight was in the light (L), average (A), or heavy (H) column. Following this procedure, each subject could be rated and assigned to one of nine possible height (by age)--weight (by height) groups. (There were eight actual categories, since the sample had no subjects in the tall-light category.)

The data is tabulated (Table 21) to show the results of category (height-weight) placement for each of the five age levels of the sample. As the totals (Table 22) for these growth measures indicate, the subjects of this sample were definitely subnormal in the general evaluation of height and weight (except for the occurrence of heavy, or overweight subjects).

Due to the large number (eight) of categories, the data for this factor is presented on two different graphs (the same overall mean is used to show category variance on the tests). The first graph consists of the three heights with average weight ratings. It would appear that for most of the motor tasks, the factor of height (at average weight) is positively related to performance.

The second graph provides a comparison of the short and average height groups with the weight "extremes" (light, and heavy for each height). Since there were no subjects in the tall-light category, the tall-heavy category was not included on this graph. Relative to height by weight, these results would support the statement that outside of average limits, weight is negatively related to performance (i.e., underweight group generally performs better than overweight group, for similar height categories).

As one would expect, the short-heavy group is especially handicapped in the jumping and running tasks. (Although results are not plotted for the tall-heavy subjects, they are consistently poor [- .5 to - 1.0 S.D.] across the seven fitness items.) The results are quite different for the skill tasks, however, and weight "extremes" seem to have less effect on the results of those tests.

In the overall analysis, groups were significantly different on four of the fourteen tasks. (The small number of subjects in some categories undoubtedly prevented further significant results.) The post hoc analysis (Table 18) shows that the height categories (short and average) which contained the heavy individuals generally contributed to the significant (between means) differences.

TABLE 17.--Growth Results.

Growth Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300 Yard Run		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Short-Light	27	34.22	18.46	26	28.85	11.49	27	13.74	8.47	27	6.96	4.67	26	7.12	2.49	26	7.05	1.50	25	126.36	40.40
Short-Aver.	12	15.83	12.41	11	21.91	9.93	12	11.17	5.87	13	6.73	4.46	12	6.17	2.08	12	7.16	1.19	11	156.64	25.00
Short-Heavy	6	17.17	20.40	6	15.17	5.27	6	12.50	7.12	6	2.25	1.75	6	5.00	1.26	6	8.72	1.17	6	208.33	17.51
Aver.-Light	6	20.50	21.29	5	35.40	12.84	6	11.50	8.46	6	8.17	4.93	6	7.33	2.50	6	6.47	1.39	5	114.80	29.12
Aver.-Aver.	17	24.52	16.52	18	28.89	12.56	17	14.88	7.88	17	6.20	4.45	17	6.82	2.24	17	6.36	1.48	17	128.12	41.78
Aver.-Heavy	8	7.75	6.84	8	22.75	10.54	8	14.38	8.02	8	6.00	2.59	7	4.00	2.31	8	7.03	0.06	8	134.50	32.95
Tall-Aver.	5	35.00	25.04	5	33.60	15.82	5	13.20	7.82	5	7.80	4.82	5	6.80	1.64	5	6.46	1.90	5	106.00	42.20
Tall-Heavy	2	11.50	12.02	3	18.67	25.48	3	8.33	9.07	3	4.00	6.08	3	3.67	4.04	3	7.57	2.10	3	161.33	49.90
Overall	83	24.30	18.89	82	26.65	12.69	84	13.19	7.70	85	6.38	4.41	82	6.37	2.47	83	6.98	1.48	80	137.18	42.99
F Statistic	3.37			2.14			0.48			1.20			2.59			2.08			5.04		
Significance	.003*			.050*			.847			.312			.019*			.057			.0005*		

TABLE 17. (cont'd.).

Growth Category	Shoot Ball			Throwing			Catch Bounce			Catch No Bounce			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Short-Light	26	1.69	1.12	26	15.96	6.12	25	4.16	1.65	26	3.96	1.78	27	5.52	2.87	27	46.44	36.59	26	19.92	3.26
Short-Aver.	13	1.00	0.91	13	13.69	6.54	13	3.92	1.89	12	3.58	1.88	12	6.92	3.63	12	27.58	32.13	13	18.62	3.23
Short-Heavy	6	2.50	1.76	6	15.17	10.70	6	4.50	0.83	6	3.17	2.48	6	7.17	3.37	6	38.17	39.71	6	20.83	2.99
Aver.-Light	6	2.67	1.03	6	15.33	2.42	6	5.00	0.00	6	4.67	0.51	6	6.50	2.74	6	44.67	39.55	6	19.50	5.17
Aver.-Aver.	18	2.06	1.55	17	14.94	5.65	17	4.35	1.54	17	4.24	1.35	17	4.88	2.80	18	38.78	32.02	16	19.31	3.16
Aver.-Heavy	8	2.38	1.51	8	15.38	3.29	8	4.88	0.35	8	3.00	2.33	8	6.25	3.15	8	29.00	28.00	8	19.13	2.53
Tall-Aver.	5	1.60	1.82	5	16.20	7.85	5	4.20	1.79	5	4.40	1.34	5	4.40	3.29	5	46.80	36.26	5	18.60	4.93
Tall-Heavy	3	2.33	1.15	3	18.00	4.00	3	5.00	0.00	3	3.33	0.58	3	3.67	0.58	3	25.67	41.00	3	20.67	0.58
Overall	85	1.87	1.36	84	15.33	6.00	83	4.35	1.45	83	3.87	1.72	84	5.71	3.03	85	39.09	34.21	83	19.51	3.31
F Statistic	1.67			0.27			0.62			0.88			1.10			0.58			0.44		
Significance	.129			.963			.734			.523			.372			.773			.874		

TABLE 18.--Comparison (Scheffé) of Significant F Means: Growth:

Task	Growth Category	2	3	4	5	6	7	8 (Tall-Heavy)
Arm Hang	1 Short-Light	*	NS	NS	NS	*	NS	NS
	2 Short-Aver.		NS	NS	NS	NS	NS	NS
	3 Short-Heavy			NS	NS	NS	NS	NS
	4 Aver.-Light				NS	NS	NS	NS
	5 Aver.-Aver.					NS	NS	NS
	6 Aver.-Heavy						*	NS
	7 Tall-Aver.							NS
Broad Jump	1	NS	*	NS	NS	NS	NS	NS
	2		NS	NS	NS	NS	NS	NS
	3			*	*	NS	*	NS
	4				NS	NS	NS	NS
	5					NS	NS	NS
	6						NS	NS
	7						NS	NS
Squat Thrust	1	NS	NS	NS	NS	*	NS	NS
	2		NS	NS	NS	NS	NS	NS
	3			NS	NS	NS	NS	NS
	4				NS	NS	NS	NS
	5					*	NS	NS
	6						NS	NS
	7						NS	NS
300-Yard Run	1	NS	*	NS	NS	NS	NS	NS
	2		NS	NS	NS	NS	NS	NS
	3			*	*	*	*	NS
	4				NS	NS	NS	NS
	5					NS	NS	NS
	6						NS	NS
	7						NS	NS

