ANTHROPOMETRIC, PHYSIOMETRIC AND HEALTH HISTORY COMPARISONS OF HIGH AND LOW ACADEMIC ACHIEVEMENT MOTIVATED EARLY ADOLESCENT BOYS

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This is to certify that the

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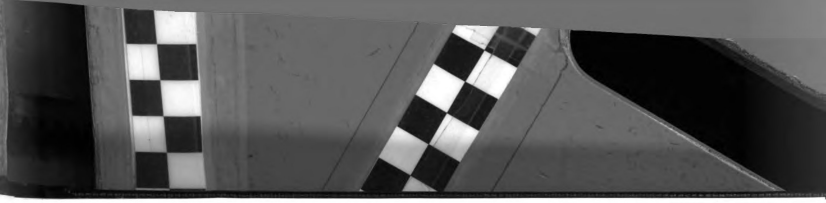

ABSTRACT

ANTHROPOMETRIC, PHYSIOMETRIC AND HEALTH HISTORY COMPARISONS OF HIGH AND LOW ACADEMIC ACHIEVEMENT MOTIVATED EARLY ADOLESCENT BOYS

BY

Roy Eston Peterson

The purpose of this study was to compare and describe a sample of high academic achievement motivated early adolescent boys to a sample of low academic achievement-motivated boys on the basis of anthropometry, physiometry and health histories. Although similar studies had been conducted using adult samples, no information was available relative to the role of these physiological variables on achievement-motivation of children. The study seemed necessary, for if educators are to make knowledgeable decisions about children then information about a child's physical being should be included in the decision-making process.

The research sample of this study was selected from the total seventh-grade boy population (four hundred eighty-eight) of two suburban school systems near Flint, Michigan. The sample of sixty-seven boys represented thirty-four of the highest and thirty-three of the lowest motivated boys who were: 1) in seventh grade, 2) twelve or thirteen years old, 3) Caucasian, and 4) from employed, intact families.

Motivation level was determined by scores on the Michigan State M-Scales (a standardized motivation measuring instrument) and cross-validated by teacher estimates of each boy's achievement motivation level. The M-Scale score separation between groups was nearly two standard deviations and the highest teacher estimate of a boy in the low group was at the fiftieth percentile along the motivation continuum; the lowest motivation estimate of a boy in the high group was the eighty-second percentile.

Information necessary to compare the two sample groups on the basis of anthropometry, physiometry and health histories was collected primarily by the health science personnel of the Mott Children's Health Center in Flint. All boys were brought to the Center to receive their comprehensive physical and health evaluation. Routine and sophisticated measurements were taken according to standardized and documented procedures.

Based on the data collected the following conclusions can be made about the anthropometric components of this sample of boys:

1. Boys with an elevated fat component of body build tended to be lower in motivation.
2. Boys with an elevated muscle rating tended to be higher in achievement motivation.
3. The linearity component of body build had no significant measured relationship with motivation.
4. Advanced skeletal age had no significant measured relationship with motivation.

5. Neither height nor weight differences were measured between groups.

The following conclusions about the physiometric variables of the study's sample of boys can be reached:

1. Of the list of sensory-motor variables tested such as vision, hearing, strength, hand dominance, reaction time and eye-hand coordination, only the time taken to complete a eye-hand coordination task proved to be different between the two groups.
2. The time taken to complete an eye-hand coordination task was significantly longer in the lower group ($p < .0005$).
3. Eye-hand coordination significantly correlated with eight of the ten variables which rejected the null hypotheses.
4. The coordination difference between groups was surpassed by only one other variable: intelligence ($p < .0005$).
5. Of the list of physical examination variables measured such as pubertal status, systolic and diastolic blood pressure, cardiac efficiency, and whether or not a health problem was present at the time of the physical, only the latter was statistically significant.
6. Boys from the lower group had more untreated health problems present at the time of examination than upper-group boys.
7. No differences existed between groups in variables observed during urinalysis, complete blood count and protein electrophoresis.

8. Serum uric acid, cholesterol and glucose differences reported in adults did not appear in this sample of children.
9. Serum uric acid (SUA), while having no significant relationship with motivation, seemed more a correlate of maturation, as pubertal status, height, bone age, grip strength, weight, humerus and hemoglobin measurements were all significantly correlated with SUA.
10. An amino acid screening test yielded a difference ($p < .06$) which may suggest individual amino acid correlations with motivation.
11. Elevated blood chemicals, reported found in first-borns when studied as adults, were not found in first-born children of this study.

Health history information leads to these conclusions about the boys in the research sample:

1. Mothers of boys in the higher group were significantly older when their boys were born.
2. Boys in the higher motivated group were significantly larger at birth.
3. There were significantly fewer complications associated with the birth of boys in the upper group.
4. Boys reporting to their parents that a health problem affected their school work tended to be from the low motivated group.
5. Frequency of serious illness, head injuries, asthma or allergies, and sick days from school was not significantly different between the two groups.

6. Superficial examination of eating habits relative to meat, vegetables, fruit and milk revealed no significant difference between groups.

The results of this research seem to indicate that there are significant physiometric, anthropometric and health history differences between high and low academic achievement motivated early adolescent boys. Information currently provided by this study and others is inadequate to impute cause-effect relationships between the differentiating variables and achievement motivation. However, the present project does imply that physiological patterns of adults cannot be projected to children any more than adult educational patterns are completely applicable to children.

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Roy Eston Peterson

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CHAPTER I

THE PROBLEM

Need for this Study

The effectiveness of education will never be maximized until educators transcend the imaginary or real boundaries of the knowledge body labelled "education" into other disciplines comprised of interests, skills and abilities pertinent to today's educational problems. This study is approached with the hope that its results will provide the practicing administrator with a perspective that will assist him in becoming a focal point for the interpretation and assimilation of multidisciplinary contributions toward the solution of educational problems. Possibly this study will help construct a baseline, or anchor-point from which educators can weave an information net around the role of physiology in achievement-motivation concepts.

This study is approached with a clear recognition of the dangers of imputing direct cause-effect relationships between the physical-being and the behavioral-being. It is prompted by the belief that mind and body are inseparable. If this inseparability holds true then it behooves educators to capitalize on the recent refinements and sophistication in measuring physical characteristics and to correlate these characteristics with behavior. Although the concept of this type of correlation is not new, advanced technology in the

biological and physical sciences dictates renewed study in this area. Some who have pursued the relationships between biochemistry and the learning processes may have been very optimistic when commenting upon the potential of capitalizing on the knowledge of the health sciences to further education.

> It is perfectly reasonable to suppose that we will be able to find specific biochemical boosters and biochemical inhibitors for different kinds of memories and imagery, or for different kinds of abilities or for different kinds of personality or temperament traits. . . . .The development of the mind of the child will come to rest in the knowledge and skills of the biochemist, and pharmacologist, and neurologist, and psychologist, and educator. [1]

Other educators are not as expansive, but certainly are as predictive. The Chairman of the Department of Communications at Michigan State University reports John E. Ivey, Jr., Dean of Michigan State University's College of Education, as saying that, although communication is currently the critical link in the learning process, biochemistry will be the important factor in education's future. [2]

Although biochemistry may hold a significant place in the future of education, to now very few definitive studies have been conducted. However, if this study can help bridge the real or imagined gap between education and the health-sciences it will have performed a service. The emphasis of the study is not as much upon a prescription for the world as it is for a description of some conditions which exist in one small part of it. Though limited in its generalizeability, this study may have relevance to questions such as:

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[1]David Krech, "Psychoneurobiochemeducation," Phi Delta Kappan, Vol. L, No. 7, March (1969) 374.

[2]David K. Berlo, unpublished lecture to a Communications Research meeting on the Michigan State University campus in East Lansing, Michigan, November 18, 1968.

- Are physical factors a component of the achievement motivation patterns of children?
- If physical factors are related to motivational patterns can educational experiences be constructed to compensate for physical abnormalities or deficiencies?
- If deficient physical patterning relative to achievement motivation is discovered, what administrative adjustments can be made? -- Such as:

  Dietary supplements?

  New kinds of school physical examinations?

  An augmented interdisciplinary approach to education?

Purpose of this Study

The specific problems which were explored in this study can be stated this way: How do early adolescent boys identified as having a high need for academic achievement compare physiologically to early adolescent boys with a lower need for achievement? What administrative implications can educators infer from the results? The purpose of this study was to compare high and low achievement motivated early adolescent boys on a number of physiometric and anthropometric measurements. If educators are required to make decisions to improve the learning of youngsters, then it is mandatory that educators obtain and be able to use as much information as possible about the children for which they are responsible. Therefore, significant physical differences found between the high and low achievement motivated groups of this study should be analyzed for their educational implications.

The implications of this study do not emphasize generalizeability. They do, however, have primary application to the setting from which the subjects were drawn.

It is necessary to summarize the project to organize and focus the remainder of this chapter as well as the literature review of Chapter II. Although a detailed design of the study is presented in Chapter III, the following synopsis is given now.

Project Summary

Purpose: This study was conducted to find if there were significant differences between high and low achievement motivated early adolescent boys in:

1. Anthropometric measurements
2. Physiometric measurements
3. Health histories

Procedure:

1. Administer M-Scales to the entire seventh-grade boy population (43[illegible]) of two suburban school districts.
2. Rank the boys from highest to lowest on their M-Scale scores.
3. Choose fifty-five boys on each extreme who meet these requirements:
   a. Caucasian
   b. Twelve-thirteen years old
   c. Come from employed, intact families
4. Have two teachers that each boy thinks know him best rate his motivation level.

5. Select thirty to thirty-five boys from each group of fifty-five boys that are the most extreme examples, i.e., for a boy to be chosen he must be among those representing at least the fifty-five highest or fifty-five lowest M-Scale scores, meet the necessary requirements listed in Step three, have the teachers' evaluations of the boy's motivational level substantiate his M-Scale ranking.
6. Administer physical examinations, collect health histories and anthropometric data from the sample of approximately thirty-five high and thirty-five low achievement motivated boys.

Hypotheses to be Tested [1]

The hypotheses for this study were reached after a review of pertinent literature. Few studies found were aimed at discerning physical correlates of high or low achievement motivated behavior. No projects reviewed studied the possibility of physical correlates to the achievement motivated behavior of boys and girls younger than high school seniors. High school seniors for physiometric research purposes are generally referred to as adults. [2] Therefore, this question could be raised: Do the same physical differences found between high and low achievement motivated adults exist between high and low achievement motivated children?

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[1]The hypotheses of this project are restated in a more complete and testable form in Chapter III,

[2]E. L. Reynolds and J. V. Wines, "Physical Changes Associated with Adolescence in Boys," American Journal of Diseases in Children, Vol. LXXXII, (1951) 529-547.

Based on the documentation supplied in Chapter II it was hypothesized that these physical differences would be found in children. Even though puberty and its resultant physical modifications may have accounted for some of the reported physical differences in adults, high and low achievement motivated boys will reflect similar correlations.

I. There are significant anthropometric differences between high and low academic achievement motivated early adolescent boys.

II. There are significant physiometric differences between high and low academic achievement motivated early adolescent boys.

III. There are significant differences between the health histories of high and low academic achievement motivated early adolescent boys.

Definitions [1] To clarify the above hypotheses the following terms are defined as they relate to the discussion, implementation and interpretation of this study.

1. Academic achievement motivation -- the level of intensity of the combination of forces which initiate, direct and sustain behavior toward a scholarly goal. [2]

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[1] A more complete list of operational definitions including specific physical measurements is included in Chapter III, 42-43.

[2] W. W. Farquhar, A Comprehensive Study of the Motivational Factors Underlying Achievement of Eleventh Grade High School Students. Research Project No. 846, U. S. Office of Education in cooperation with Michigan State University, 1959, 3.

2. Early adolescent -- a chronologically twelve- or thirteen-year-old child.
3. Physiological measurements -- measurements of the general physical characteristics of an organism for purposes of comparing or classifying.
   a. Anthropometric measurements -- measurements of the size, weight and proportions of the body.
   b. Physiometric measurements -- measurements of the physiologic functions of the body by serologic or other physiologic methods. [1]

Overview of the Dissertation

This study is presented in five sections. Chapter I is designed to provide a preview of the project, as well as to expose some of the biases and presuppositions undergirding the entire opus. The latter purpose would seem to be essential to help protect the reader against unnecessary (and unintended) subjective contamination.

In Chapter II, relevant literature is reviewed. Literature related directly to this problem is sparse. The literature review of Chapter II relates to concepts rather than documentation of procedures of instrumentation.

Cited support for physical examination procedures and instruments is discussed in Chapter III. Sources of support for the ideas in the study often are drawn from outside the field of education. The interpretation, however, is focused directly upon educational implications.

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[1] Dorland's Illustrated Medical Dictionary (24th edition, 1965) W. B. Saunders Co., Philadelphia.

Chapter III is the operational blueprint of the study in which descriptions of the population, sample, operational measures, operational definitions of specific variables, testable hypotheses and statistical design are found. And Chapter III gives documentation for the specific physical examination procedures followed and instrumentation used in the study.

The first three chapters serve a preparatory role to Chapter IV, Analysis of Results. Chapter IV is largely in tabular form, subdivided into three main sections, each corresponding to one of the three hypotheses of the project. The acceptance or rejection of the null hypotheses is stated in Chapter IV.

In Chapter V conclusions are given and the implications of these results are discussed.

CHAPTER II

REVIEWING THE LITERATURE

This chapter focuses on the purpose of the project and its relationship to previous literature. Because the chapter concentrates on the physiological concepts of academic achievement motivated behavior, very little effort is put into explaining specific physical examination techniques. However, Chapter III legitimizes sample selection and physiometric measures of the study by citing relevant research.

Chapter II is subdivided into three major sections that coincide with the hypotheses as stated previously:

1. The Relevance of Anthropometric Measurements to Achievement Motivation
2. The Relevance of Physiometric Measurements to Achievement Motivation
3. The Relevance of Health Histories to Achievement Motivation

There is a variable that seems to have pertinence to each of the subdivisions, therefore it seems necessary to discuss that variable, birth order, first. Birth order is reported to be an integral part of not only achievement motivation, but also intelligence, eminence and biochemistry. With birth order seeming to be involved in more than one part of the study it is mandatory to review some of the relevant birth order research.

Birth Order

W. D. Altus [1] extensively reviewed the literature relating birth order to achievement and the need for achievement. His twenty-nine citations imply the following conclusions:

Birth Order and Intelligence

1. Birth order may be of significance when identifying very bright youngsters. The eldest are most likely to be bright.
2. The supportive data (to the above) are not conclusive nor definitive, but are consistent and compelling. [2]

Birth Order and the Need for Achievement

1. The order of birth is influential in the channeling of the power drives. [3]

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[1] W. D. Altus, "Birth Order and Its Sequelae," Science, Vol. CLI, 44-49 (January 7, 1966).

[2] L. M. Terman, Genetic Studies of Genius, Vol. I (Stanford University Press, Stanford, California) 121, (1925); J. M. Cattell, Scientific Monthly, Vol. V, 371 (1917); W. D. Altus, American Psychologist, Vol. XVII, 304 (1962).

[3] A. Adler, Children, Vol. III, 14 (1928).

2. First-borns tend to be more cooperative and curious. [1] These two personality traits seem to be components of the achievement motivation pattern. [2]

Other often-cited birth order studies include the observations of Sampson and Bartlett as they state that first-born males have a higher need for achievement. Also Cobb and French and Schachter conclude that first-born males are more likely to obtain a college education. [3]

There is not complete agreement on the role of ordinal position, however. Rosenfeld reports a dissenting opinion in his comparison of birth order to affiliation and achievement motives. He states that,

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[1] D. A. Dean (unpublished thesis, State University of Iowa, 1947) 21; P. C. Capra and J. E. Dittes, "Birth Order as a Selective Factor among Volunteer Subjects," Journal of Abnormal Social Psychology, Vol. LXIV, 203 (April, 1962).

[2] H. G. Gough, "The Construction of a Personality Scale to Predict Academic Achievement," Journal of Applied Psychology, Vol. XXXVII, 261-66 (October, 1953); G. G. Gebhart and D. T. Hoyt, "Personality Needs of Under- and Over-achieving Freshmen," Journal of Applied Psychology, Vol. XLII, No. 2, 125-28 (1958); W. F. Brown, N. Abeles and I. Iscoe, "Motivational Differences Between High and Low Scholarship Students," Journal of Educational Psychology, Vol. LXV, 214-23 (April, 1954).

[3] E. E. Sampson and F. T. Hancock, "An Examination of the Relationship Between Ordinal Position, Personality and Conformity," Journal of Personality and Social Psychology, Vol. V, 398-407 (April, 1967); E. W. Bartlett and C. P. Smith, "Child-Rearing Practices, Birth Order and the Development of Achievement-Related Motives," Psychological Reports, Vol. XIX, 1207-1216 (December, 1966); S. Cobb and J. R. French, "Birth Order among Medical Students," Journal of the American Medical Association, Vol. CLXLV, 312-313 (January 24, 1966); S. Schachter, "Birth Order Eminence and High Education," American Sociological Review, Vol. XXVIII, 757-68 (October, 1963).

at the best, the relationship between first-borns and achievement motivation is not clear, as his study indicates a negative correlation. [1] Because of the suspected but uncertain relationship between birth order and achievement motivation, those first-born children in the sample of this study will be noted and observed separately to guard against a source of research confusion.

A number of studies have hypothesized that the reason for eminence, aptitude and achievement motivation differences between first-born children and later-born is basically because of differences in child-rearing practices. [2] Later in this chapter Gordon and Gordon [3] are reported to have found differences in blood chemistry as well. Similar biochemical differences between first- and later-borns were found to exist in a study by Kasl, et al. [4]

After discussing the reported differences in achievement motivation levels and blood chemistry between children of different ordinal positions, a review of literature relative to each hypothesis may begin.

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[1] H. M. Rosenfeld, "Relationships of Ordinal Position to Affiliation and Achievement Motives," Journal of Personality, Vol. XXXIV, 467-80 (December, 1966).

[2] Altus, op. cit. (1966) 48; P. R. Sears, E. Maccoby, H. Levin, Patterns in Child Rearing (Row Peterson and Company, Evanston, Illinois, 1957) 418; J. L. Lasko, Genetic Psychology Monograph, Vol. XLIX, 97 (1954).

[3] B. E. Gordon and K. K. Gordon, "Birth Order, Achievement and Blood Chemistry Levels among College Students," Nursing Research, Vol. XVI, No. 3, 234-236 (Summer, 1967).

[4] S. V. Kasl, G. W. Brooks, S. Cobb, "Serum Urate Concentrations in Male High School Students," Journal of American Medical Association, Vol. CLXLVIII, No. 7, 713-16 (November 14, 1966).

Anthropometric Measurements and Achievement Motivation

Somatotyping and Achievement Motivation

A definitive study concerning the direct relationship between body build and the need for achievement (n Ach) by Cortes and Gatti [1] found a positive and significant correlation between mesomorphy and n Ach while a negative and significant correlation between ectomorphy and n Ach also was observed in their sample. Because the somatotype technique used is the same as that used in the present research project, Cortes study is reviewed in more depth than others.

The conclusions of this study are based on the results collected from two diverse experimental groups. One group was comprised of one hundred non-delinquent senior boys at a private high school (ninety-two percent later attended college). The other experimental group of one hundred consisted completely of convicted juvenile delinquents.

All subjects were first somatotyped using Parnell's method. [2] Then their n Ach was measured by a technique widely used by McClelland and his associates. [3] This is a projective test similar to the Thematic Apperception Test in which a subject interprets a set of pictures.

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[1] J. F. Cortes and F. M. Gatti, "Physique and Motivation," Journal of Consulting Psychology, Vol. XXX, No. 5, 408-414 (October, 1966).

[2] R. W. Parnell, Behavior and Physique, (E. Arnold Co., London, 1958). (Parnell's somatotyping method is used in this project and is explained in more detail in Chapter III, 50-52.

[3] J. W. Atkinson (Ed.) Motives in Fantasy Action and Society, (Van Nostrand, Princeton, New Jersey, 1958).

The verbal interpretation of the pictures was then scored for n Ach level by two scorers, both had worked with McClelland. The coefficient of agreement on scores was +.95. Finally the somatotype ratings were compared with the results of the n Ach test.

The experimental non-delinquent group reflected a significant, at the .01 level of probability, and positive association (+.35) between mesomorphy and n Ach, as originally hypothesized. A significant and negative correlation (-.27) existed between ectomorphy and n Ach.

In the sample of delinquents a correlation of +.20 existed between n Ach and mesomorphy. Once again a negative correlation was found between ectomorphy and n Ach. Both correlations are significant at the .05 level of confidence.

With these results the authors went on to conclude:

> Obviously the relationship found is not one of cause and effect. The results allow us only to speak only of an association between n Ach and physique, an association which is not due to chance but which cannot be called very strong for the positive correlations between the variables are not high, varying from +.20 to +.54. We cannot determine which variable comes first, physique or n Ach, nor whether both variables are directly influenced by a third common factor. [1]

Walker, et al, [2] have long equated the mesomorphic as an energetic individual. Cortes and Gatti hypothesize that a person possessing the mesomorphic traits of high energy, confidence and competition would also possess the components of high n Ach.

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[1]Cortes and Gatti, op. cit., 413.

[2]R. N. Walker, "Body Build and Behavior," Child Development, Vol. XXXIV, 1-23 (March, 1963).

> However, it seems reasonable to assume that physique, through the organs of the body, glandular secretions, and the particular chemotype, predisposes, together with many other variables, toward some types of motivation more than toward others. [1]

Maturation and Achievement Motivation

Besides somatotyping, the general area of anthropometric data relevant to maturation as measured by height, bone age and pubertal status could have pay-off as a research item. Research in this area has led some European schools to experiment with the use of a hand x-ray to determine bone age at school entry. [2] J. M. Tanner has suggested that some estimate of developmental age should be made. He suggested that it should be allowed for and that a series of educational experiences should be provided for the late maturer. [3]

What information has led some educators and child development people to these conclusions? Basically, information that could be classified in two ways: 1) the results of maturation on intelligence; 2) the results of maturation on behavior. Intelligence does not always have a direct relationship to motivation. However, if the present study's definition of academic achievement motivation is ". . . . . the combination of forces that initiate, direct and sustain behavior

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[1]Cortes and Gatti, op. cit., 413.

[2]L. M. Bayer, "Children's Growth and Maturation as Factors in Education," Pediatric Digest, 59-66 (August, 1965).

[3]J. M. Tanner, Education and Physical Growth Implications of the Study of Children's Growth for Educational Theory and Practice, (University Press, London, 1961).

toward a scholarly goal," then it could be contended that ability will be one component of sustaining behavior toward a scholarly goal. If inability prohibits success, goal-oriented behavior will be difficult to sustain.

Maturation and Intelligence Children who are physically advanced for their age score higher on mental tests than those less mature, but of the same chronological age. The difference is consistent at all ages that have been studied from six to twenty years. [1] Intelligence score differences between early and late maturing individuals seem to level out after age twenty.