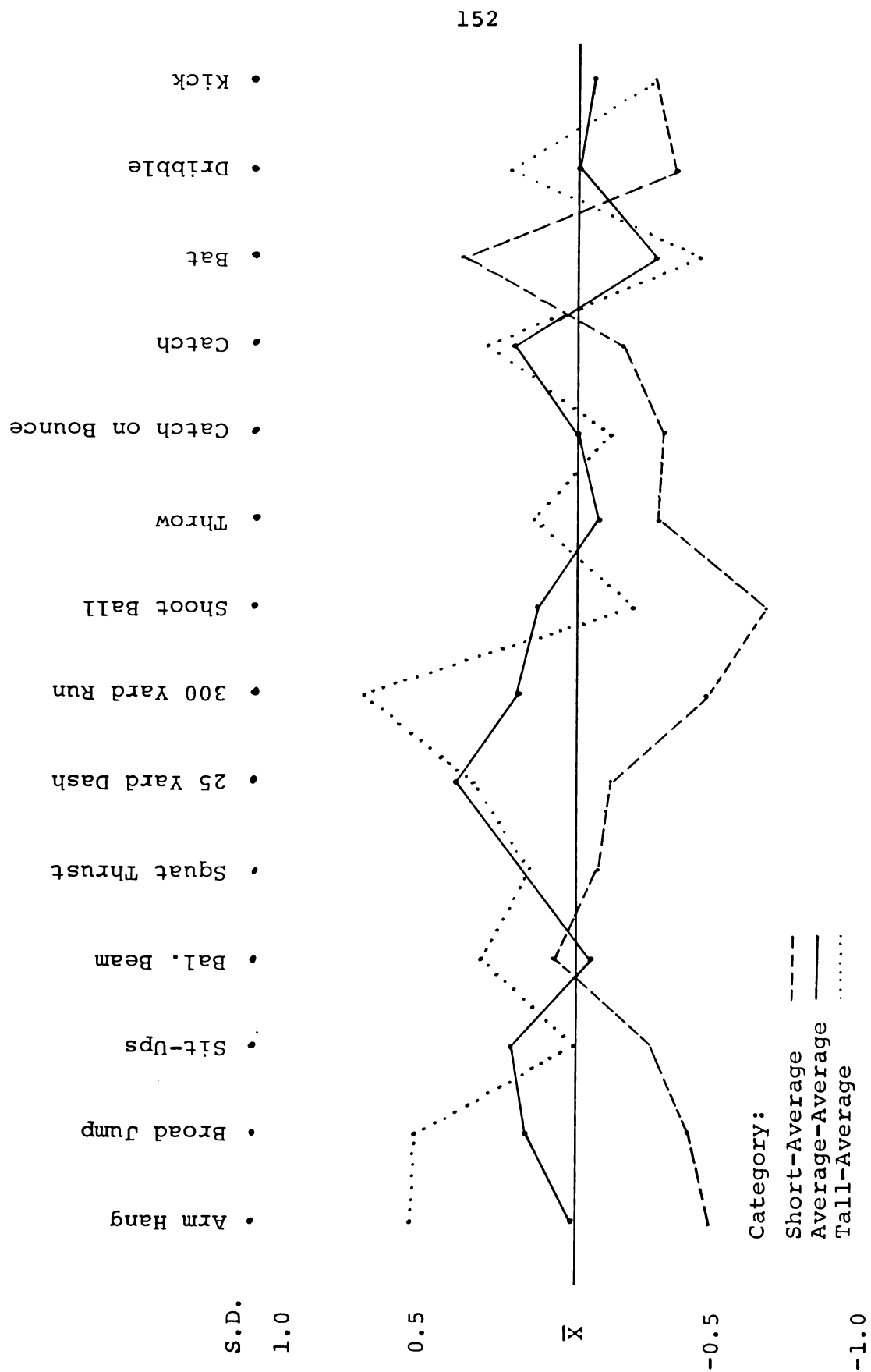


Figure 7.--Growth Results--Average Weight Categories

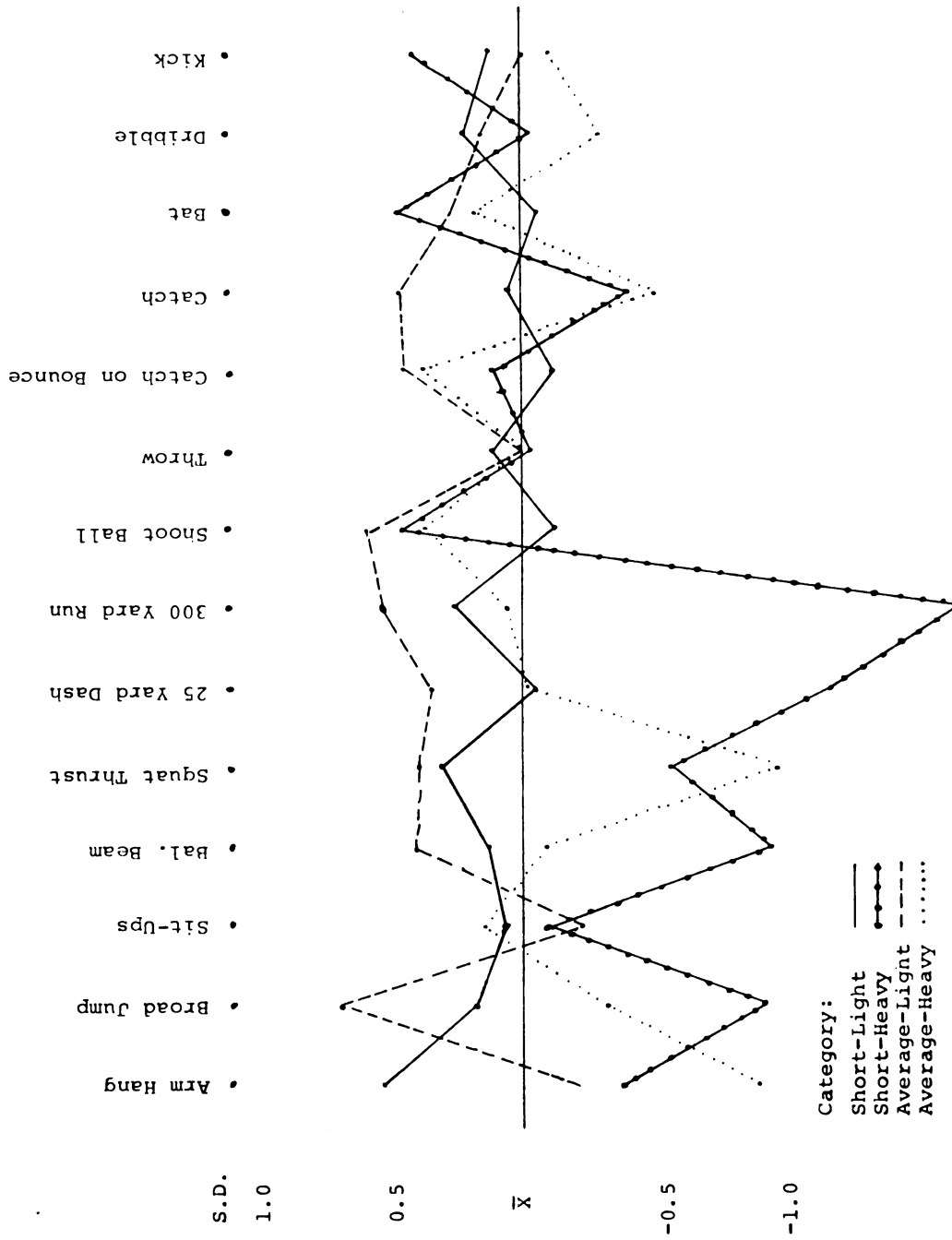


Figure 8.--Growth Results--Weight Extremes

TABLE 19.--Growth Category Assignment--Height and Weight Data for Boys.

Age	Height	Weight		
	A (Aver. Range)	L Light	A Average	H Heavy
18+	66--72	129, less	130-175	176, more
17	65.5--71	124, less	125-170	171, more
16	64.5--70	119, less	120-160	161, more
15	65--69	109, less	110-150	151, more
14	60--67	99, less	100-135	136, more
13	58--63	86, less	87-120	121, more
12	56--61	76, less	77-107	108, more
11	54--59	69, less	70-95	96, more
10	52.5--57	64, less	65-85	86, more
9	51--55	56, less	57-80	81, more
8	48--53	51, less	52-70	71, more

Height and weight data adapted from: H. V. Meredith and V. B. Knott, "Height Weight Interpretation Folder For Boys" (Washington, D.C.: National Education Association, 1967).

TABLE 20.--Growth Category Assignment--Height and Weight
Data for Girls.

Age	Height	Weight		
	A (Aver. Range)	L Light	A Average	H Heavy
18+	63.5--67.5	119, less	120-150	151, more
17	63.5--67.5	116, less	117-147	148, more
16	63.5--67.5	114, less	115-145	146, more
15	63--67	109, less	110-140	141, more
14	62--66	99, less	100-135	136, more
13	60--64.5	89, less	90-125	126, more
12	57--62	79, less	80-110	111, more
11	55--59.5	69, less	70-95	96, more
10	53--57.5	64, less	65-85	86, more
9	51--55	56, less	57-77	78, more
8	49--53	51, less	52-70	71, more

Height and weight data adapted from: H. V. Meredith and V. B. Knott, "Height Weight Interpretation Folder For Girls" (Washington, D.C.: National Education Association, 1967).

TABLE 21.--Subjects in Growth Categories, By Age Level.

Growth Category	1	2	3	4	5	6	7	8	9
	S-1	S-A	S-H	A-L	A-A	A-H	T-L	T-A	T-H
Age									
8 & 9	4	2	2	0	6	0	0	2	0
10--12	7	3	0	1	1	2	0	0	0
13--15	6	3	0	3	2	3	0	1	2
16--18	2	3	0	2	5	1	0	2	0
19--21	8	2	4	0	4	2	0	0	0

TABLE 22.--TMR Subjects in Height and Weight Categories,
as Compared to Expected (Normal Curve) Results.

Height (By Age)	Short	Average	Tall
Expected N	17	53	17
Actual (TMR)	47	32	7
Weight (By Height)	Light	Average	Heavy
Expected N	17	53	17
Actual (TMR)	34	36	16

It would appear that there are some definite relationships between the factors of growth and motor performance of trainable retardates, and use of this technique on a larger sample might be worthwhile.

Main Effects: Activity Program

The subjects from one of the schools had been involved in a regular physical education (thirty minutes daily) program for the school year (eight months, September through June) preceding the testing of the sample. This was the first year that a physical education teacher had been employed at the school, and results should be considered on that basis. The program included instruction in game skills, but the general emphasis was on locomotor and fitness development. The subjects attending the other (no physical education) school were provided frequent activity periods, under the direction of their regular classroom teachers.

It was concluded that an analysis of the data for this factor would be more reasonable if done by age levels. This was especially necessary for this sample, since the age distribution was quite different for the two schools (at the youngest and oldest levels), as illustrated in Table 23.

The very limited number of subjects in many (age level) categories has undoubtedly restricted more significant findings for this factor. In those instances where

significant differences resulted (two at the 8 and 9 year level, and three at the 13-15 year level), all were in favor of the "physical education" groups.

At 8 and 9 years level, the "physical education" group had better mean scores on all fourteen tasks. At the 10-12 year level, the "physical education" group performed better on eleven of the fourteen items. This category had better mean scores on seven tests at the 13-15 year level, on nine tests at the 16-18 year level, and on eleven items at the 19-21 year level. The "physical education" groups seemed to have a general advantage on the fitness items, where the results (all age levels) showed them to have the better mean score on 28 of the 35 measures.

While cause-effect inference can not be made on the basis of this data, the results do give support to the existence of a positive effect on performance through regular physical education classes. It appears that the results of programing are more quickly effected at relatively earlier ages. One might predict that the advantages realized in one year of programing with these TMR subjects would become more significant with continued exposure to regular physical education.

TABLE 23.--Number of Subjects in Activity Program, by Age Level.

School Program	Physical Education	No Physical Education
Age		
8 & 9	13	3
10--12	10	6
13--15	12	8
16--18	7	9
19--21	3	17

TABLE 24.--Activity Program (Ages 8 & 9).

Activity Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Dash		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	12	32.92	22.18	13	21.15	9.62	13	10.08	8.51	13	4.73	3.06	12	6.42	2.11	11	7.95	1.79	12	148.17	47.67
No Phys. Ed.	3	21.67	15.70	3	12.00	1.73	3	10.00	8.66	3	1.50	1.50	2	4.50	0.71	3	9.03	0.95	3	175.00	18.03
Overall	15	30.67	21.06	16	19.44	9.38	16	10.06	8.24	16	4.13	3.08	14	6.14	2.07	14	8.19	1.68	15	153.53	44.22
F Statistic		0.67			2.56			.0002			3.05			1.53			0.97			0.88	
Significance		.428			.132			.989			.103			.240			.345			.366	

Activity Category	Shoot Ball			Throwing			Catch Bounce			Catch			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	13	0.77	0.60	12	11.42	6.80	11	3.00	2.10	11	2.36	2.11	12	5.25	3.60	13	23.23	29.18	11	17.09	3.56
No Phys. Ed.	3	0.00	0.00	3	1.67	1.53	3	1.33	1.53	3	0.00	0.00	3	1.67	2.89	3	2.67	2.08	3	17.00	2.64
Overall	16	0.63	0.62	15	9.47	7.28	14	2.64	2.06	14	1.86	2.11	15	4.53	3.68	16	19.38	27.40	14	17.07	3.20
F Statistic		4.69			5.78			1.61			3.55			2.52			1.41			.002	
Significance		.048*			.032*			.228			.084			.136			.255			.968	