Maturation and Behavior The studies of Pressey and Pressey concerning interests and social attitudes of adolescents provide an excellent example of the relation of biological and cultural factors. [2] They found that interests themselves are to a large extent culturally-determined, but the age at which an adolescent attains a state of maturity in them is dependent on his physiological development. Emotional age of the boys and girls measured by the Presseys' instrument

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[1] F. Boas, "The Relationship between Physical and Mental Development," Science, Vol. XCIII, (April 11, 1941) 339-42; G. Binning, "Earlier Physical and Mental Maturity among Saskatoon Public School Children," Canadian Journal of Public Health, Vol. XLIX, No. 1 (January, 1958) 9-17; B. O. Ljung, "The Adolescent Spurt in Mental Growth," Stockholm Studies in Educational Psychology, (Uppsala: Almquist and Wiksell, 1965); J. M. Tanner, Growth at Adolescence, (Blackwell Publications, Oxford, 1962) 309.

[2] S. L. Pressey and L. C. Pressey, "Development of the Interest-Attitude Tests," Journal of Applied Psychology, Vol. XVII (1933), 1-16.

showed spurts at the same time as spurts in growth. Davidson and Gottlieb found the similar results with pre- and post-menarcheal girls of the same age and educational status. [1]

The literature also suggests that there are other indices of a behavior differential depending on the onset of physical maturation. Latham found early-maturing boys more likely to become athletic achievement leaders. [2] In school, early-maturers appeared more confident and relaxed and were rated by adults as "more attractive." [3] Aggression in the sense of the simple desire to dominate was higher in early-maturing boys. [4] In the same study Thematic Apperception Tests gave evidence that late-maturing boys harbor more feelings of insecurity, inadequacy and rejection. The irony of the findings is stated by Tanner.

> All the differences described above could well be explained on the basis of the alleged behaviour and feelings of predominately mesomorphic persons (who are early-maturing as well) and predominately ectomorphic ones (who are late-maturing as well). [5]

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[1] H. H. Davidson and L. S. Gottlieb, "The Emotional Maturity of Pre- and Post-Menarcheal Girls," Journal of Genetic Psychology, Vol. XI (3rd Quarter, 1950)129-48.

[2] A. J. Latham, "The Relationship between Pubertal Status and Leadership in Junior High School Boys," Journal of Genetic Psychology, Vol. LXXVIII (2nd Quarter, 1951) 185-94.

[3] M. C. Jones and N. Bayley, "Physical Maturing among Boys as Related to Behavior," Journal of Educational Psychology, Vol. XLI (March, 1950) 129-48.

[4] P. H. Mussen, M. C. Jones, "Self-Conceptions, Motivations and Interpersonal Attitudes of Late- and Early-Maturing Boys," Child Development, Vol. XXVIII, No. 2 (June, 1957) 243-56.

[5] J. M. Tanner, op. cit. (1962) 221.

Physiometric Measurements and Achievement Motivation

Although a few investigators have studied the relationship between physiology and achievement motivation in adults, no citation was found in the literature which addressed itself to this relationship as it might exist in children. Therefore, the review of literature relative to the role of physiology in achievement motivation must be limited to studies of adults. Currently those relationships which do exist can only be estimated when discussing physiology's role in a child's achievement motivation level. This literature review does not provide documentation to enable estimation of this relationship in children, but it does report those physiometric measurement patterns that seem to indicate a relationship between body chemistry and functioning and achievement motivation levels of adults.

Body Chemistry and Achievement Motivation

The concept of relating body chemistry to achievement motivation is relatively new. Much of the original impetus came from the study of gout. Investigators were impressed by the frequency that gout was mentioned as a disease encountered by persons of distinction and achievement. [1] Gout is often a physical manifestation of those who have a heightened level of uric acid in their blood. In 1955 Orowan pointed out that significant levels of serum uric acid exist only in higher apes and man. [2] Because the most definitive results of the relationship of body chemistry and achievement motivation have been found in uric acid studies, this is where the review began.

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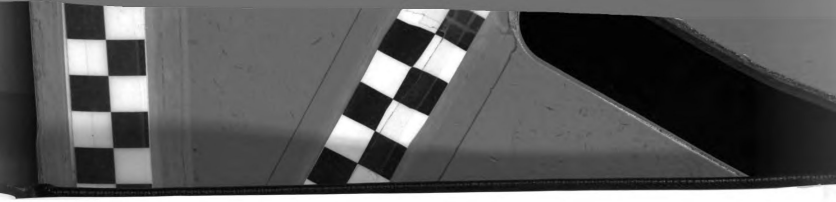
[1] D. Stetten, Jr., "Gout," Perspectives in Biology and Medicine, Vol. II (Winter, 1959) 185-96.

[2] E. Orowan, "Origin of Man," Nature, Vol. CLXXV, No. 4459 (April, 1955) 683-84.



Serum Uric Acid and Intelligence Stetten and Heardon have studied the relationship of serum uric acid concentration and intelligence test scores of 817 U. S. Army inductees. They found that a correlation of +.076, significant at the .015 level of confidence, existed between the inductees' scores on the Army Classification Battery and their serum uric acid concentrations. [1] These results were duplicated by Kasl [2] as he found a correlation of .097 between the Otis Self-Administering Test of Mental Ability scores of 138 high school boys and their serum uric acid levels. Of considerable interest also is the recent evaluation of the effect of glutamic acid in the improvement of human cognitive functioning. [3]

> Feedings of glutamic acid have been reported to result in increased drive and in positively affecting personality characteristics related to cognitive performance. Glutamine has been shown by recent work to be involved in the production of uric acid resulting from the biosynthesis of purines. [4]

Kasl's statement seems to implicate uric acid with the RNA-DNA (also involved in the above process) studies of intelligence, particularly in light of Gordon's statement:

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[1]D. Stetten, Jr., and J. Z. Heardon, "Intellectual Level Measured by Army Classification Battery and Serum Uric Acid Concentration," Science, Vol. CXXIX, No. 3365 (June, 1959), 1737.

[2]S. V. Kasl, G. W. Brooks, and S. Cobb, "Serum Urate Concentrations in Male High School Students," Journal of the American Medical Association, Vol. CXCVIII, No. 7 (November 14, 1966), 713-16.

[3]W. Vogel, et al, "The Role of Glutamic Acid in Cognitive Behaviors," Psychological Bulletin, Vol. LXV, No. 6 (January, 1966),367-82

[4]Op. cit., Kasl, et al, 418.

> Uric acid, a metabolite of nucleic acids, and thus of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) has been found to be related positively to academic achievement. It probably functions as an endogenous cortical stimulant. [1]

Serum Uric Acid and Achievement Motivation Three studies at the University of Michigan have provided the following findings about serum uric acid (SUA).

Brooks and Mueller [2] gave support to the theory that a tendency to gout is a tendency to the executive suite and that serum uric acid is related to behavioral characteristics that lead to outstanding performance. They reported the findings after rating fifty-one University of Michigan professors on seven behavior scales, then correlating their behavioral ratings with their SUA levels.

TABLE 2.1 [3]

CORRELATION OF TOTAL BEHAVIOR SCORE AND SUBSCALES WITH SERUM URIC ACID (FIFTY-ONE COLLEGE PROFESSORS)

Variable	Pearsonian Correlation Coefficient
Total behavior score	0.66*
Drive	.57*
Achievement	.54*
Leadership	.54*
Pushing of self	.43*
Range of activities	.51*
Attitude towards pressure	.12
Emphasis on research	0.19

*Correlations significant at the $p \leq .05$ level or better

[1] Op. cit., Gordon (1967) 234.

[2] G. W. Brooks, E. Mueller, "Serum Urate Concentrations among University Professors," Journal of the American Medical Association, Vol. CXCV, No. 6, (February 7, 1966) 415-518.

[3] Ibid, 417.

Kasl, Brooks and Cobb [1] studied sixty-two high school boys interviewed and examined while in high school and again four years after high school graduation. The boys were divided into three groups: 1) those who completed college (CC); 2) those who attempted college but dropped out (AC); and 3) those who did not go to college. An evaluation of high school grades suggested that the AC group was more highly motivated, for they attempted college even though they had poor grades. The highest uric acid levels were found in this group; and within the group, those that attended college longest had the higher serum uric acid concentrations. In the study it was also found that first-borns had higher uric acid levels.

Dunn, et al, [2] performed the initial work that spawned the previously mentioned University of Michigan studies. Dunn found serum urate related to the type of work his subjects performed. Reasonably certain that factors of individual variability, age, disease and drug ingestion were not responsible, Dunn found that male executives had a higher serum uric acid level than craftsmen. An additional study compared one hundred thirty-eight high school boys and found:

1. Increasing Otis Test scores showed an increase in serum uric acid (SUA).
2. Straight 'A' students had the highest SUA.
3. Students with the most extracurricular activities had elevated SUA measurements.

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[1] Op. cit., Kasl, et al.

[2] J. P. Dunn, G. W. Brooks, J. Mausner, G. Rodnan, S. Cobb, "Social Class Gradient of Serum Uric Acid Levels in Males," Journal of the American Medical Association, Vol. CLXXXV, No. 6 (1963) 431-36.

4. Students receiving the highest teacher rating on such traits as leadership, responsibility, and industry had higher SUA values.

There was no association of serum urate levels among the subjects' parents relative to the level of education of the parents, father's occupation, nor occupational preferences.

Other Biochemicals and Achievement Motivation Other biochemicals besides serum uric acid have been correlated with a need for achievement. R. E. Gordon, a University of Florida psychiatrist who is the most published researcher in this area of interest, has replicated the serum uric acid results of the three University of Michigan studies a number of times. [1] Gordon found the following relationships among forty-three nursing students of Wagner College.

TABLE 2.2 [2]

BIRTH ORDER OF NURSING STUDENTS IN RELATION TO BLOOD CHEMICAL LEVELS AND GRADE POINT AVERAGE

Mean Scores	Only Child	First-born with Siblings	Middle Child	Last Child
G. P. A.	3.0	2.6	2.5	2.4
Uric Acid Level	5.1	5.0	4.9	3.8
Cholesterol Level	220	200	200	180
Sugar Level	95	87	89	84

[1] R. E. Gordon, R. H. Lindeman, and K. K. Gordon, "Some Psychological and Biochemical Correlates of College Achievement," Journal of American College Health Association, Vol. XV, (April, 1967) 326-31; R. E. Gordon and K. K. Gordon, "Birth Order, Achievement and Blood Chemistry Levels among College Nursing Students," Nursing Research, Vol. XVI, No. 3 (Summer, 1967) 234-36.

[2] Ibid., 236.

Another Gordon study seems to indicate SUA as being more associated with motivation than ability. The conclusion was drawn when it was found that Wagner College freshmen and sophomores with a Scholastic Aptitude Test score of 500 or less had higher SUA levels than their higher ability (SAT >500) classmates. Apparently, many lower ability students required high motivation just to compete in college. The SUA levels of high ability students with high GPA were positively correlated with their GPA. Correlations between serum uric acid and grade point averages were nearly as high as correlations between Scholastic Aptitude Test scores and grades. [1]

Students with SAT > 500 had a negative correlation between SUA and cholesterol. This finding suggests that high-ability students with inner drive may have been less pressured by academic duties. Low-ability students had a positive significant correlation between SUA and cholesterol. Presumably high-motivated, low-ability students were burdened by their studies and therefore had an elevated cholesterol. [2] This presumption is consonant with the findings of Brooks and Mueller as they found the same results in their sample of university professors who felt "overburdened." [3] Friedman and Rosenman studying blood and cardiovascular patterns found that their sample of men exhibiting a behavior characterized by intense ambition, competitive "drive," a constant preoccupation with occupational deadlines

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[1] R. E. Gordon, "Serum Biochemicals and College Student Personality, Performance and Health," unpublished, written in 1968.

[2] Ibid., 3.

[3] Op. cit., Brooks, Mueller, (1966).

and a sense of time urgency had a much higher serum cholesterol level than their more sedate sample groups. The "pressured" group also had a hastened clotting time and seven times the incidence of coronary artery disease and three times the incidence of arcus senilis (a circular opaqueness around the cornea). [1]

Non-biochemical Physiometric Measurements and Achievement Motivation

Visual Acuity Becker has reported that visually acute individuals (college students) tend to show motivational patterns that contrast those who are either near- or far-sighted. Normally-sighted persons, and those mildly near-sighted, tend to be achievement oriented and emotionally unattached. Those far- and near-sighted tended to be emotionally attached. [2]

Another study seems to further differentiate normally-sighted persons and ametropes (near- or far-sighted persons) in regard to associated motives underlying or giving direction to achievement motivation. Normally-sighted persons seem to be motivated to achieve "via" independence [3] while ametropes seem to be motivated through their social and systematic needs. [4]

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[1] M Friedman and R. H. Rosenman, "Association of Specific Overt Behavior Pattern with Blood and Cardiovascular Findings," Journal of the American Medical Association, Vol. CLXIX, No. 12 (March 21, 1959) 1286-95.

[2] G. Becker, "Visual Acuity, Birth Order, Achievement Versus Affiliation, and other Edwards Personal Preference Schedule Scores," Journal of Psychosomatic Research, Vol. IX (December, 1965) 277-83.

[3] H. C. Gough, Manual for the California Psychological Inventory, (California Psychologists Press, California, 1957).

[4] G. Becker, "Visual Acuity and Motivational Patterns Underlying Achievement," Journal of Psychosomatic Research, Vol. X (December 1966) 275-79.

Blood Pressure Although blood pressure has long been associated with hypertense, hyper-reactive individuals, no proof is offered in the literature as to the relationship between blood pressure and achievement orientation. The only mention of blood pressure was in Heckhausen's book, The Anatomy of Achievement Motivation. [1] Even here there is only a one-sentence statement that glibly refers to a systolic blood pressure difference between high and low achievement motivated persons. The statement offered no proof of the difference nor did the book's footnotes and bibliography.

Genetic Factors A considerable amount of research has led to the conclusion that there are strong associations between heredity and ability. Using the same logic in explaining the relationship between ability and motivation that was stated earlier in this chapter, one could impute a genetic influence on achievement motivation. However, no studies have shown a direct relationship of heredity to achievement motivation. The only project reporting a genetic influence on motivation studied the genetic factors in activity motivation. [2] Though there is little known at this time about the genetic influence on achievement motivation, the current state of the science of genetic investigation repressed this study from pursuing the possible genetic correlates of achievement motivation.

Neurological Factors An hypothesis gaining favor in explaining the "underachievement phenomenon" is that the achievement problems are an expression of a basic neurological defect. Many terms describe

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[1] H. Heckenhausen, The Anatomy of Achievement Motivation, (Academic Press, New York, 1967) 215.

[2] S. Scarr, "Genetic Factors in Activity Motivation," Child Development, Vol. XXXVII, No. 3 (September, 1966) 663-73.

describe this pattern. Among the most widely used are: 1) minimal brain dysfunction; 2) hyperkinetic syndrome; 3) dyslexia; 4) cerebral dysfunction; and 5) minimal brain damage. The myriad labels are further confounded by even more definitions. [1]

For example, Anderson describes the symptoms found in a group of thirty hyperkinetic children as follows:

1. Motor development tends to be slow in most of the children.
2. Muscle coordination is generally below average.
3. The majority are reading at least two years below expectation from their intelligence quotient test. Reversal and mirroring is common in reading and writing.
4. Soft neurological signs are common.
5. A high percentage of abnormal brain waves.
6. Visual perceptual and visual motor difficulties. [2]

Clements and Peters have named the syndrome minimal brain dysfunction. The dominant symptoms are:

1. Specific learning deficits -- child cannot read at grade level, mild stress may bring out dyslexic type errors.
2. Perceptual motor deficits -- printing, writing and drawing poor and erratic performance when copying geometric figures.
3. General coordination deficits -- child awkward or clumsy.
4. Hyperkinesis -- child appears to be in constant motion.

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[1] M. Beekman, unpublished presentation to the Mott Special Education Colloquium at the Mott Children's Health Center, Flint, Michigan, April 14, 1969.

[2] W. W. Anderson, "The Hyperkinetic Child: A Neurological Appraisal," Neurology, Vol. XIII (November, 1963) 968-73.

5. Impulsivity -- may occur in handling objects, talking, aggressive behavior.
6. Emotional lability -- high strung, irritable, aggressive behavior.
7. Short attention span or distractibility.
8. Equivocal neurological signs.
9. Abnormal or borderline abnormal EEG. [1]

Most writers, independent of their orientation, suggest that the child's intellectual ability as measured by the WISC, or some other instrument not dependent upon the child's reading ability, predicts a higher level of performance than found in grades or achievement test scores. [2] Because of the discrepancy between ability as tested and achievement, these youngsters may show up in the low-achievement-motivated sample.

Health Histories and Achievement Motivation

There were no studies found in the literature that were addressed directly to the relationship that may exist between health history and achievement motivation. The longitudinal growth studies of children in Shaker Heights, Ohio, might be considered in this section. However, the study charted growth, as the result of health history, against achievement. Using a Wetzel Grid [3] the ten-year study found a direct

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[1] S. D. Clements and J. E. Peters, "Minimal Brain Dysfunctions in the School-Age Child," Archives of General Psychiatry, Vol. VI (March, 1962) 185-97.

[2] R. P. Anderson, an unpublished paper, "The Basis of Underachievement: Neurological or Psychological," 1967.

[3] N. C. Wetzel, Instruction Manual in the Use of a Grid for Evaluating Physical Fitness (N.E.A. Service, Chicago, 1941).

relationship between normal growth patterns and expected achievement. When a child's growth did not keep up with his peers his school achievement tended to slow down as well. [1]

Brooks and Mueller, [2] Kasl, [3] Dunn, [4] and Gordon [5] included certain aspects of health history in their studies. Among the factors were: alcohol, coffee and cola consumption, smoking and sleeping habits, exercise and work hours; although these factors modified body chemistry, there was no reason to believe that the resulting biochemical change affected achievement motivation.

Summary

A search of relevant literature revealed no studies reported that directly compare any physiological differences which may exist between high and low achievement motivated boys. However, a number of pertinent facts have been uncovered. These facts prompt close observation of certain components of this study and require research awareness of others.

Birth Order and Achievement Motivation

One of the most compelling conclusions of this chapter is that birth order has relevance to the attainment of scholastic eminence. Reasons stated for this imply that first-borns seem most likely to be bright. They also tend to have a higher need for achievement. Although most of the studies conclude that the tendency of first-borns

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[1] H. H. Hopwood and S. S. Van Iden, "Scholastic Underachievement as Related to Sub-par physical Growth," Journal of School Health, Vol. XXXV, No. 8 (October, 1965) 337.

[2] Op. cit., Brooks-Mueller. [3] Op. cit., Kasl.

[4] Op. cit., Dunn. [5] Op. cit., Gordon, (1967).

to be brighter and more motivated is because of child-rearing practices, some researchers have found biochemical differences between first- and later-borns. There is, however, a reluctance to specify a cause and effect relationship of ordinal position and biochemical differences.

Because of the relationships between birth order and intelligence, blood chemistry and motivation, first-born boys in the sample will be noted and appropriately observed.

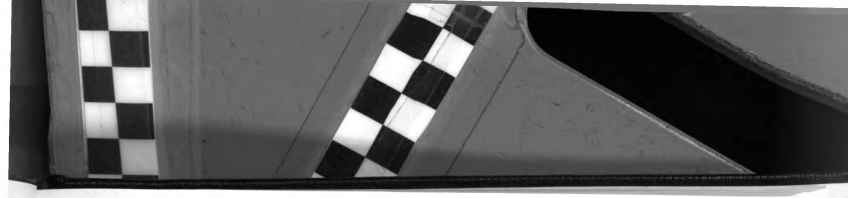
Anthropometry and Achievement Motivation

Somatotyping has supplied the research result that mesomorphy is significantly related to achievement motivation. Ectomorphy is negatively correlated, significant at the .05 level of confidence. The study cited used the same somatotyping technique to be incorporated in this study.

Effects of maturation (as measured by bone age) on youngsters of the same chronological age indicates that the earlier maturing individual is more likely to score higher on intelligence tests than those less mature. Also early maturing boys were reported to have developed a more pronounced need to dominate and lead, while late-maturers harbored more feelings of insecurity, inadequacy and rejection.

Physiometry and Achievement Motivation

The most consistent research finding relative to the role of biochemistry in achievement motives is that serum uric acid (SUA) seems associated with achievement. This association is reported in



two ways: 1) the positive correlation of heightened SUA levels and ability; and 2) the positive correlation of heightened SUA and achievement motivation. Of the two correlations the latter seems dominant. Cholesterol elevation has been reported in students with a higher motivation.

Other physiometric differences that have been reported to exist between high and low achievement motivated individuals include visual acuity differences. Normally-sighted and mildly near-sighted college students tend to be more achievement oriented than far- and near-sighted students. Studies of the relationship of blood pressure, heredity and neurology have not clearly pointed up achievement-behavior differences.

Health History and Achievement Motivation

Of the three general areas of inquiry, the subject of health and motivation was least studied. However, a ten-year longitudinal growth study revealed an association between sub-par physical growth and underachievement. Beverage intake, exercise and work habits, smoking and sleeping habits have been charted and seem to have an effect on body chemistry, but achievement motivation is not consistently affected.

Conclusion

The overriding result of this literature review has focused the question: Do the same physical relationships that exist between high and low achievement motivated men exist between high and low achievement motivated boys? An automatic transference of these researched relationships cannot be made from adult to child. The research attempted

to define if the same physical patterning relative to achievement-motivation is evident before the pubertal process is complete. With a backlog of physiological information eventually educators may be better able to make child-centered decisions based on more complete information about the child and his total development.

CHAPTER III

RESEARCH DESIGN

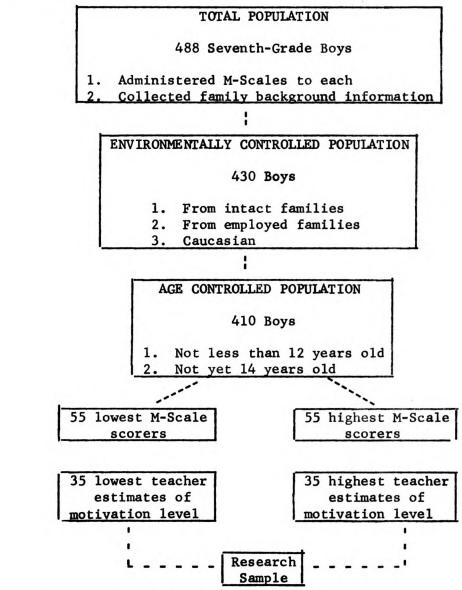
The purpose of this study was to compare high and low achievement motivated early adolescent boys on a number of physiometric, anthropometric, and health measurements. The content of Chapter III focuses on the means by which comparisons of the high and low achievement motivated groups were made, as well as a description of the two groups of boys themselves.

In the first section of the chapter a description of the tested population, the research sample, and the means by which the sample was derived are given. Then the hypotheses, originally stated in the first chapter, are elaborated upon. This elaboration is supported by an augmented list of operational definitions and measurements. Finally, the protocol followed in testing for physiological and health differences is presented.

The following table (Table 3.1) is offered to assist the reader in understanding the organization of the first section of the chapter.