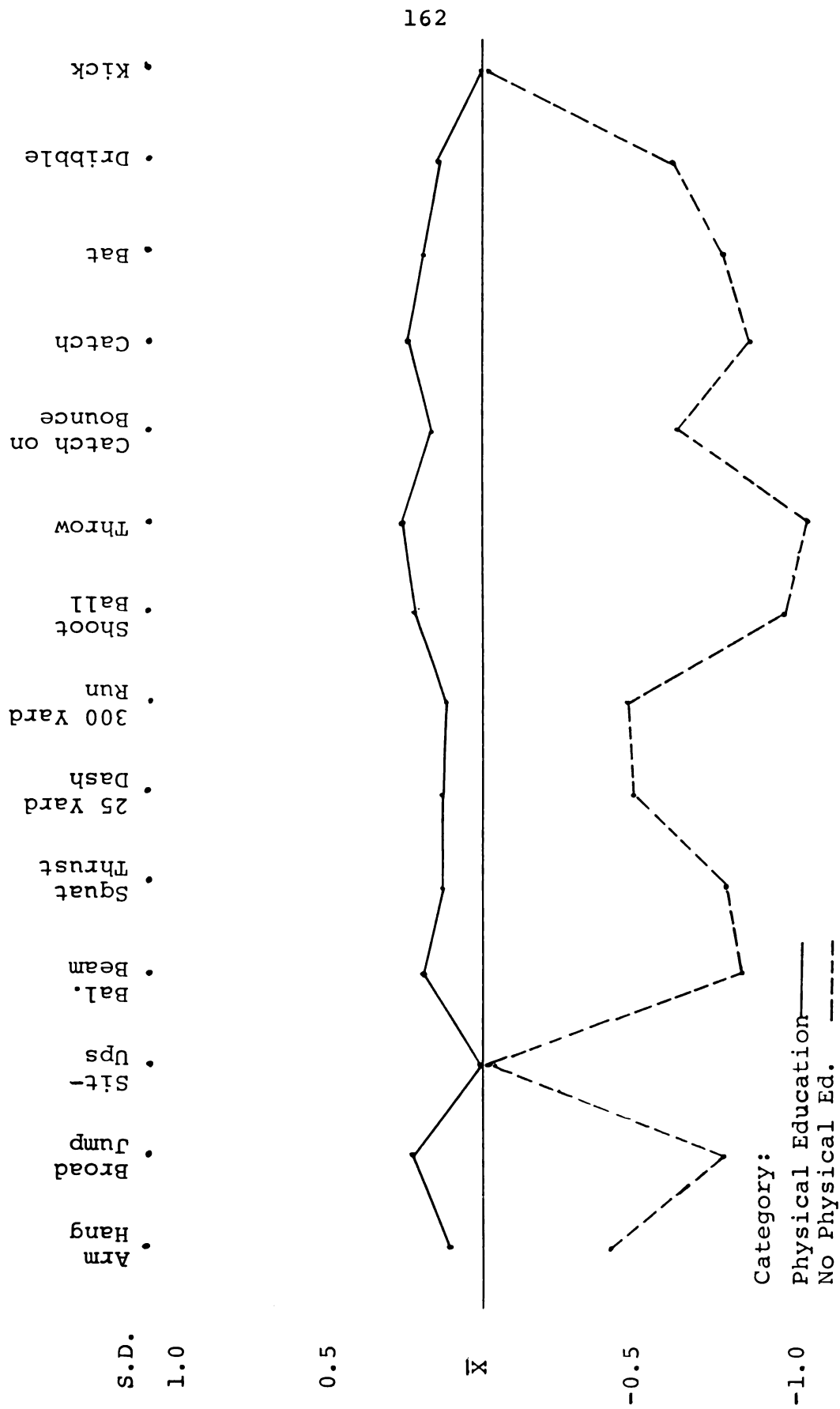


Figure 9. Activity Program Results--Ages 8 & 9

TABLE 25.--Activity Program (Ages 10--12).

Activity Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Run		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	10	34.50	19.63	8	27.50	9.10	9	16.00	6.69	9	7.22	4.21	10	6.80	2.20	9	7.39	1.45	7	118.43	22.97
No Phys. Ed.	5	17.60	14.67	5	24.80	8.20	6	10.17	7.33	6	8.00	3.70	5	5.60	1.95	6	6.55	0.50	5	141.60	36.94
Overall	15	28.87	19.42	13	26.46	8.52	15	13.67	7.32	15	7.53	3.90	15	6.40	2.13	15	7.05	1.21	12	128.08	30.43
F Statistic		2.86			0.29			2.54			0.13			1.06			1.83			1.82	
Significance		.115			.601			.135			.720			.322			.200			.208	

	Shoot Ball			Throwing			Catch Bounce			Catch			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	9	1.33	1.50	8	15.88	7.24	9	3.89	1.76	9	3.44	1.81	10	6.50	2.84	9	23.00	22.16	8	20.75	1.83
No. Phys. Ed.	6	1.17	1.33	6	12.83	8.47	6	3.33	2.25	5	3.80	2.17	5	6.40	1.95	5	19.20	20.32	6	19.83	3.43
Overall	15	1.27	1.39	14	14.57	7.63	15	3.67	1.91	14	3.57	1.87	15	6.47	2.50	14	21.64	20.81	14	20.36	2.56
F Statistic		0.05			0.52			0.29			0.11			.005			0.10			0.42	
Significance		.829			.483			.601			.748			.945			.757			.529	

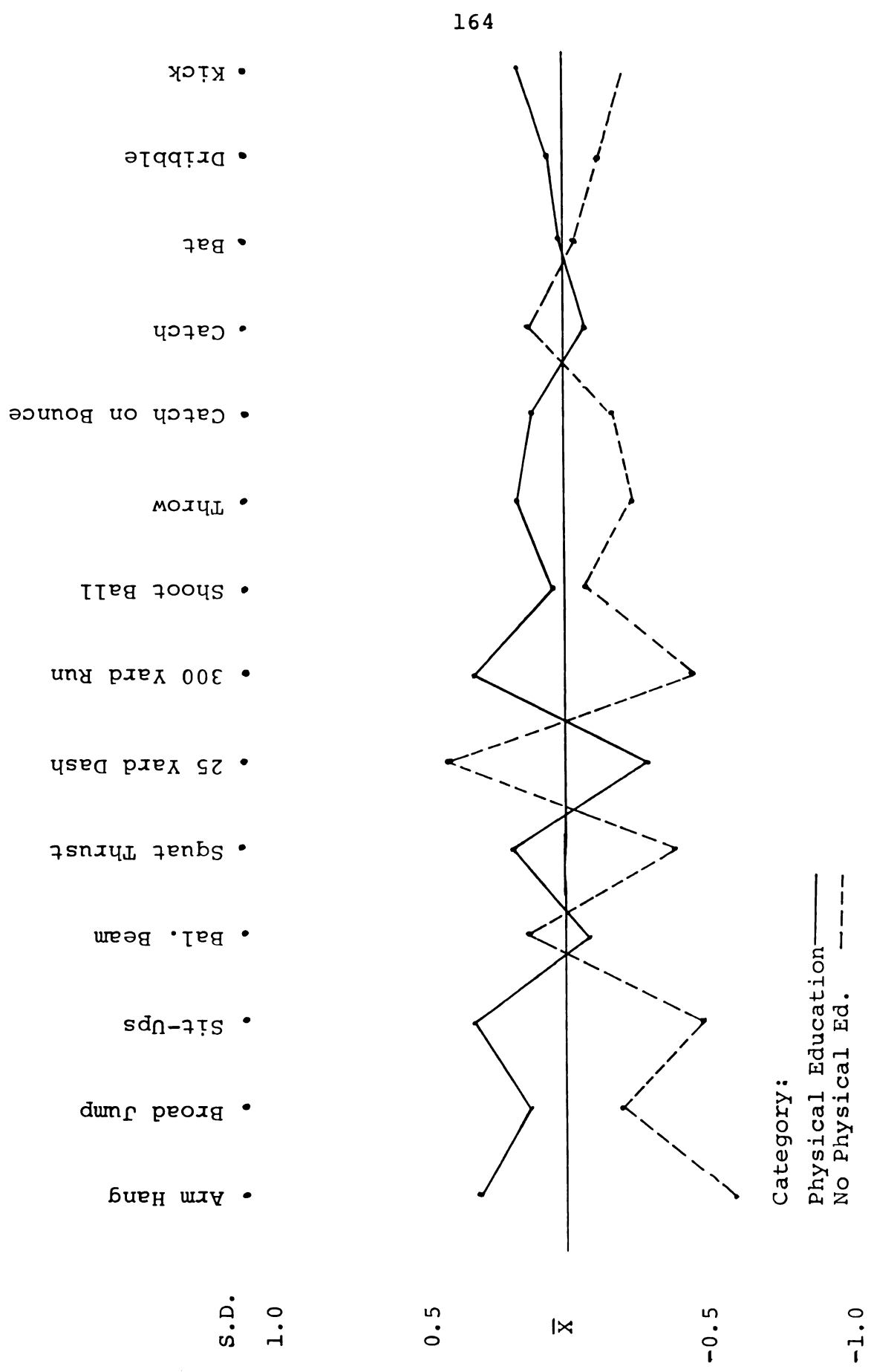


Figure 10.--Activity Program Results--Ages 10-12

TABLE 26.--Activity Program (Ages 13--15).

Activity Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Run		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	11	34.82	20.00	11	32.18	16.36	12	14.58	10.24	12	9.08	4.49	12	7.75	3.02	12	6.84	1.50	11	139.82	40.77
No Phys. Ed.	8	16.38	20.10	8	24.38	16.78	8	10.25	9.84	7	3.36	3.77	8	4.38	3.25	8	6.59	1.15	7	135.86	45.60
Overall	19	27.05	21.61	19	28.89	16.55	20	12.85	10.05	19	6.97	5.01	20	6.40	3.47	20	6.74	1.34	18	138.28	41.42
F Statistic		3.92			1.03			0.89			8.02			5.65			0.16			0.04	
Significance		.064			.324			.359			.012*			.029*			.690			.850	

Activity Category	Shoot Ball			Throwing			Catch Bounce			Catch			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	12	2.25	0.97	12	18.00	3.44	11	4.82	0.40	12	4.25	1.06	12	6.67	3.11	12	43.83	39.66	12	19.08	3.50
No Phys. Ed.	8	2.38	1.30	8	15.88	4.16	8	5.00	0.00	8	4.38	0.92	8	3.38	2.26	8	44.25	42.54	8	19.38	3.50
Overall	20	2.30	1.08	20	17.15	3.79	20	4.89	0.32	20	4.30	0.98	20	5.35	3.20	20	44.00	39.72	20	19.20	3.41
F Statistic		0.06			1.56			1.59			0.07			6.57			.0005			0.03	
Significance		.808			.228			.224			.788			.020*			.982			.857	