TABLE 3.1

RESEARCH SAMPLE SELECTION FROM TOTAL TESTED POPULATION OF SEVENTH-GRADE BOYS



Population

The population of this study was drawn from two suburban school districts within the metropolitan area of Flint, Michigan. At the time of the study the two districts reflected a strong middle class socio-economic base. The districts were basically "bedroom communities" with a vast majority of their wage earners working in the Flint business and industrial complex. Neither school district had more than one-half percent non-white school population. The low percentage of non-white school population was important to the study because many of the normal values on which comparisons of the motivated and non-motivated groups were made were drawn primarily from Caucasian populations.

Of the two participating school districts, District A, which provided the majority of the test population, was more affluent. District A had two junior high schools listed in Table 3.2 as School I and School II. Of the two schools, the attendance area of School I seemed to have more expensive residential areas as indicated by larger lots, newer and larger dwellings and distance from industrial plants. Using the same criteria, the attendance area of School II seemed to represent a similar, if not slightly more expensive, housing pattern than that of School III, the only junior high school of District B.

A total of four hundred eighty-eight seventh-grade boys constituted the original tested population. The tested boys included all seventh-grade boys who were in school on the day of the test administration.

TABLE 3.2

ORIGINAL POPULATION OF SEVENTH-GRADE BOYS

Schools	Number of Boys Tested
School District A:	
School I	194
School II	118
School District B:	
School III	176
Total	488

The Instrument for Determining Motivation Level

The instrument chosen to initially discriminate motivation level was the Michigan State M-Scales developed in 1963 as an objective paper-pencil indicant of achievement motivation level.[1]

Essentially, the M-Scales of Project 846 represent an attempt to study the non-intellectual facets related to the extremes of academic achievement. [2] The Scales were based on the assumption that if a student achieved higher or lower than one standard error of estimate from the regression prediction of his actual achievement, he was a discrepant, or under- or over-achiever. It was further assumed that the major reason for a student being so far from his predicted achievement was academic motivation.

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[1]W. W. Farquhar, A Comprehensive Study of the Motivational Factors Underlying Achievement of Eleventh Grade High School Students, Research Project 846, U. S. Office of Education in cooperation with Michigan State University.

[2]W. W. Farquhar and E. W. Christensen, Motivational Factors Influencing Academic Achievement of Eleventh Grade Puerto Rican High School Students, Research Project No. 2603A and B, Office of Education, Department of Health, Education and Welfare, December 1967, 5.

Louis J. Hofman [1] applied a multitrait-multimethod matrix to the study of the need for achievement construct. The tests examined were: 1) the McClelland and Atkinson TAT; 2) the French Test of Insight; 3) the Edwards Personal Preference Schedule; 4) a self-report measure of n-achievement and n-affiliation; and 5) the M-Scales. The test scores were obtained on a sample of eleventh and twelfth grade male students.

The construct validity of these measures was assessed by: 1) comparing the intercorrelations of the test scores within a matrix; 2) examining the correlations of the n-achievement scores with intelligence and achievement scores; 3) a factor analysis of test scores.

The multitrait-multimethod matrix yielded intercorrelations of n-achievement scales generally positive and significantly different from zero. The projective methods (Test of Insight and TAT) were less adequate than the objective methods of measurement.

The correlations of Edwards Personal Preference Inventory, the Self-Report Inventory, and the M-Scales with Lorge-Thorndike intelligence scores were positive and significantly different from zero ($r = .286$, $.167$, and $.388$ respectively), while the Test of Insight and the TAT were not as related ($r = .217$ and $.089$ respectively).

The correlations of the motivation scores with academic achievement were similar. The EPPS, the Self-Report Inventory and the M-Scales were positively and significantly related ($r = .360$, $.301$, and $.356$), while the TOI and TAT correlations were lower ($r = .200$ and $-.098$).

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[1] L. J. Hofman, "An Application of the Multitrait-Multimethod Matrix to the Study of the n-Achievement Construct" (an unpublished Ph.D. dissertation, Michigan State University, 1965).

The Hofman study indicated the respectability of the M-Scales as an instrument to be used as an initial screening device to locate a research sample of highly achievement motivated boys and a group less motivated.

Three of the original four M-Scales were used to determine the academic achievement motivation level of the present study's population. The Preferred Job Characteristics Scale (PJCS) was deleted because of the lack of clear occupational goals found in most seventh-grade boys. Deletion of the PJCS dimished the necessary test administration time as well. The one-hundred-fifty-four-item instrument given to the test population was comprised of the following sections.

The Generalized Situational Choice Inventory (GSCI). The GSCI was comprised of fifty-three test items chosen from the list of the original 200 GSCI items of the M-Scales. For each forced-choice pair of responses (one indicating high and the other low academic motivation) students were instructed to select the alternative with the highest preference.

Examples:

1. I would prefer to:
   a. Be graded at the end of a course with the possibility of making an "A" or,
   b. Get a "C" at the beginning of a course along with everyone else.
2. I would prefer to:
   a. Inherit a great deal of money, or
   b. Earn a great deal of money..

3. I would prefer to:

   a. Do a less recognized but complete job, or

   b. Do a recognized but incomplete job.

Word Rating List (WRL) Items fifty-four through one hundred twenty-one were developed to measure the "looking glass self." The items were selected for this M-Scale of extracting descriptive words and phrases from the self-concept literature and a review of personal, motivational and intellectual characteristics by students representing extremes in academic performance. For each item the student was asked to rate the way he thought his teacher would typically describe him if she were to use those words or phrases. The rating was on a four-point scale (1 = never, 2 = sometimes, 3 = usually, and 4 = always).

Sample words:

Teachers feel I am:

1.	Confident	1 2 3 4
2.	Careful	1 2 3 4
3.	A planner	1 2 3 4
4.	Original	1 2 3 4
5.	Stubborn	1 2 3 4

Human Trait Inventory (HTI) Items one hundred twenty-two through one hundred fifty-four consisted of personality statements from previous research differentiating between any level of achievement (high, low or discrepant). The same four-point rating scale of never, sometimes, usually, and always was used.

Examples:

1.	I worry about my grades.	1 2 3 4
2.	I plan my activities in advance.	1 2 3 4

3. When I have an opinion, I stand up for it. 1 2 3 4

4. I like being with people in social gatherings. 1 2 3 4

5. I like to be consistent in the things I do. 1 2 3 4

M-Scale Administration The M-Scales were originally developed for high-school-age youth; however, the instrument had been given to junior high students previously without hindering reliability appreciably. [1] To compensate for the possibility of testing beyond the reading and vocabulary levels of seventh-grade students adequate reading and vocabulary assistance was provided during test administration.

The M-Scales were given according to the accompanying test manual. [2] The tests were administered in large groups consisting of eighty-three to one hundred eighteen boys. School cafeterias proved to be the most comfortable and expansive areas for the purpose. Arrangements were made to have one test proctor for every fifteen students. In all testing situations the test proctors, who were teachers, graduate students in educational administration, and school administrators, were told to supply all of the reading and vocabulary help necessary for test completion. The students were told the assistance was available. Although testing time for the M-Scale is normally about fifty minutes, some youngsters were given up to ninety-five minutes in which to complete the test.

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[1] Informed of this fact during personal conversation with Doctor Farquhar January 8, 1969, in East Lansing, Michigan.

[2] Op. cit., Farquhar, 1963.

Test Results Test responses were recorded on light sensitive answer sheets which were corrected by Michigan State University's Test Scoring Center, which also generated input for further computer analysis of data.

The M-Scale yielded a range of scores from fifty-one to one hundred twenty-two with a mean of 94.0 and a standard deviation of 13.1. The results of the test are recorded in Table 3.3.

TABLE 3.3

FREQUENCY DISTRIBUTION OF M-SCALE SCORES BY SCHOOL

M-Scale Scores	School III	School II	School I	Group Total
121-125	0	0	1	1
116-120	2	2	7	11
111-115	7	10	23	40
106-110	15	15	23	53
101-105	20	10	21	51
96-100	31	18	35	84
91-95	24	13	23	60
86-90	29	18	20	67
81-85	15	12	9	36
76-80	15	11	14	40
71-75	8	9	6	23
66-70	2	0	2	4
61-65	1	0	0	1
56-60	1	0	0	1
51-55	1	0	1	2
	171	118	185	474*
75%tile	101.0	105.0	107.0	104.0
50%tile	93.4	94.3	97.9	95.6
25%tile	85.5	84.7	89.0	86.3

Total Group

Range = 51-122
Mean = 94.0
S. Deviation = 13.1

*14 tests were invalidated because of incorrect marking or no identification.

A more specific breakdown of test results including each school's mean, standard deviation, Kuder-Richardson Reliability Coefficient #20, and standard error of measurements as prepared by the Data Processing Department of Michigan State University is presented in Table 3.4.

TABLE 3.4

M-SCALE RELIABILITY COEFFICIENTS BY SCHOOL

Items	School I		School II	School III
	Morning Group	Afternoon Group		
Number of boys	95	90	118	176
Standard Deviation	14.85	12.80	12.30	12.32
Reliability Coefficient	.94	.92	.91	.91
Standard Error	3.37	3.47	3.61	3.66

Environmental Controls

To control for environmental factors that could enter into the results, the total tested population was further reduced by dropping from the sample those boys who were not from intact families. Boys from unemployed families were not included. Elaboration on these controls is included in the following sections.

Intact Families For purposes of this study an intact family is defined as a family whose original mother and father are living at home with the children of the family. The number of boys in the original tested population that identified their families as other than intact was fifty-one. These fifty-one boys were discarded from the research sample.

Veroff's [1] finding in 1960 that need for achievement tended to be high in those individuals from intact homes served as the main reason for using family unity as an environmental control factor.

Employed Families If a boy notes that neither his mother nor his father was employed full-time, the boy's family was identified as unemployed. Unemployed families were not used in the sample so an income level considered as insufficient to provide an adequate diet would not become a prevalent factor.

The environmental control of deleting all unemployed families from the research sample only affected seven families from the entire original population. This small number may reflect the economic conditions of the two school district attendance areas involved, or it may be a reflection upon the study's broad definition of "employed family."

Caucasian A determination as to whether or not a boy was Caucasian was made by observation. The control of this factor was necessary because a number of physiological and anthropometric normal values used in this study were drawn from primarily Caucasian populations.

Age Control

All of the boys in the research sample had to be twelve or thirteen years old. By ruling out underage and overage seventh-graders, physiometric and anthropometric measures were protected from being skewed because of the boys' ages. Determination of pubertal status

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[1] J. Veroff, J. Atkinson, S. Feld and G. Gurin, "The Use of Thematic Apperception to Assess Motivation in a Nationwide Interview Study," Psychological Monographs, Vol. LXXIV, No. 499 (1960) 12.

could also insure a certain amount of maturational homogeneity; however, the evaluation was not practical before the boys were physically examined. This determination would have the same limitations if used in a conventional school setting.

Twenty boys were identified as fourteen years or older and therefore not included in the research sample.