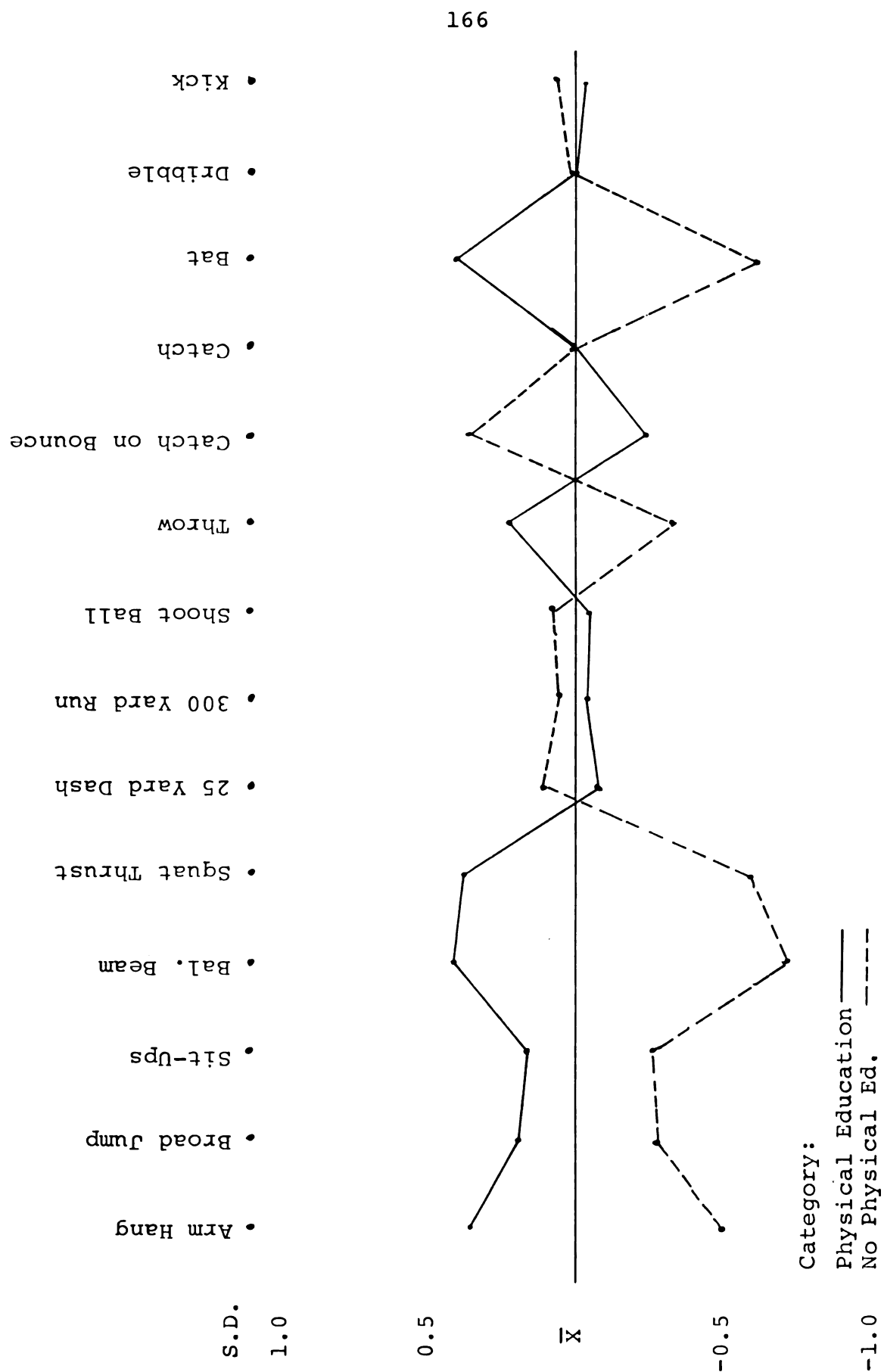


Figure 11.--Activity Program Results--Ages 13-15

TABLE 27.--Activity Program (Ages 16--18).

Activity Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Run		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	6	23.33	14.61	5	28.80	19.28	5	15.00	4.64	6	5.08	3.98	6	7.33	2.07	6	6.43	1.41	6	109.17	37.67
No Phys. Ed.	9	12.11	12.37	9	31.22	11.36	9	12.78	4.60	9	8.67	4.10	9	5.78	1.86	9	6.17	1.04	9	120.67	35.24
Overall	15	16.60	14.00	14	30.36	13.97	14	13.57	4.57	15	7.23	4.31	15	6.40	2.03	15	6.27	1.16	15	116.07	35.36
F Statistic		2.57			0.09			0.75			2.81			2.32			0.18			0.36	
Significance		.133			.769			.405			.117			.152			.680			.557	

Activity Category	Shoot Ball			Throwing			Catch Bounce			Catch			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	6	1.67	1.03	5	18.60	2.88	6	5.00	0.00	6	5.00	0.00	6	5.67	2.07	6	39.50	30.23	5	20.20	1.92
No Phys. Ed.	9	2.56	1.59	9	15.44	4.56	9	4.78	0.67	9	4.22	1.64	9	5.78	2.64	9	31.22	28.98	9	20.00	4.00
Overall	15	2.20	1.42	14	16.57	4.22	15	4.87	0.52	15	4.53	1.30	15	5.73	2.34	15	34.53	28.70	14	20.07	3.32
F Statistic		1.45			1.93			0.65			1.31			.008			0.28			0.01	
Significance		.250			.190			.435			.272			.932			.603			.919	

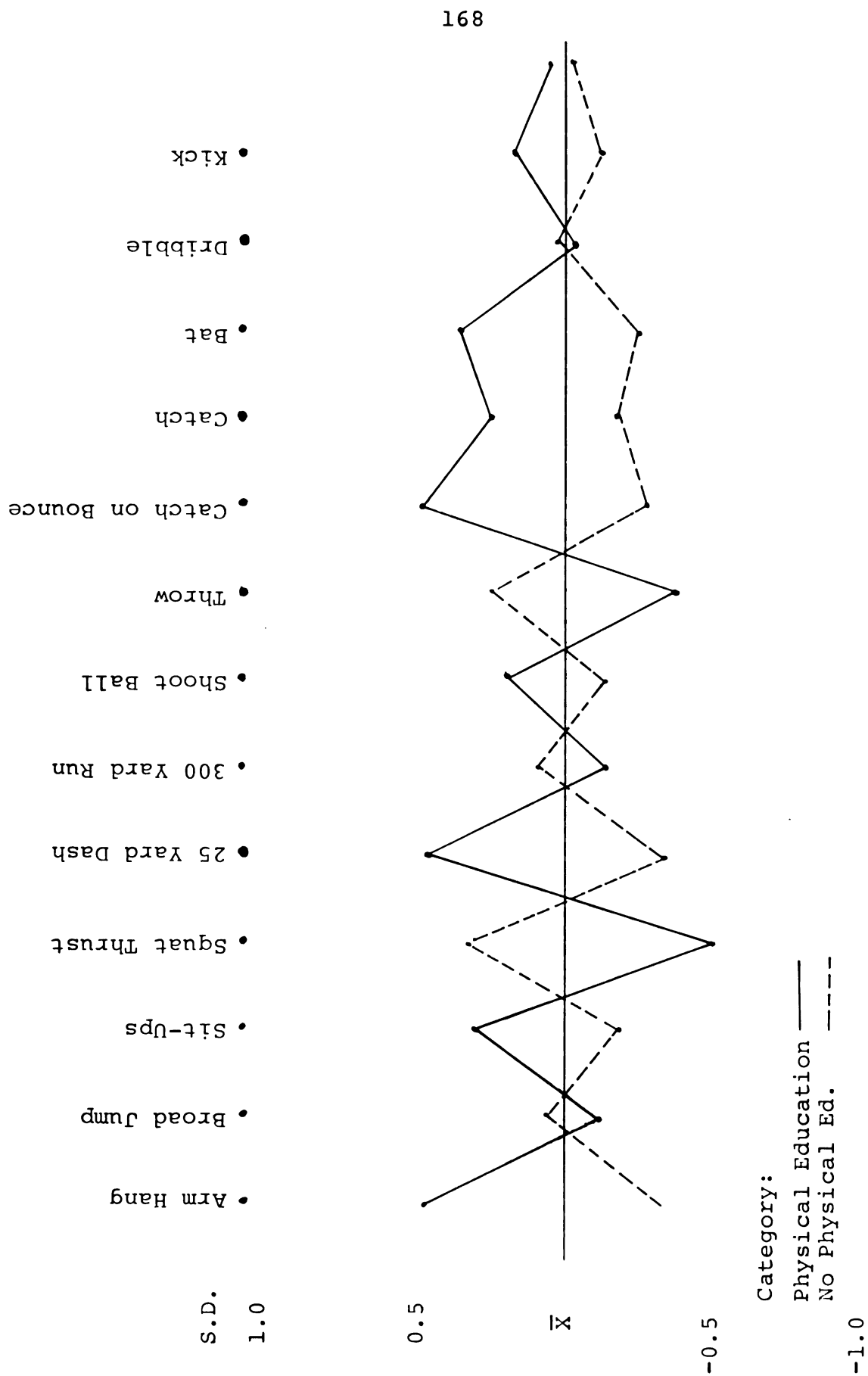


Figure 12.--Activity Program Results--Ages 16-18

TABLE 28.--Activity Program (Ages 19--21).

Activity Category	Arm Hang			Broad Jump			Sit Ups			Balance Beam			Squat Thrust			25-Yard Dash			300-Yard Run		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	4	24.00	17.38	4	31.00	11.60	4	18.50	6.03	4	6.63	2.43	3	8.67	2.08	4	6.33	0.59	4	121.25	56.18
No Phys. Ed.	17	19.88	15.77	17	27.18	10.55	16	14.50	6.04	17	6.09	5.19	17	6.12	2.12	16	6.96	1.57	16	151.19	49.29
Overall	21	20.67	15.71	21	27.90	10.57	20	15.30	6.10	21	6.19	4.74	20	6.50	2.26	20	6.84	1.44	20	145.20	50.67
F Statistic		0.21			0.41			1.40			0.04			3.71			0.61			1.12	
Significance		.649			.529			.252			.844			.070			.443			.303	

Activity Category	Shoot Ball			Throwing			Catch Bounce			Catch			Batting			Dribbling			Kicking		
	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.
Phys. Ed.	4	2.50	1.29	4	18.25	3.86	4	5.00	0.00	4	5.00	0.00	4	8.75	0.96	4	62.00	31.86	4	21.25	2.06
No Phys. Ed.	16	2.56	1.31	17	17.29	3.79	17	5.00	0.00	17	4.35	1.17	17	6.06	3.05	17	63.41	29.64	17	20.29	3.27
Overall	20	2.55	1.28	21	17.48	3.72	21	5.00	0.00	21	4.48	1.08	21	6.57	2.96	21	63.14	29.25	21	20.48	3.06
F Statistic		.007			0.21						1.18			2.94			.007			.305	
Significance		.933			.656						.292			.103			.933			.587	