TABLE 3.5

THE RESULTS OF RESEARCH CONTROLS ON THE TESTED POPULATION

Population Controls	Number of boys
Original Test Population	488
Environmental Controls:	
From unintact families	51
From unemployed families	7
Nonwhite	0
Age Controls:	
Less than 12 years old	0
14 years old or older	20
Total Controlled Population	410

Choosing The Two Research Groups

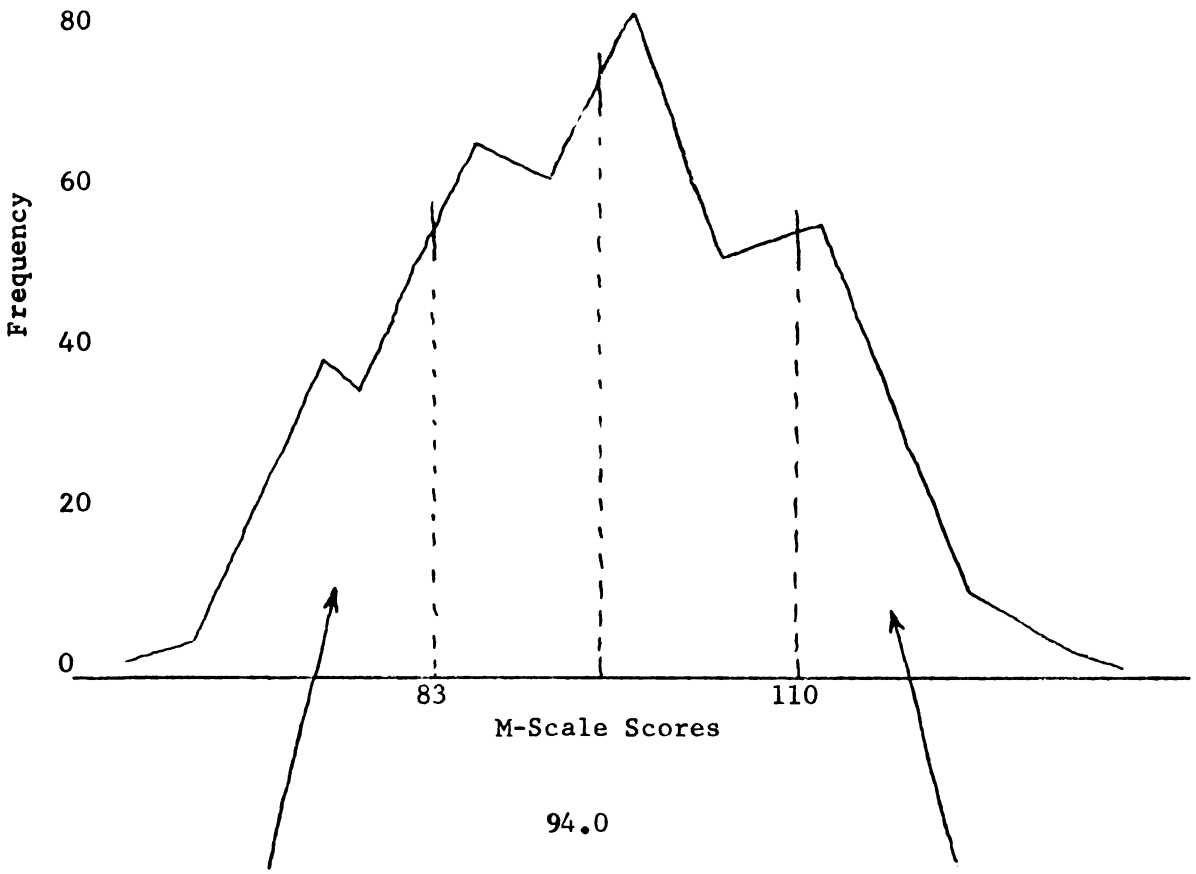
Step I. M-Scale Scores

A high achievement motivated sample and a low achievement motivated sample were identified from the four hundred ten remaining boys after the application of the study's controls. The fifty-five boys in the

refined population who had the highest M-Scale scores comprised the high achievement motivated group. The fifty-five boys with the lowest M-Scale scores comprised the low achievement motivated group.

TABLE 3.6

M-SCALE SCORES AND DESCRIPTION OF HIGH AND LOW ACHIEVEMENT MOTIVATED SAMPLE GROUPS



Low Group Scores ≤ 18.8%tile

High Group Scores ≥ 86.3%tile

Total Mean = 94.0
Standard Deviation = 13.1

Step II. Teacher Cross-Validation

Every boy given the M-Scales was asked on his personal data sheet, "Name two teachers that you think know you best." Both teachers identified by each of the boys defined in the previous step estimated the academic achievement motivation level of the boy that felt "this teacher knows me best." In other words, if John Jones identified Teacher X and Teacher Y as knowing him best, Teacher X and Teacher Y would both estimate John's academic achievement motivation level in comparison to other boys in his class.

TABLE 3.7

DISTRIBUTION OF TEACHER ESTIMATES OF ACHIEVEMENT MOTIVATION LEVEL OF 110 STUDENTS IN INITIAL SAMPLE

	55 High Scorers		55 Low Scorers	
%tile Estimate	First Teacher Identified	Second Teacher Identified	First Teacher Identified	Second Teacher Identified
90%	29	25	5*	3*
75%	13	14	7*	9*
50%	7	13	18*	14*
25%	2	2	10	14
10%	1	1	13	13
No estimate	3	0	2	2

*Includes ratings from remedial groups

Step III. Choosing the Most Extreme Students

From the one hundred ten boys that were cross-validated by teacher estimates of academic achievement motivation, seventy were chosen to be in the research sample. Those chosen had the thirty-five highest and thirty-five lowest teacher estimates of motivation level within their respective groups. Those boys with an average teacher estimate of achievement motivation level of less than 82.5% were not eligible for the highly motivated sample. Those boys with an average teacher estimate of achievement motivation over 50 percent were not eligible for the lower motivated sample.

TABLE 3.8

DISTRIBUTION OF TEACHER ESTIMATES OF ACHIEVEMENT MOTIVATION OF THE 70 BOYS IN THE RESEARCH SAMPLE

	Higher Motivated Sample			Lower Motivated Sample		
%tile Estimate	First Teacher Estimate	Second Teacher Estimate	Total Group Mean	First Teacher Estimate	Second Teacher Estimate	Total Group Mean
90%	22	24		1*	0	
75%	11	10	85.3%	2*	2*	
50%	0	0		12*	11*	
25%	0	0		8	13	32.5%
10%	0	0		12	9	
No estimate	2	1		0	0	

*Includes ratings from remedial groups

A Summarizing Description of the Research Groups

Boys in either research sample group had these characteristics: 1) came from employed families; 2) came from intact families; 3) Caucasian; and 4) greater than twelve years of age, but less than fourteen years old.

Higher Achievement Motivated Sample A boy in this sample scored no lower than one hundred ten on the M-Scales. Two teachers that he identified as "knowing him best" estimated his academic achievement motivation level at no less than at the eighty-second percentile compared to other boys in his class. More complete information on his family and his abilities is provided in the next chapter.

Lower Achievement Motivated Sample No boy in this group scored higher than eighty-three on the M-Scales. The two teachers who rated his motivational level felt that his level rated, at most, about at the fiftieth percentile within his class. More specific information relative to the environmental characteristics of this group and the group's abilities and disabilities is given in the next chapter.

Hypothesis I

Null hypothesis I: No significant difference will be found in anthropometry as indicated by average anthropometric measurements, between high and low academic achievement motivated groups of early adolescent boys.

Symbolically: $H_0: \mu_1 = \mu_2$

Legend: μ_1 = High academic achievement motivated group anthropometric measurement mean.

μ_2 = Low academic achievement motivated group anthropometric measurement mean.

Alternate hypothesis I: There will be significant anthropometric differences between high and low achievement motivated early adolescent boys as indicated by average anthropometric measurements of the two groups.

Symbolically: $H_1: \mu_1 \neq \mu_2$

Legend: μ_1 = High academic achievement motivated group anthropometric measurement mean.

μ_2 = Low academic achievement motivated group anthropometric measurement mean.

Operational Measures of Hypothesis I

The following anthropometric variables were measured pursuant to hypothesis I of the study:

Height Height was measured with the boys in stocking feet. It was recorded in inches to the nearest one-half inch using a clinical height measuring device.

Weight Weight was measured with the boys in their undershorts and stockings. It was recorded in pounds to the nearest one-half pound using a clinical scale of the Continental Scale Corporation of Chicago, Illinois.

Bone Age Each boy was given a bone x-ray of both hands as part of his anthropometric evaluation. The x-rays were read by the Chief of Radiology of Hurley Hospital in Flint. A bone-age determination was made using the standards of Greulich and Pyle. [1] A cross validation of the bone-age estimate was made by the head of the Department of Pediatric Medicine of the Mott Children's Health Center. There was complete agreement between the two physicians on the bone-age estimates in sixty-six out of sixty-seven x-rays.

Body Build A detailed explanation of how the somatotyping procedure used in this study was done can be found in Parnell's book, Behavior and Physique. [2] This method of somatotyping was chosen for reasons of objectivity, consistency and in deference to the modesty of early adolescent boys, for many other body typing techniques require nude photography in order to analyze body builds.

Parnell identifies three basic components of body build: fat (endomorphy); muscularity (mesomorphy); and linearity (ectomorphy). Because Parnell did not supply body build charts for twelve and thirteen-year-olds, it was necessary to construct a body build chart for the specific population of this study. A comprehensive explanation

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[1] W. W. Greulich and S. I. Pyle, Radiographic Atlas of Skeletal Development of the Hand and Wrist (Stanford University Press, Stanford, California, 1959).

[2] R. W. Parnell, Behaviour and Physique (E. Arnold, London, 1958).

of constructing a body build chart can be found in Parnell, [1] but briefly the procedures are as follows.

The first physical component, endomorphy, is secured by measuring subcutaneous fat in three body sites: 1) on the back of the arm; 2) just below the shoulder-blade; and 3) slightly above and anterior to the hip bone. Measurements were taken using skin-fold calipers and steel measuring tape. The three skin-fold measurements of an individual were summed. From the totals a mean fat measurement was computed as well as the standard deviation from the mean. The mean total skin-fold was assigned a value of four. A skin-fold scale was constructed with standard deviations being the unit of measurement. A skin-fold value of one equalled the minimum amount of fat that could be recorded, a value of seven represented the maximum fat score. A similar scale of one to seven with four as the mean was also used to describe the muscularity and linearity components of body build.

The second component, muscularity, was measured by recording the width of the humerus and femur bone, and the circumference of the calf and biceps. These measures were charted and when combined with a height measurement supplied a muscularity factor, which then had to be corrected for the amount of fat that may have been present in the muscle and bone measurements.

The third component, ectomorphy, was obtained by dividing the boys' height by the cube root of his weight. This method provided a ponderal index which was then scaled using the one to seven rating explained earlier in this section.

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[1] Ibid., 20-22.

A boy's body type then consisted of three indices -- fat, muscle and linearity -- with an index of four being the mean for a given component. A boy having a somatotype of 3-5-4 would be a boy who had slightly less fat than average for this study's population, his muscularity was greater than the mean and he was approximately average in his linear component. The chart used to determine somatotype for boys in the present study's sample is found in Table 3.9.

TABLE 3.9

DEVIATION CHART OF PHYSIQUE

Fat: **Skinfolds** (MMS.) Triceps / Subscapular / Suprailiac / Total Fat	TOTAL SKINFOLD MEASUREMENTS												
	12	14	18	22	27	33	40	48	57	68	83	100	120
ENDOMORPHY ESTIMATE	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
Height (ins.)	52.5	54.0	55.5	57.0	58.5	60.0	61.5	63.0	64.5	66.0	67.5	69.0	70.5
Bone: Humerus	5.3	5.4	5.6	5.7	5.9	6.0	6.2	6.4	6.5	6.7	6.8	7.0	7.1
(CMS.) Femur	7.9	8.2	8.4	8.6	8.8	9.1	9.3	9.5	9.8	10.0	10.2	10.4	10.7
Muscle: Biceps	22.3	22.9	23.6	24.2	24.8	25.5	26.1	26.7	27.4	28.0	28.6	29.3	29.9
(CMS.) Calf	27.7	28.4	29.2	30.0	30.8	31.6	37.4	33.2	34.0	34.8	35.6	36.4	37.1
First Mesomorphy estimate:	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
Correction for fat (Total fat MMS.)	12	15	18	22	27	33	40	48	57	68	83	100	120
Fat Value Correction	+½	+1	+1½	+2	0	-½	-1	-1	-1½	-2	-2½	-3	-4
Corrected MESOMORPHY	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
Ponderal Index = Height / $\sqrt[3]{\text{Weight}}$	11.9	12.2	12.4	12.6	12.9	13.1	13.4	13.6	13.8	14.0	14.3	14.5	14.8
ECTOMORPHY ESTIMATE	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7

Hypothesis II

Null hypothesis II: No significant difference will be found in physiometry, as indicated by average physiometric measurements, between high and low academic achievement motivated groups of early adolescent boys.