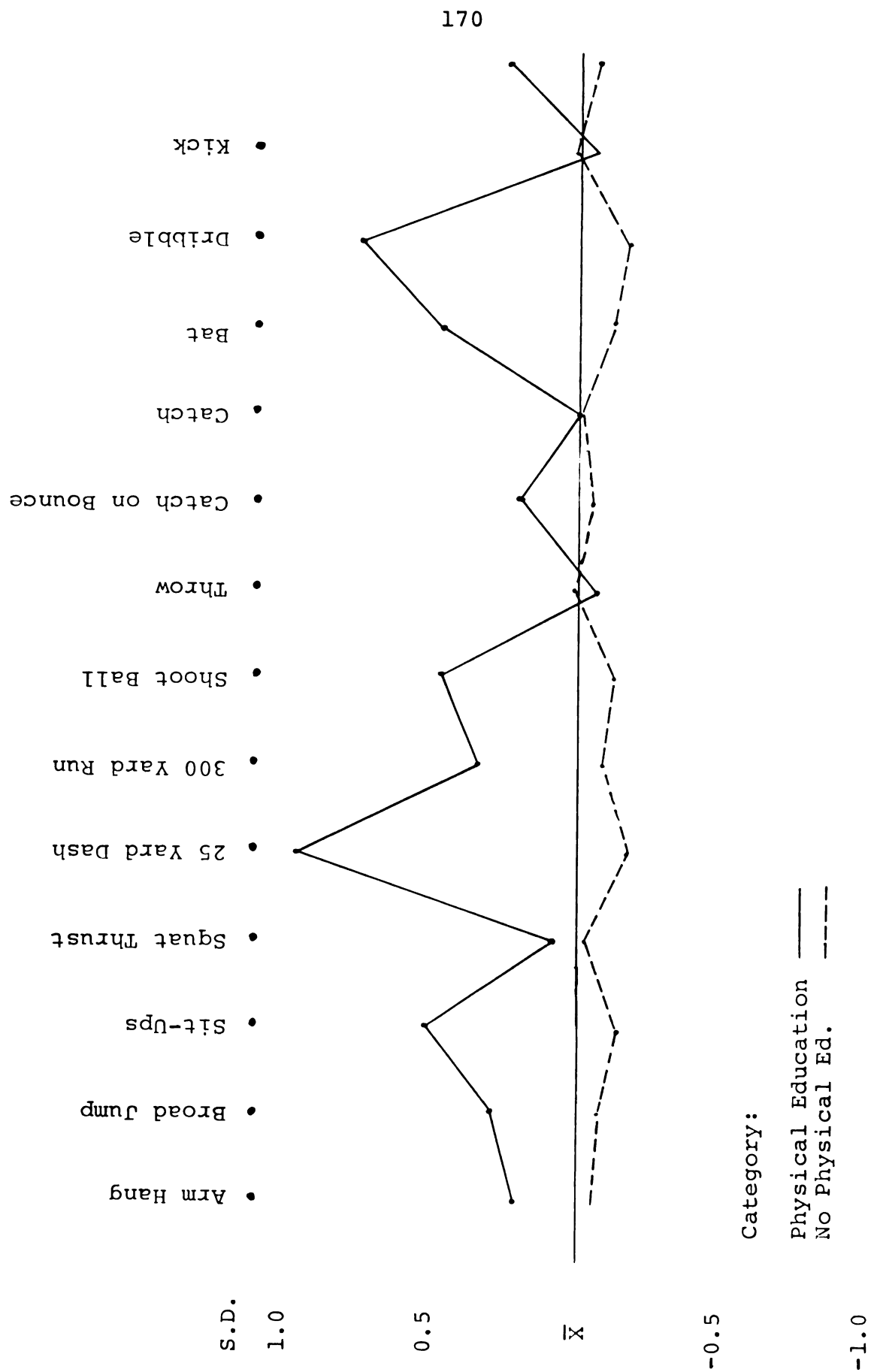


Figure 13.---Activity Program Results--Ages 19-21

Discussion of Findings

The Motor Performance Test Battery. Results would support the idea that performance on tests of the type used to measure gross motor fitness are quite different from the game skill tasks, relative to the influence of some of the factors investigated. This is especially evident for the factors of age, sex, and etiology. For the factor of age, significant results were generally on skill tasks, whereas for the factors of sex and etiology, significant differences were basically on the gross motor fitness tests. These findings would definitely strengthen an argument for the inclusion of both types of tasks on any battery which purports to give a general measure of motor performance.

The results also provide evidence which gives further insight into some of the individual test items. The arm hang test appears to be more a measure of relative body weight than of gross motor fitness (component of arm and grip strength). One might conclude this by noting that the arm hang was the only task where the younger (age level) subjects scored higher than the older groups, and that the short and heavy groups (Growth factor) scored lowest on this item. On the basis of these findings, this investigator would recommend the exclusion of the arm hang test from the motor performance battery.

Results further indicate that some modification of the catching tasks is in order. For the sample tested, the direct catch and the catch on one bounce items were

not discriminatory enough, since too many subjects (older age levels) achieved perfect scores. A possible change in the administration of these items would involve use of a smaller (e.g., tennis) ball, and/or an increase in distance the ball travels through the air. Results do indicate (Table 2) that catching on one bounce is easier than the direct (air) catch for the age range sampled.

The remaining tests appear to be adequate and might be retained in the motor performance battery. One necessary requisite, however, would be the further evaluation of those tests (squat thrust, shooting a ball, catch on the bounce, batting) where reliability coefficients were low.

Factors Influencing Motor Performance. A review of results for each of the eight factors is presented in the summary (Chapter V) of this study. It is evident that several of the factors are worthy of further investigation. On the basis of the results of this study, there are some factors which should be essential considerations for certain aspects of activity programming, and for constructing TMR performance standards (norms).

It would appear that planning of the program content (activities) should be influenced by the etiological composition of the group (class), and that the prescription of activities could be related to individual growth and dominance patterns.

In establishing motor performance standards, it would seem imperative to differentiate between mongoloid subjects and other trainables, at least for gross motor fitness tasks. Age and sex would also be important factors in constructing performance norms for the trainable mentally retarded.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The two basic purposes of this study were:

1. To establish the utility of a test battery for evaluating the motor performance of a sample of trainable retardates, ages eight through twenty-one.
2. To select specific environmental and organic factors which appear to produce differential effects on performance of the motor tasks in the test battery.

The eighty-eight subjects who provided data for this study were enrolled in school programs for the trainable mentally retarded, in one of the two cities of Lansing, or East Lansing, Michigan.

An evaluation of individual motor performance was obtained with a fourteen-item motor test battery, which included seven gross motor fitness tasks and seven basic game skills. The tests included several motor tasks selected from the literature, and some new tests devised especially for the stated purposes of this study.

Eight factors were selected for investigation: the two environmental factors of type of activity program, and parent education level; and the six organic factors of age, sex, IQ, dominance, etiology, and growth.

Data collected for each subject was recorded on individual CDC 3600 computer cards, and the one-way analysis of variance with unequal number of replications permitted (UNEQ1 routine) was used in the data analysis. If the F ratio showed significance within the .05 level, the Scheffé test was used to determine which pairs of category means were significantly different.

Relative to the main effects of the factors investigated, the findings of the study may be summarized as follows:

1. Organic Factors and Motor Performance.

Age: Except for the youngest age levels, there is much less (than normal) difference in performance on gross motor fitness tasks among various age categories. This pattern is not consistent for game skill items, however, where differences are more significant and age level may be considered a definite positive influence on performance.

Sex: Males performed significantly better than females on fitness tasks (except for dynamic balance). This is in general agreement with findings for normal and EMR samples. While

differences may be considered significant, it should be noted that the mean score differences are not so extreme as those found in higher functioning (mental) groups. There is a definite connection between type of task and performance by sex. On the game skills (as opposed to gross motor fitness tasks) for example, female mean scores may approximate or exceed male means.

IQ: Many children who are in the higher intelligence (IQ of 51, or more) levels of trainable functioning groups are brain injured or may have emotional problems which serve to restrict their average motor scores. In the comparison of IQ groups, the medium (40 to 50) category performed better than the high group, and significantly better on some motor tasks than the low (30 to 40) IQ group.

Etiology: Those children in the familial category were generally more physically capable than those trainable retardates whose etiology was unknown, brain injured, or mongolism. Many etiological relationships are specific to the type of motor performance evaluated. Mongoloid individuals are relatively more capable in skill tasks than on gross motor fitness

tasks. Since several kinds of motor performances appear to be related to etiology, program content or planning should be influenced by etiological considerations.

Dominance: The establishment of unilateral dominance (hand and foot) appears to be positively related to motor performance, and those who have an opposed (opposite hand and foot) dominance were generally poorer in motor skills. The incidence of left handedness and the lack of unilateral dominance was found to be much higher in this trainable sample than what is reported for the general population.

Growth: The trainable children of this sample were found to be generally subnormal in growth measures and especially deficient in standing height. There was a generally positive effect of height upon motor ability. For children of similar height (and age), weight had a negative effect on performance in tests of gross motor fitness.

2. Environmental Factors and Motor Performance.

Parent Education: Level of parent education seemed to have a negative effect on performance level, as those in the low group scored better on all motor tasks. This effect is at least

partially influenced by etiological factors, however.

Activity Program: Regular physical education classes exerted a positive influence on the motor performance of trainables in this sample.

Based on the application of the test battery to this sample, it would appear to be a useful instrument for evaluating motor performance levels of trainable retardates, ages eight through twenty-one. The exclusion of the arm hang test, and modification of the catching tasks would be recommended as possible adaptations of the battery used. Further investigation of some items, as to validity and reliability with trainable subjects, would also be prerequisite to gathering normative data for the motor tasks in the test battery.

Of the eight factors investigated, the organic factors of age, sex, etiology, and IQ, and the environmental factor of activity (physical education) program, appear most worthy of further study for constructing category standards and for planning more effective activity programs.

Conclusions

Subject to the limitations cited in the study, the following conclusions appear to be warranted:

1. Evaluation of Motor Performance of the Trainable Retardate.

- a. One of the difficulties encountered with retardates at this mental level, is their lack of understanding regarding score totals (number concepts) or timed repetitions. This concept is as essential a consideration as task (simplicity) selection. When one realizes that the motivation to achieve motorically among normals is based upon competition (with norms, peers, or one's self), the possible influence of this aspect of mental deficiency becomes quite apparent.

To counteract this basic lack of intrinsic motivation, this investigator would conclude that some variation from typical test administration is in order. One example would be the use of much verbal encouragement and direction during individual performances. Another would be the provision of frequent practice periods (for the purpose of orienting children as to task objectives) before the actual testing (recording scores) situation.

- b. Results of this study show that the type of task (game skill versus gross motor fitness) used to evaluate the motor ability of trainable children is an important consideration. (The significant findings for such factors as age, sex, and etiology are closely related to the type of task.) This would lead one to conclude that game skill tasks as well as gross motor fitness tests should be included on a battery which purports to measure the general motor ability of these children.
 - c. Relative to the use of test scores as normative data, results based on the factor of etiology indicate that it would be illogical to compare motor performances of mongoloid children to the other trainable children of this sample, in terms of performance expectation on gross motor fitness items. It is evident that in addition to standards based on age and sex, for many motor tasks, standards based on etiological considerations should be employed.
2. Physical Education Programming.
- a. Program content should include instruction in game skills as well as gross motor

fitness activities, since both types of performances seem important in overall motor development.

- b. The concept of sequencing is important in planning activities related to motor development, particularly in game skills (results show that catching a ball on one bounce is easier than catching it directly).
- c. If possible, the physical education class should be formed on the basis of mental age (ability grouping), since specific content could be varied for low (30 to 40) and higher (40 to 50) IQ groups.
- d. Program content should relate to the etiological composition of the activity class. Results indicate that most of the mongoloid children should be given additional activities to develop strength, balance, speed and endurance, while many brain injured children may need special emphasis in ball (reception) skills.
- e. The high degree of variability in performance found among these children, suggests that an adequate physical education program must necessarily be highly individualized, to effectively promote the development of motor skills in each child.

- f. Results related to type of activity program indicate that instruction is most effective (improvement greater) at the younger age levels. This would support the concept of emphasizing the development of basic motor skills in younger children, since secondary skills are dependent on this development.

Recommendations

1. Similar research on several of these factors should be done with other trainable samples, to determine how the interaction of some factors might produce interrelated effects on motor performance scores. Using such statistical techniques as multivariate analysis, the relative influence of specified factors may be studied. Similar studies with larger TMR samples might reduce the number of factors to be investigated.
2. Research should be specifically designed to answer several questions which are pertinent to the findings of this study:
 - a. Would length of time in a regular physical education program directly effect performance of TMR children in terms of increasing variability by chronological age, and between males and females?

- b. Would the employment of techniques aimed at raising the motivation level (extrinsic rewards, etc.) of TMR children substantially effect motor achievement scores?
- c. Does the familial child (as defined in this study) compare (to other etiological groups) as favorably in classroom behavior as in motor performance?
- d. Do young trainable children who have been involved in programs emphasizing single hand and foot skills demonstrate greater (and/or earlier) development of unilateral dominance than similar children who have not had such experiences?
- e. Excluding children where retardation is related to genetic defect (i.e., mongolism), is there a positive relationship between standing height and mental age?
- f. How do results from an activity program based on individually prescribed activities (on the basis of etiology, test scores, etc.) compare to those of a program which provides similar content for whole groups of TMR children?

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APPENDICES

APPENDIX A

APPENDIX A

Included in this appendix is a review of each of the fourteen test items, with a description of the equipment, procedure, directions, and scoring for each.

Gross Motor Items

1. Straight Arm Hang

Apparatus: Bar--a one inch (diameter) pipe, thirty inches long, with a "T" connection screwed on each end (See Appendix B). An eye-hook assembly was put into each end so the bar could be hooked into the chains of an outside swing set. Thus, the apparatus was adjustable to any height along the length of the swing chains.

Procedure: Check to see that the bar and subject's hands are relatively dry. The bar is adjusted so that the testee can reach it (arms fully extended) while standing on a box (ten inch height). The grip (palms away from face) is checked to ensure that thumbs grasp under (fingers over) the bar. On starting, the box is removed, so that the feet cannot contact it. Subject should be hanging with arms straight and feet several inches above the ground, so that toes cannot touch unless the bar is released. The tester should eliminate swinging (feet, etc.) movements of the subject during the test.

Directions:

I want to see how long you can hold on to the bar without letting go. Hold on while I move the box away from under your feet and don't let your feet down to the ground until I say 'stop.'

Scoring: Time, in seconds (stop watch, or watch with sweep second hand) to nearest whole second. Time begins when testee hangs free (box removed) and ends whenever feet (or one foot) contact ground (or anything else). Possible range: 0 to 60 (maximum). One attempt (if the initial attempt is considered invalid, a second trial may be given).

2. Standing Broad Jump

Apparatus: A standard (folding) gym mat, ten feet long by five feet wide is extended on the floor. On the top surface, tape indicates measures in feet and inches. (Feet and half-feet are written on respective tapes--to facilitate scoring.) A base (12" by 12") or square of masking tape should be placed on the floor at the take-off end of the mat.

Procedure: Testee stands on the base at the lower (scale) end of the mat. Proper stance and jump are demonstrated by the tester. Testee is given three jumps--all are recorded in inches. The testee gets as close (but not on top) to the mat edge as possible.

Directions:

Now stand on the base and get your toes up close to the mat (may have to help place feet in proper position

for some subjects). I want to see how far you can jump. Just one big jump and then stand still so I can see where your feet land.

Scoring: Distance, in inches. From the edge of the mat (toes before take-off) to the back of the heel (or other body part) closest to that edge. All three jumps are recorded, with the best one considered as the individual's final score. Possible range: 0 (unable to jump or to lift feet together on take-off) to whatever distance an individual is capable of.

3. Sit ups

Apparatus: Done on a gym mat; watch, or clock with second hand.

Procedure: A demonstration of the proper sit up is given by the tester. The testee lies on his back, hands clasped in back of his head. Feet are extended and together, held (over ankles) in contact with the mat by the tester, who counts the repetitions. Testee is to commence on signal "go," and continues until told to "stop" (sixty seconds).

Directions:

Keep your hands on the back of your head all the time. Sit all the way up and touch your elbows to your legs, then lie back down and do some more. Start when I say 'go' and keep doing more sit ups until I say 'stop.'

Scoring: Number of complete repetitions in one minute. One repetition--starting with the back in contact with the mat, sit up (maintaining hand contact with the

head) until elbows contact legs. The testee maintains hands in contact with the back of his head and returns (shoulders) to the mat to begin a second repetition. Final repetition is counted if the testee has risen to an upright (trunk and legs at 90°) or forward (toward knees) position. It is not counted if he has not reached this position on the "stop" signal. Repetition is not counted if hand-head contact is not maintained, or if elbow is used to push off mat. Range = 0 (unable to do any sit ups in proper form) to one's individual capacity within sixty seconds.

4. Dynamic Balance

Apparatus: A balance beam of two eight foot long 2" by 4" boards, joined together into a "T" shape. (The two inch end of one is fastened against the center of the four inch side of the other, and braces fixed on each end so that the beam will not wobble.) This apparatus is, in effect, two eight foot beams--one four inches wide, and by turning it over, another two inches wide (see Appendix B). Beginning twenty-four inches from each end, the markings are in feet (1 to 7 on the four inch beam, 8 to 14 on the two inch side).

Procedure: The wider (four inch) side is exposed first. The tester demonstrates the proper walking technique. The testee should advance one foot in front of the other, stepping heel to toe. (No large steps or running

should be permitted.) The testee is aided to starting position on top of the end of the beam, if necessary. He is given two attempts (if a second is needed) on the four inch side. If he fails to go all the way to the end of the beam on two attempts, the best of his two tries will be his score (he does not attempt the other side at all). If the testee walks the full length of the four inch beam (first, or second attempt), the two inch side is turned up and the procedure repeated on this side. The testee gets two chances to walk the full length of the two inch beam, regardless of the attempts (one, or two) needed to complete the four inch beam.

Directions:

Let's see if you can walk all the way across this board, without putting your feet down on the floor. Take little steps, and put one foot in front of the other when you walk.

As the testee walks the four inch side, if he steps off, or when his foot touches the floor, the tester says "stop." The testee is told he has one more chance to walk the beam and is returned to the starting position again. If the testee walks the complete length of the four inch beam (first, or second attempt), the two inch side is turned up, and similar directions are given for this side.

Scoring: Distance in feet, to nearest one-half foot. (Mark which testee had passed with back foot, before stepping off beam.) The best distance (of two attempts) is the score given. If the testee does not

complete the four inch side, his score will be within the range of 0 to 6.5 (feet). If he completes the four inch beam, he gets a score of 7. When the beam is turned over (two inch side) he has two more attempts to increase his score (8 to 14). If he fails to walk the full length in two attempts, his maximum distance is recorded. Possible range in scoring = 0 to 14.

5. Squat Thrust

Apparatus: None (performed on floor surface).

Procedure: One repetition of the four-count squat thrust is demonstrated (1)--from standing position, squat down, placing hands on the floor; (2)--supporting weight on the hands, thrust feet back so that legs are fully extended, and weight is supported on toes and hands, keeping knees off floor; (3)--bring both feet up near hands, to again assume squatting position; (4)--rise to standing position. Testee is asked to demonstrate one repetition, to indicate understanding of the task. When tester is satisfied that task is understood, he prepares testee to start and says, "go." After thirty seconds time, the tester says "stop" and records the number of complete repetitions.

Directions:

We're going to see how many you can do, so go as fast as you can. Start when I say 'go,' and keep doing more until I say 'stop.'

During the test, the testee may have to be reminded to place "hands down" to start another repetition, to fully extend legs (in thrust), to stand all the way up (at the end of each repetition), etc.

Scoring: Number of complete repetitions in thirty seconds. The final repetition is counted if the testee has reached the final step and is rising to standing position when "stop" is called. Tester should not allow testee to perform incomplete repetitions. Range = 0 (unable to perform task) to individual capacity (within thirty seconds).

6. 25-Yard Dash

Apparatus: Two bases; two stop watches.

Procedure: A straight distance of twenty-five yards is measured on an outside (preferably grass) area. At the starting line, two bases are placed (about ten feet between them) so that testees may run in pairs. One tester stands at the finish distance, twenty-five yards away. An assistant starts the two runners, and on the command "go," swings his arm downward, so that the tester at the finish line can start the watches. The testees should be directed to run to a place (baseball screen, etc.) approximately five yards beyond the finish line. This is to ensure that they will not slow down at the twenty-five yard distance (timer's position). For this test, there is one repetition only. (Unless a child begins running too soon, falls down, etc.)

Directions:

I want to see how fast you can run. I will say ready, go. Stay on your base until I say 'go,' then run to the baseball screen (fence, etc.) as fast as you can.

Scoring: Time in seconds, to nearest one-tenth second. A higher score indicates poorer performance (more time elapsed).

7. 300-Yard Run

Apparatus: A stop watch; a watch with sweep second hand.

Procedure: An outside, rectangular course is measured, 25 by 50 yards (150 yards around). Groups of testees (five to eight) may perform at once in this test. The testees must run around the rectangular course twice (finish at starting point, second time around). A tester and assistants should be stationed at each of the four corners of the course, to direct and encourage the runners. The tester gives the group (about to run) directions and starts them. On his "go" signal, he starts the stop watch. As the runners go all the way around the course and are coming to his position again, the tester tells them to "go around once more." When the first runner finishes his second lap (300 yards), the tester tells him to stop, and at this point he stops the watch. At the same time, he notes the position of the second hand on his wristwatch, so that each additional runner to finish will be given a (plus) score in seconds--from the sweep hand. (Number of

seconds that elapse after first runner finishes.) Following completion of the whole group, the first place runner's score (total seconds) is read from the stop watch. This score is then added to every other runner's "plus" score, to give their final score in seconds.

Directions:

Do you see the people standing there? (point to all corners of the course). When I say 'go' you all should run that way (point) and go around (person), then run around the next (point), then around (point) and right back around me. You will have to go around again, once more the same way. If you get tired you may walk for a little way, but don't stop. I have a watch to see how fast you can go around, so try to keep running. Are you ready? Go!

Scoring: Time in seconds, to nearest whole second.

(A child who does not finish or run the course correctly is not scored on this test. Retesting, if necessary, should be given on another day, as this is an endurance task.) Range = individual capacity. A higher number of seconds indicates poorer performance (more time elapsed).

Skill Items

8. Shoot Ball In Barrel

Apparatus: A fiber barrel, thirty inches high, with an eighteen inch inside diameter. The barrel is placed on the floor with four pieces of masking tape placed (on floor) around the base, to indicate its position (may be moved by ball during testing). A shooting line (masking tape) is placed seven feet from the base (nearest part) of the barrel. The barrel should be positioned several feet

away from walls furniture, etc.; a ball, 8 1/2 inch diameter, utility type.

Procedure: A tester demonstrates the task, shooting (two hands) the ball into the barrel. The testee is given one practice shot, then takes five additional shots for score. The ball should be held with both hands when shooting. The tester should reposition the barrel after each shot, and return the ball to the testee.

Directions: "Keep your feet in back of the line and try to get the ball into the barrel. You have to use two hands to throw the ball."

Scoring: For a score, the ball must not contact anything (floor, walls, etc.) except the top of the barrel before going in. Testee gets one point if the ball goes into the barrel, zero if it does not. The practice shot does not count. Range = 0 to 5 points.

9. Throwing (Accuracy)

Apparatus: Target (see illustration 4, Appendix B). The plastic bowling pin serves to focus the child's attention, and the strings make scoring easier and more objective: ball, plastic "wiffle," softball (4 1/2 inch diameter) size; throwing line (masking tape), ten feet from the target pin.

Procedure: The task is demonstrated by the tester. The testee is given one practice throw, and then five throws for score. The overhand throw is demonstrated and emphasized, but not required.

Directions: "Keep your foot in back of the line (tape on floor). Throw the ball, let's see if you can hit the pin!" After the practice throw, and during the test the target pin should be referred to several times, so that testee remains attentive to task.

Scoring: Total points. Each throw may be scored from 0 to 5 points (see illustration). Scoring range = 0 to 25 points. Hand dominance is also evaluated during this test (record throwing hand used in each of the five attempts).

10. Catch Ball on the Bounce

Apparatus: Rolling board (see illustration, Appendix B). This controls the speed and direction of the ball, and thus helps to standardize all "throws"; a ball, 8 1/2 inch diameter, utility type; base (12" by 12") or a twelve inch square (masking tape) on the floor, with the front edge six feet from the end of the rolling board.

Procedure: A tester stands on the base to demonstrate the test. An assistant releases the ball which rolls down the board, bounces on the floor, and is caught by the tester. Testee is placed on the base and given one practice trial. This is followed by five attempts for score. Tester should bring the subject's attention to the ball just before it is released each time.