Symbolically: $H_o: \mu_1 = \mu_2$

Legend: μ_1 = High academic achievement motivated physiometric measurement mean.

μ_2 = Low academic achievement motivated group physiometric measurement mean.

Alternate hypothesis II: There will be significant physiometric differences between high and low achievement motivated early adolescent boys as indicated by average physiometric measurements of the two groups.

Symbolically: $H_1: \mu_1 \neq \mu_2$

Legend: μ_1 = High academic achievement motivated group physiometric measurement mean.

μ_2 = Low academic achievement motivated group physiometric measurement mean.

Operational Measures of Hypothesis II

The first five measures of this hypothesis are an attempt to evaluate the subjects' sensory-motor abilities.

Hearing Each boy in the sample was given an audiometric screening test using an Eckstein Brothers Tritone Audiometer. A pass-fail rating was used to determine auditory acuity at frequencies of 500, 2000, and 4000 cycles per second (the speech range). The frequencies were checked at 15, 30, and 50 decibels, roughly described as normal hearing level, slight hearing loss, and serious loss.

Vision Vision was tested both with the child wearing his glasses and not. The Titmus Vision Tester-Pediatric Model was used to test near- and far-sightedness. Vision less than 20/20 was recorded as a vision problem.

Reaction Time Reaction time was measured in hundredths of a second. The equipment used in this measurement was supplied by General Motors Institute in Flint, and the University of Michigan in Ann Arbor.

Each boy responded to the activation of an electric timer by flipping a toggle switch to the "STOP" position. The boy was given three practice tries at turning the clock off in as short a time as possible. Then five test trials were given with the fastest time recorded for analysis purposes.

Eye-Hand Coordination The method used to test eye-hand coordination was reported procedurized in 1968. [1] It consists of timing each boy's performance in following a form-board maze perforated with one hundred twenty-five holes. The subject must insert a stylus in each hole as he encounters it while following the maze. One practice trial was run. The average time in hundredths of a second was taken on the next two succeeding trials. The test-retest reliability of this test is reported as .89. [2]

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[1] G. K. Poock, Prediction of Elemental Motion Performance Using Personnel Selection Tests, Methods-Time Measurement Research Study Report 115, The M.T.M. Association for Standards and Research, Ann Arbor, 1968.

[2] Ibid., 24.

Grip Strength The Smedley Hand Dynamometer was used as an indicant of strength. Subjects were given three trials with each hand with the best effort of each hand being recorded in kilograms. The total kilograms was recorded by adding the highest measurement of each boy's left and right hand squeezes. A measure of handedness was also recorded by subtracting the lesser hand total from the kilogram record of the greater hand squeeze.

Both procedures were followed as recommended in the Smedley Dynamometer Manual. [1]

The next five physiometric measures were obtained by the pediatric staff of the Mott Children's Health Center in Flint, Michigan.

Pubertal Status The pubertal status of each boy was evaluated using the standards of Gruelich. [2]

Blood Pressure Each boy's blood pressure was measured using his right arm while he was in a recumbent position.

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[1]Anonymous, "Manual for Smedley Hand Dynamometer" (mimeographed) C. H. Stoelting Company, Chicago, Illinois, 1965.

[2]W. W. Greulich, et al, "Somatic and Endocrine Studies of Pubertal and Adolescent Boys," Society for Research in Child Development, Monograph, Volume VII, No.3, Washington, D.C., National Research Council (1942)

Step Test This is a test of cardiovascular response to stressful exercise. It correlates well with athletic "condition." [1] The procedure of having each boy exercise for four minutes by stepping up on and down from an eighteen-inch step, then recording heart rate at regular intervals for the next three and a half minutes as described in Gallagher, [2] was followed. The total heart beats were then indexed according to Gallagher and Brouha. [3]

General Health Condition The physical examination procedure followed closely the recommendations of Gallagher. [4] Any recommendations to correct a health condition listed by the pediatrician was recorded as a health problem. It should be noted that no serious health problems were found during physical examination of the sixty-seven boys in the research sample.

The remaining physiometric measurements relative to hypothesis II were conducted by the laboratory staff of the Mott Children's Health Center. The variables were measured by analyzing a urine specimen as well as 12 ml of venous blood from each boy.

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[1] J. R. Gallagher, Medical Care of the Adolescent (Appleton, Century Crofts, New York, 1966) 41.

[2] Ibid., 41.

[3] J. R. Gallagher and L. Brouha, "Physical Fitness: Its Evaluation and Significance," Journal of the American Medical Association, Vol. CXXV, (1944) 834.

[4] Op. cit., Gallagher (1966) 28-29.

Blood Sugar Blood sugar levels were determined by the method of Hultman, [1] modified by Dubowski, [2] and further modified by Hycel. [3]

Cholesterol The amount of total cholesterol was determined by a method recommended by Hycel [4] that employs the Lieberman-Burchard reaction.

Uric Acid The Hycel method of uric acid determination was employed. [5] It is based on the Caraway [6] modification of the Folin and Denis [7] procedure of determining serum uric acid.

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[1]E. Hultman, "Rapid Specific Method for Determination of Aldosaccharides in Body Fluids," Nature, Vol. CLXXXIII, (1959) 108.

[2]K. M. Dubowski, "An O-toluidine Method for Body Fluid Glucose Determination," Clinical Chemistry, Vol. VIII (1962) 215.

[3]Anonymous, Direct Sugar Determinations (a Hycel, Incorporated booklet, Hycel, Inc., Houston, Texas, 1965)

[4]Anonymous, Cuvette Chemistry System (A Hycel, Incorporated booklet, Hycel, Inc., Houston, Texas, 1965).

[5]Anonymous, Uric Acid Determinations, a booklet of Hycel, Incorporated (Hycel, Inc., Houston, Texas, 1967).

[6]W. T. Caraway, "Determination of Uric Acid in Serum by a Carbonate Method," American Journal of Clinical Pathology, Vol. XXV (1955) 840-45.

[7]O. Folin and W. Denis, "A New Method for the Determination of Uric Acid in Blood," Journal of Biological Chemistry, Vol. XIII (1912) 469-75.

Vitamin A The concentration of serum Vitamin A was measured by the method employing the Price-Carr reaction as instructed by Kaser and Stekol, and May. [1]

Thyroxine A sample of serum was sent to Bio-Science Laboratories in Van Nuys, California, where the thyroxine (T_4) concentration was determined by column chromatography.

Amino Acid Screening The aminoaciduria screening test was employed to determine the value of creatinine and amino acid in each boy's urine sample. The ratio was calculated by dividing the amino acid concentration by the creatinine concentration. [2]

Protein Electrophoresis The Gelman procedure and apparatus for performing serum protein electrophoresis was used. [3]

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[1]M. Kaser and J. Stekol, "A Critical Study of the Price-Carr Reaction for the Determination of B-carotene and Vitamin A in Biological Materials," Journal of Laboratory Clinical Medicine, Vol. XXVIII, No. 7 (April, 1943) 904-909; C. D. May, et al, "Clinical Studies of Vitamin A in Infants and Children," American Journal of Diseases of Children, Vol. LIX, No. 6 (June, 1940) 1167.

[2]C. C. Clayton, and B. F. Steel, "A Modified Copper Method for the Estimation of Alpha Amino Nitrogen in Urine," Clinical Chemistry, Vol. XIII (January, 1967) 49.

[3]Anonymous, Electrophoresis, a manual of the Gelman Instrument, Ann Arbor, Michigan (1967).

Other Measures Using standard procedures for routine complete blood counts and urinalyses, the laboratory staff of the Mott Children's Health Center measured the following:

Hemoglobin

Hematocrit

White blood cells per cubic mm. of blood

White blood cell differential

The acidity-alkalinity ($_{p}$H) of urine

The specific gravity of urine

Hypothesis III

Null hypothesis III: No significant difference will be found in health histories between high and low academic achievement motivated groups of early adolescent boys.

Symbolically: $H_o: \mu_1 = \mu_2$

Legend: μ_1 = High academic achievement motivated health history measurement mean.

μ_2 = Low academic achievement motivated group health history measurement mean.

Alternate hypothesis III: There will be significant health history differences between high and low achievement motivated early adolescent boys as indicated by average health history forms of the two groups.

Symbolically: $H_1: \mu_1 \neq \mu_2$

Legend: μ_1 = High academic achievement motivated group health history measurement mean.

μ_2 = Low academic achievement motivated group health history measurement mean.

Operational Measures of Hypothesis III

The primary instrument used to collect information relative to hypothesis III was a questionnaire which was mailed to the home of each subject. The parent was asked to fill in information relative to the boy's health history. A copy of the health history form is presented as Table 3.10.

TABLE 3.10

HEALTH HISTORY QUESTIONNAIRE

How much did he weigh at birth? ____pounds, ____ounces.

What was his mother's age when he was born? _____

Were there any birth complications? / / yes / / no
If yes, please explain._____

Has he had any serious illness? / / yes / / no
If yes, what illness and when?_____

Has he ever had a handicapping condition such as a heart problem?
/ / yes / / no If yes, what and when?_____

Has he ever been "knocked out" or unconscious? / / yes / / no
If yes, please explain._____

Has he ever had asthma or an allergy? / / yes / / no
If yes, please explain._____

As a baby, or a young boy, has he ever had convulsions? / / yes / / no
If yes, please explain._____

Since sixth grade about how many days of school has your boy missed per year because of illness?

/ / less than 5 days per year / / 10 - 15 days per year
/ / 5 - 10 days per year / / more than 15 days per year

Has your boy every complained that a health problem affected his school work?_____

How would you describe your boy's energy level as it relates to school work?_____

Please rate your boy's appetite on these items. Check the appropriate box.

Types of Food	Dislikes all	Likes Some	Likes Most	Likes All
Meats				
Vegetables				
Fruits				
Milk				

Upon receipt of the health history form from the parents, pertinent information was categorized and recorded as follows:

Birth Weight The mother's recollection of birth weight of the boy recorded in ounces to the nearest ounce.

Mother's Age at Delivery The age of the mother at the time the child was born was recorded in years.

Birth Complications The mother's report of birth complications recorded on a yes-no basis. If she provided an explanation of the birth complications that left a doubt as to the seriousness of the complication, a staff pediatrician determined whether or not the complication should be recorded.

The questions of whether or not the boy had any: 1) serious illnesses; 2) handicapping condition; 3) ever been "knocked out" or unconscious; 4) convulsions; or 5) allergies or asthma, were handled in the same way as the "birth complications" question. The answer was recorded as discrete information with a pediatrician determining if, in fact, a response should be recorded as a yes or no.

School Absences Because of Illness The parents were asked to estimate the number of school days that their boy had missed due to illness per year for the past two years. Their report was coded in four categories: 1 = less than 5 sick days per school year, 2 = 5 to 10 sick days per school year, 3 = 11 to 15 days per school year, and 4 = more than 15 days absent from school per year because of illness.