Directions: "Now keep your feet on the base when you catch the ball. It will hit the floor and bounce to

you. Are you ready? Watch the ball." (Each time the ball is released, the tester says, "ready, catch.")

Scoring: total points. The ball must be caught after one bounce. One point for each catch, zero for a missed (dropped) ball. Scoring range = 0 to 5 points. A repetition does not count if the testee leaves the base to catch the ball.

11. Catch Ball--No Bounce

Apparatus: Rolling Board, same as for test No. 10; ball, same as for test No. 10; base, 12" by 12" square (or a twelve inch square of masking tape), placed with forward edge thirty-six inches (three feet) from the end of the rolling board.

Procedure: Tester demonstrates, catching the ball as it rolls off the board--before it touches the floor. Testee gets one practice catch, then five for score. A repetition is not counted (repeat) if the testee moves his feet off the base to catch the ball.

Directions:

Now you have to reach your hands out and catch the ball when it comes off the board. Don't let it touch the floor. Keep your feet on the base. Are you ready? Catch!

As the ball is released each time, the tester brings attention to the ball and says, "Catch!"

Scoring: As for test No. 10, range = 0 to 5 points.

12. Batting A Suspended Ball

Apparatus: Ball, plastic "wiffle," softball size (4 1/2 inch diameter); nylon string, eight feet long, for suspension of the ball (see illustration, Appendix B); plastic bat, 30 inches long; base, 12" by 12" (or twelve inch square of masking tape).

Procedure: The task is demonstrated by a tester and assistant. The testee is asked to swing the bat, to determine stance preference (left or right handed). The subject is then placed in correct position, alongside the base. The ball is brought back to the wall (see illustration) and is released by the tester when the subject is prepared to swing. The testee gets one practice, then five for score.

Directions: "Let's see how hard you can hit the ball. Watch my hand and hit the ball when it comes. Are you ready?" (Release ball.) After the practice attempt, the ball is held in position and the testee's attention focused on it ("ready?") each time it is released.

Scoring: Total points. One of three possible scores for each of the five attempts (0--if the ball is missed completely, or the string is hit first; 1--if the ball is touched or "tipped" by bat, but not hit directly; 2--where ball is hit solidly back in the direction of the tester). Scoring range = 0 to 10 points.

13. Ball Dribble--One Hand

Apparatus: Ball, rubber utility type, 8 1/2 inch diameter.

Procedure: Task is demonstrated by the tester, emphasizing the use of one hand only. The subject is allowed to move after the ball as he bounces it, but is directed to try to keep the ball bouncing in one place. (Dribbling area should be about ten square feet of clear floor space.) The tester begins timing for sixty seconds on the first bounce of the ball. If the subject loses control during the first attempt, he is told to stop, and a second trial is given (another sixty seconds). If the child changes hands, uses two hands to bounce, or loses contact with the ball for more than two successive bounces, he is told to stop, and scored for that trial. If the testee dribbles for the entire sixty seconds on his first attempt, no second trial is given. The tester counts the number of successful (hand to ball contact) bounces during the sixty (or less) seconds.

Directions:

Now I want to see if you can bounce the ball with one hand like this (demonstrate). I'm going to count all the bounces you can do, so keep bouncing the ball until I say 'stop.' If the ball bounces away you can go after it, but try to keep it bouncing in one place. Just bounce it with one hand, until I say 'stop.'

Scoring: Total number of dribbles on the best attempt. (Or the first attempt, if done for sixty

seconds.) Range = 0 to an individual's maximum (within sixty seconds).

14. Kicking (Accuracy)

Apparatus: Target, basically the same as for test No. 9 (throwing), except the thirty inch pipes are used (instead of seventy-two inch ones) as the supports for the cross piece (see illustration, Appendix B). The strings are moved to the wire supports which makes them hang ten inches apart; ball, rubber utility type, 8 1/2 inch diameter; base (12" by 12") is taped to the floor so that the forward edge is ten feet from the target pin.

Procedure: Tester demonstrates the task. The testee is placed directly in back of the base (with ball placed on top). No steps are used in performing the kick. One practice kick is given (not scored), then five kicks for record. Kick is with the toe, not the side of the foot. Emphasize a "controlled" kick, so that the ball rolls on the floor (is not kicked in the air). If a ball is kicked improperly, testee is given further directions, and the attempt taken over.

Directions:

Let's see if you can kick the ball with your toe, so it rolls right into the bowling pin (show pin). Stand in back of the base, and now kick the ball at the pin.

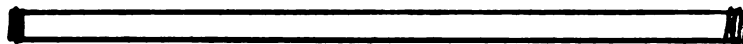
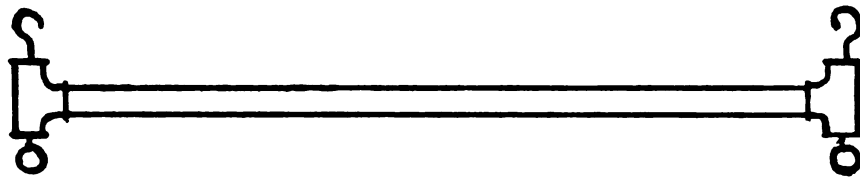
If the ball is kicked with poor force or direction, the tester tries to point out the proper way on successive kicks.

Scoring: Total points. Possible score on each repetition is 0 to 5 (see Appendix B). The scoring range = 0 to 25 points. The foot (kicking) used for each repetition is also recorded--for an evaluation of foot dominance.

APPENDIX B

Illustration 1. Arm Hang Apparatus

Bar apparatus may be hooked into chains of a swing set (with seat off), or a set of chains hung especially for it. The hooks allow a quick adjustment of the bar--according to the height of the testee.



one pipe
(1" diam., 30" long)



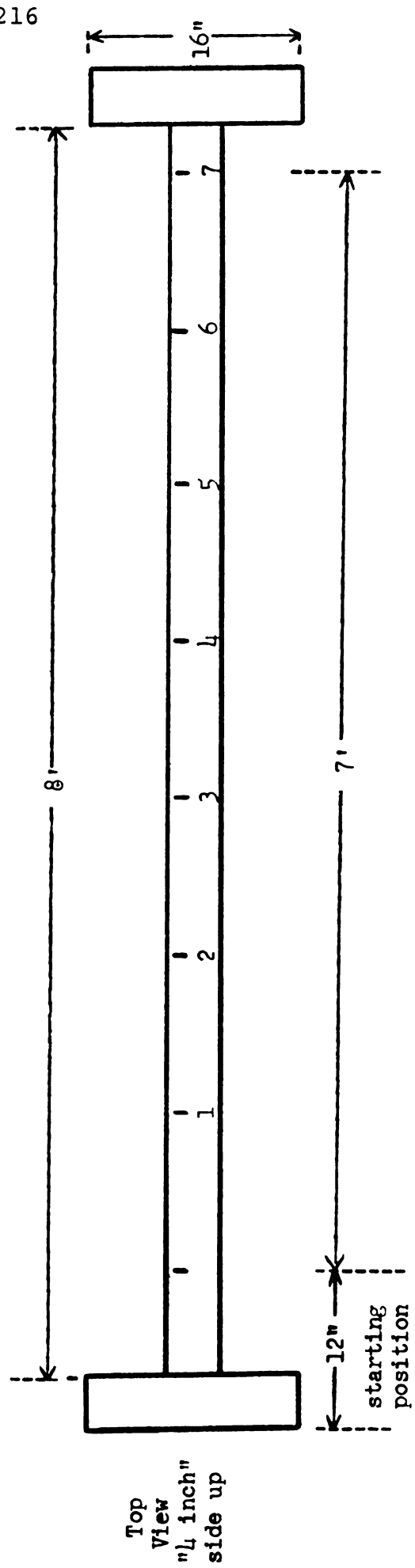
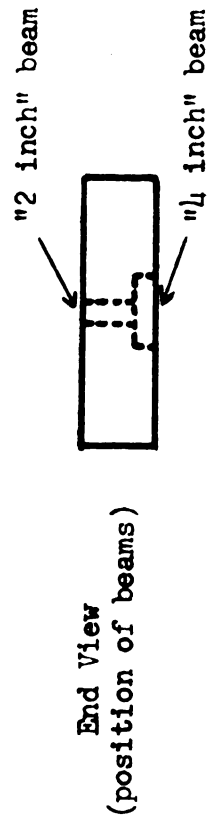
two "T" connectors ($2\frac{1}{2}$ ")



two eye-hooks (center fits inside "T")

Illustration 2. Balance Beam (dual)

Materials: Three (2" x 4") boards, each 8' long. (Two form the walking beams, and one the end supports).



Materials (Catching, Kicking, and Throwing Tests).

1. Base supports. A one-gallon milk container (top taped closed) with one of the sides cut out. A twelve inch length of pipe (one-half inch diameter) is cemented into the center of this container. A connector (dual, one-half inch by one inch) is screwed onto the top. With the one inch end open, different lengths of pipe (one inch diameter) may be screwed into this base.
2. Pipes (one inch diameter). Used as uprights for the test apparatus. Two thirty inch pipes, and two six foot pipes.
3. Cross-piece, throwing and kicking test. Two thirty-six inch pipes (one-half inch diameter) joined by a connector, to form a six foot bar. Wire loops are taped to this cross-piece, so that target strings may be pinned to it (see illustrations 3 and 4). On each end of the bar, a right-angle connector is joined with a short (five inch) piece of one-half inch diameter pipe--which fits inside the top of the upright (one inch diameter) pipes.
4. Plastic bowling pin. Target for throwing and kicking, is twelve inches long. It is

fastened to a string and pinned to the center loop of the cross-piece (forty-two inches from cross-piece to pin bottom).

5. Wooden beads. Two of each color--for point value--according to distance from the target pin. Each bead is fastened to a forty-two inch length of string, the end of which is tied to a safety pin (can be pinned to cross-piece loops for kicking, or to other strings--for the throwing test).
6. Rolling board (catching tests). A strip of plywood (eight inches wide by seven feet long) has two one inch by one inch boards fastened on top, so that a six inch "track" is formed.

Illustration 3. Kicking Target

Materials:

Uprights--30" pipes (1" diameter).

Wire loops are taped on the cross-piece as shown (one in the center, four on each side--5" apart, and a fifth--10" from the fourth).

Strings (42" long) and colored beads are pinned on loops 10" apart, as shown.

Points:

5= hit pin.
 4= red bead (string).
 3= blue bead " .
 2= yellow " " .
 1= hit base
 0= outside base

A ball passing between two strings (beads)--no contact--counts for higher (color) value.

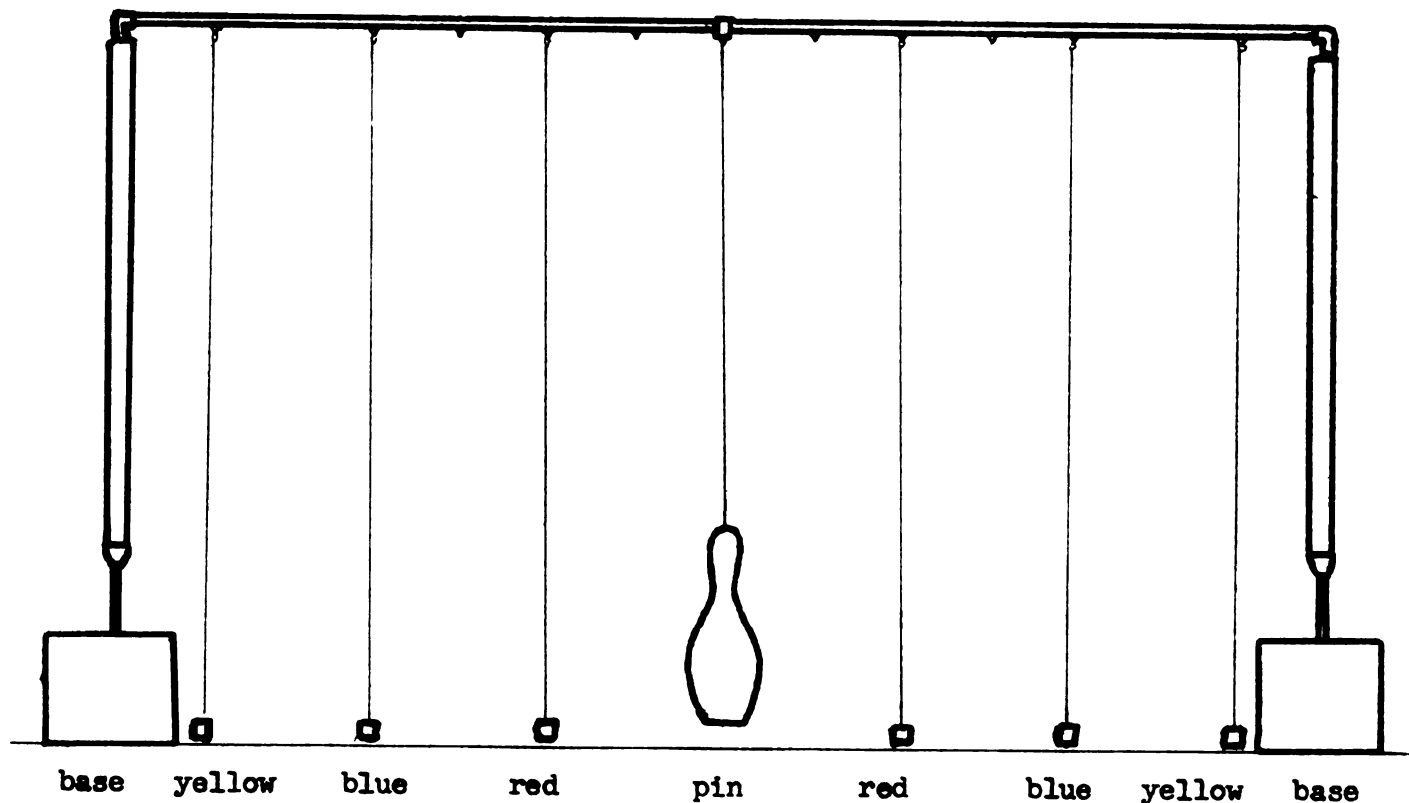


Illustration 4. Throwing Target

Materials: Uprights, 6' pipes (1" diameter); Strings (with safety pins on each end) of varying lengths (5", 10", 15", 20") from center of cross-piece are pinned on to loops five inches apart. To each of these, the beads and strings used in the kicking test (plus green) are pinned (as illustrated); Tape (color matches bead) is placed on string, the same distance above the pin as the bead is below it.

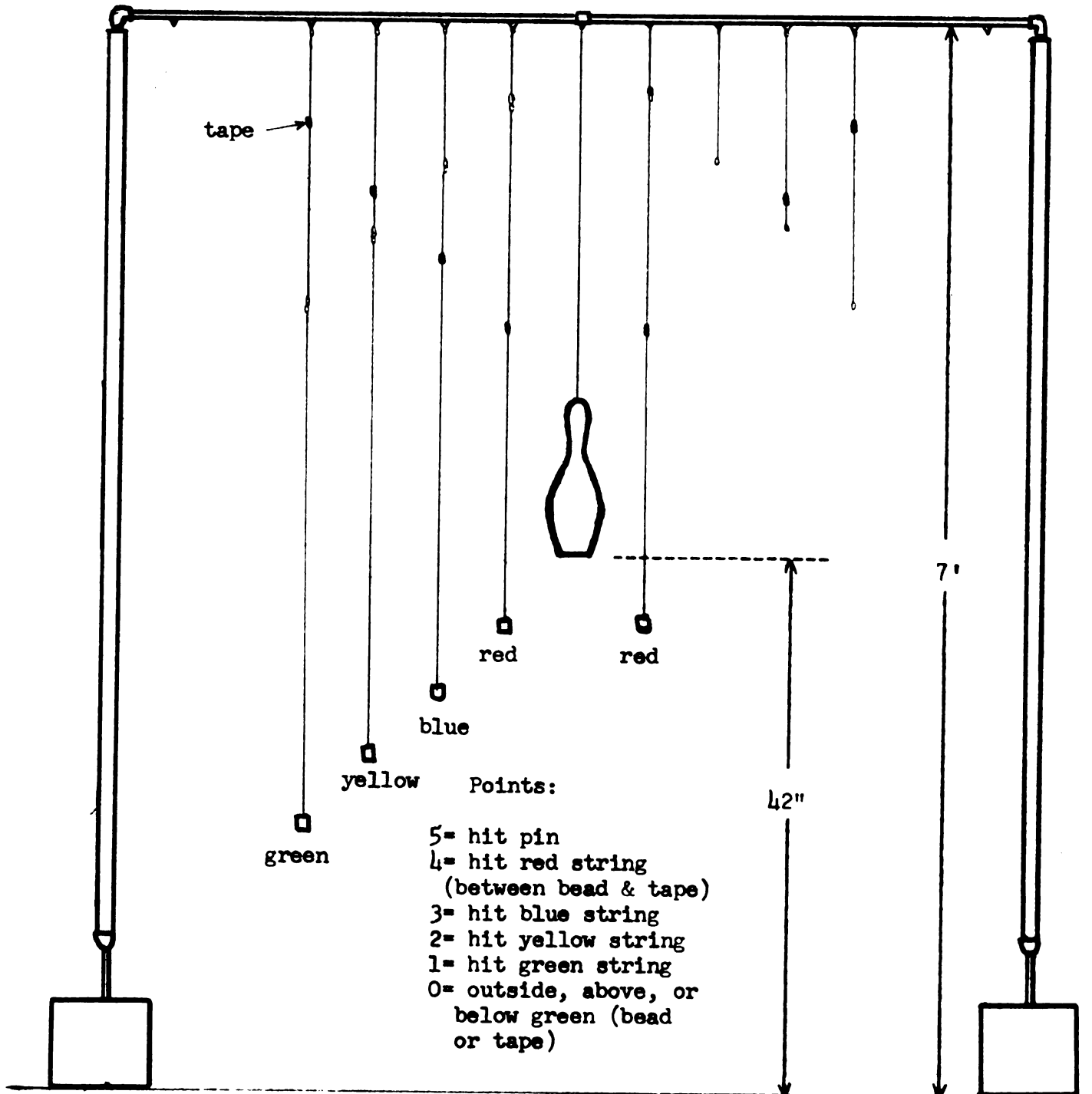
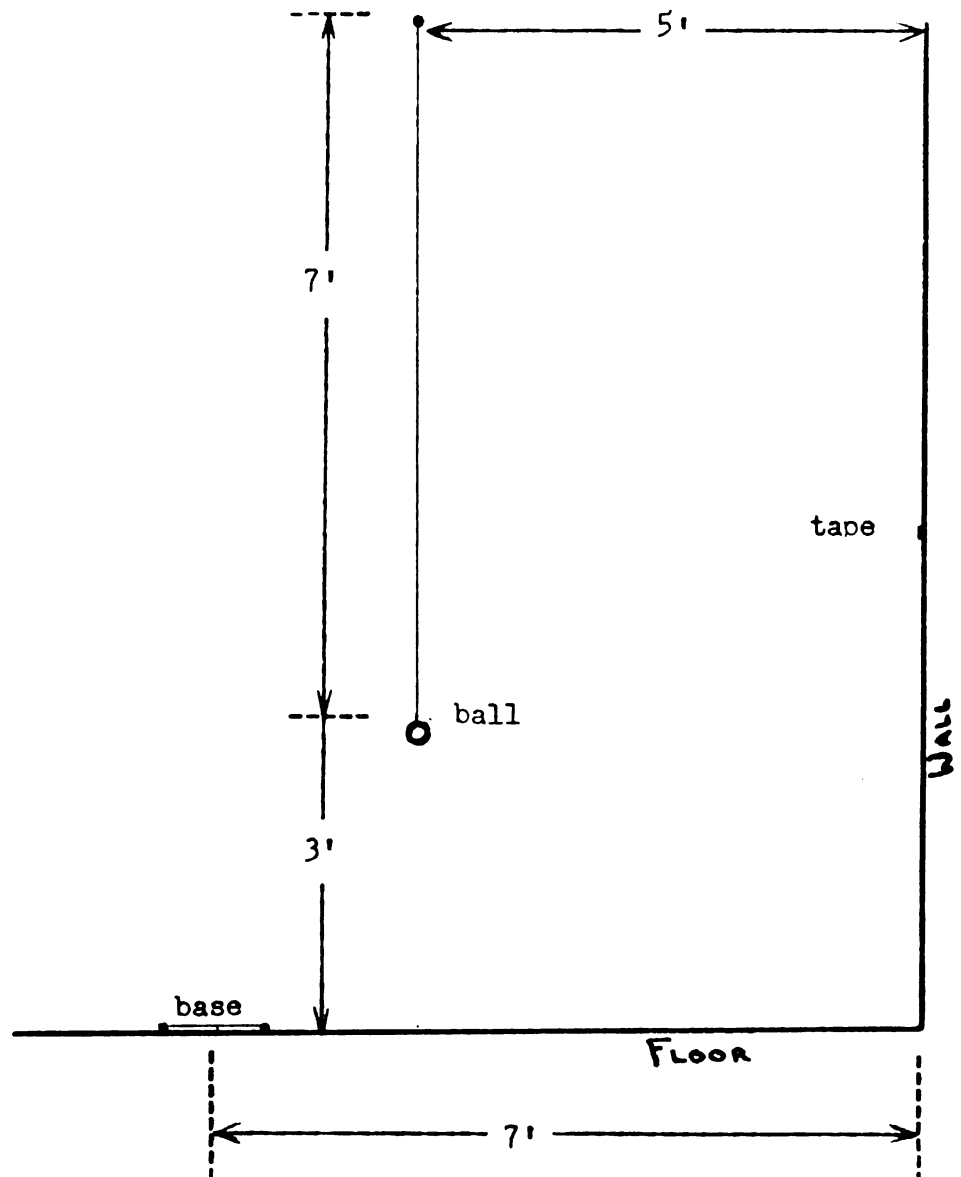


Illustration 6. Batting Apparatus

Wiffle ball ($4\frac{1}{2}$ inch diam.) is suspended from a fixed point, 10 feet above the floor. The string length is fixed so that the top of the ball is 3 feet from the floor. Ball is held against a piece of tape (5' high on wall) prior to release for each repetition. Arc of ball should be in a line perpendicular to the wall and across the center of the base (taped on floor).



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