Report of Health-Related School Problem Problems of a health nature that were brought to the attention of the parent by the boy as a school problem were recorded when reported by the parent, (e.g., a boy complains to his mother that he cannot see the blackboard, therefore cannot do his school work).

Energy Level toward School Activities The parent was asked in an open-ended question to describe the boy's energy level as it related to school work. These responses were categorized as describing above average, average, or below average school-directed energy levels. Two raters agreed on the categorization of responses in every case.

Eating Habits Parents were asked to rate their boy's appetite relating to meats, vegetables, fruits, and milk. The parents' ratings were quantified by a four-point rating scale: 1 = likes all (kinds of meat, vegetables or fruits), or much milk; 2 = likes most; 3 = likes some; and 4 = dislikes all.

Other Descriptive Measures

A number of other variables were used to further describe the boys in the research sample. Although these measures are not used directly in testing the hypotheses, they should be clarified.

Age The boys' ages were recorded in months to the nearest month.

Intelligence Quotient (I.Q.) score An I.Q. score for each boy was obtained from the boy's cumulative record. If scores were not available, a test was given preceding the physical examination. Therefore, all scores were from tests administered at some time during the present school year. The intelligence test used was the Lorge-Thorndike for Seventh-Graders.

Siblings Each boy reported this information via a personal data questionnaire given at the time of M-Scale administration. The number recorded represents the total number of children in the family.

Oldest Child This variable was reported by the research subject when asked if he was the oldest child in the family.

Father's Work The subject was asked what his father did for a living. His response was categorized by two raters as to whether the father's work was: 1) professional; 2) business; 3) skilled; 4) unskilled.

Mother's Work Each subject was asked if his mother worked full-time. The response was recorded on a yes/no basis.

Data Collection Process

Inviting the Research Sample The parents of each of the seventy boys selected for the study received a letter from the president of the Mott Children's Health Center informing them that their son was one of seventy seventh-grade boys chosen to participate in a study designed to examine the relationship between health and school interest and performance. A permission slip authorizing the Health Center's pediatric staff to administer a comprehensive physical examination, including a blood and urine specimen, to the child, was enclosed with the letter as well as a self-addressed stamped envelope.

Starting the day after the parents received the letter, a personal phone call was placed to the parents of every child answering their questions about the project and soliciting their cooperation. It was explained to the parents that the complete physical examination would be provided at no cost to them and the results of the boy's examination would be available to the family physician. Of the seventy boys invited, sixty-seven permission slips were received. One boy from the higher motivated group and two from the lower group declined participation. The parents of the three boys who did not wish to participate gave the following reasons:

1. "An examination of this type is against our religious beliefs."
2. "_____ just had a physical examination four days ago."
3. "_____ doesn't want to have a physical."

Collecting Health Histories As permission slips were received by the Health Center, health history forms were sent to the parents for them to fill out and mail to the Center or have their boy bring the form with him to the physical examination.

The Physical Examination All physical examinations were completed at the Mott Children's Health Center in Flint, Michigan. They were scheduled at 3:00 p.m. Even though the period from 1:00 p.m. (the end of the boys' lunch hour) to 3:30 p.m. (the time when blood and urine specimens were taken) could not be considered a true "fasting period" for purposes of laboratory evaluation, a somewhat controlled condition relative to the subjects' food intake existed as all boys were subject to a "closed-campus" lunch period in their schools. This condition may have closely simulated an actual physical state of a child in a school setting as compared to an evaluation of the youngster in an artificial clinical context.

The subjects were scheduled into the Mott Children's Health Center in small groups of four to eight. This provided each boy with more individual testing than if all sixty-seven boys were scheduled simultaneously. The collection of data during the physical examination was accomplished by setting up a number of stations for: vision testing; audiometric testing; anthropometric measurements; step test; laboratory specimen

collection; coordination; reaction-time; strength testing; and the physical examination itself. After each boy had visited all stations he was taken to Flint's municipal hospital where bone-age x-rays were taken. At no time were the health scientists aware of a boy's achievement motivation estimate and subsequent grouping.

The entire procedure was completed in two hours, so by 5:00 p.m. parents were able to take their children home. By the time all measurements were collected on a group of subjects a total of nineteen professionals became directly involved.

TABLE 3.11

PROFESSIONAL STAFF DIRECTLY INVOLVED IN THE

PHYSIOLOGICAL COLLECTION OF

RESEARCH SUBJECTS

Staff	Data Collected
4 Pediatricians	Physical examinations, Harvard Step Test, blood pressure
4 Nurses	Vision and hearing tests, Harvard Step Test, general assistance
4 Laboratory technologists	Blood and urine sample, collection and analysis
1 Pre-med student	Anthropometric measurements
2 Nurse aides	General assistance
1 Administrator	Reaction-time, coordination and strength tests
1 Secretary	Recording and tabulating data
1 X-ray technician*	Take and Develop bone-age x-rays
1 Radiologist*	Interpret bone-age x-rays
19 Professional Staff Members	

*Hurley Hospital Staff

Additional laboratory service was provided by Bio-Science Laboratories in Van Nuys, California.

Summary

The research sample of this study was selected from the total seventh-grade boy population (four hundred eighty-eight) of two suburban school systems near Flint, Michigan. The sample of sixty-seven boys represented thirty-four of the highest and thirty-three of the lowest motivated boys who were: 1) in the seventh grade; 2) twelve or thirteen years old; 3) Caucasian; and 4) from employed, intact families. Motivation level was determined by scores on the Michigan State M-Scales (a standarized motivation measuring instrument) and cross-validated by teacher estimates of each boy's achievement motivation level. The M-Scale score separation between groups was nearly two standard deviations and the highest teacher estimate of a boy in the low group was at the fiftieth percentile along the motivation continuum; the lowest motivation estimate of a boy in the high group was the eighty-second percentile.

Information necessary to compare the two sample groups on the basis of anthropometry, physiometry and health histories was collected primarily by the health science personnel of the Mott Children's Health Center in Flint. All boys were brought to the Center to recieve their comprehensive physical and health evaluation. Routine and sophisticated measurements were taken according to standardized and documented procedures.

CHAPTER IV

ANALYSIS OF RESULTS

Introduction

Chapter IV contains the results of the tests run on the two groups of boys and other information collected from them and their families. First, information that further describes the boys is presented. Information such as the work of each boy's father, the number of siblings in the family and the ordinal position of the boy is found in the beginning section. The data in the section are used in the description of the group's familial and environmental background rather than in the physiologically-oriented hypotheses. Within the second section the results of the anthropometric measurements are analyzed. Physiometric data are analyzed in the third section of the chapter. Fourth, the health histories of the two groups of boys are examined in light of the information collected. Finally, the results are reviewed in the discussion section.

Statistical Methods

Factor Analysis Using the tool of factor analysis, the sixty-four variables identified in Chapter III were arrayed. It was postulated that by the use of factor analysis the number of variables could be collapsed. Two advantages would accrue from such a procedure. One,

the tests would be lengthened and thus the reliability increased. Two, the total number of subsequent contrasts would be reduced so that the Alpha level (Type I error - rejecting a null hypothesis when it should be accepted) would have been better controlled. The factor analysis proved unsatisfactory. That is, the intercorrelational matrix revealed values of such low magnitude that one could only conclude that the measures were independent of each other.

Inherent in the use of factor analysis as it related to this study was the problem of there being nearly as many variables studied as there were research variables. Another problem stemmed from the fact that the variables were diverse, ranging from environmental and familial conditions to heredity (as measured to a certain extent by anthropometry) and to physiometric data. This diversity may have accounted for the independency of the variables. The lack of correlation decreased the utility of factor analysis and was discovered to be an inadequate statistical tool for reducing the number of variables obtained during data collection. Use of factor analysis was abandoned because it did not sufficiently account for the variance among factors studied. Specifically, the rotation analysis of sixteen factors accounted for seventy-four percent of the total variance. After the second rotation, successive rotations accounted for only two and one-half percent to five percent of the total variance.

The possibility of using I.Q. as a covariant was discarded while analyzing output generated by the factor analysis program. The primary reason for not pursuing I.Q. as a covariant was that I.Q. scores did

not correlate significantly with any health, anthropometric or physiometric variable except coordination, where a low negative correlation (-.38) existed. In other words, children scoring higher on the intelligence test tended to complete the coordination test in less time.

The means and standard deviations of each variable are found in the appendix (p. 117). The eigenvalues, twenty of which were greater than 1.00, generated by the factor analysis program are also in the appendix (p. 120).

Analysis of Variance The primary statistical method used was a one-way analysis of variance. Results reflect differences between group means of the sixty-four variables accounted for in this study. A level of confidence of .05 was set based on reported results of comparable studies. [1]

Descriptive Data

In Chapter III there was an elaboration upon how the research sample was selected, what variables were controlled, and what measures were taken to assure that the high and low groups were in fact different on motivational levels. This portion of Chapter IV further defines the two research groups in terms of other variables which may have had relevance to the study's three main hypotheses. The additional description attempts to pinpoint the kinds of variance that could be injected into the research by the family and environmental factors which have been charted in this study.

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[1] See Chapter II, 13, 19-21.

Energy Level Rating

To get a third perspective on the subjects' academic achievement motivation (the other two measurements were the M-Scales and teacher estimates) the boys' parents were asked to rate their sons' energy levels as it related to school activities. The parent ratings substantiated the previous groupings. The school-related energy levels of the boys were rated above average, average and below average, by their parents.

Of the parents of the boys in the higher motivated group, thirty-two rated their sons above average and two boys received average ratings from their parents. Lower-motivated boys' parents reported their sons' school-directed energy to be above average once; average six times and below average twenty-six times. A chi-square contingency table on these frequencies yielded significance at less than .0005.

Intelligence Test Scores

The two research groups did score quite differently on the Lorge-Thorndike Test. Even though there was a large overlap in the range of scores of the two groups, the difference in mean group scores was over twenty points (high n Ach group mean = 118.47, low n Ach group mean = 97.52). Using a one-way analysis of variance it was found that the approximate significance probability of the statistic was less than .0005.

With such a large difference between the groups on I.Q. scores the idea of using intelligence as a covariant was considered. However, an intercorrelation matrix, generated by a factor analysis

program illustrated that I.Q. scores were only significantly correlated with eye-hand coordination, delivery age and birth weight (r's = .38, .32 and .25 respectively). Therefore, the idea was abandoned.

TABLE 4.1

DESCRIPTIVE DATA: I.Q. TEST SCORES

(LORGE-THORNDIKE)

Group	Range	Mean	SD	F. Statistic	Significance Probability
Low Group	69 - 128	97.52	13.24	48.44	.0005
High Group	84 - 133	118.47	11.37		
Total Sample	69 - 133	108.14	16.15		

Family Size and Birth Order

Boys comprising the lower n Ach group came from slightly larger families than the higher group. However, the size difference is not significant at the .05 level, neither is the number of boys who were first-born in the lower group (eight) as compared to the upper group (fifteen).

TABLE 4.2

DESCRIPTIVE DATA: FAMILY SIZE AND

BIRTH ORDER DIFFERENCES

Group	1st-Born Child*	Range of Siblings per Family	Mean	SD	F	Significance Probability
Low Group	8	1 - 10	4.21	1.82	2.80	.10
High Group	15	1 - 8	3.56	1.35		

*The difference between the two groups is not significant at the .05 level of confidence.

Family Employment

Employment patterns of the two group's fathers reflect some differences. Fathers of the lower group had their modal frequency of employment in the "unskilled" category; while the upper group had more fathers in the "professional" category. Approximately the same number of mothers were employed full-time in each group.

TABLE 4.3

DESCRIPTIVE DATA: FAMILY EMPLOYMENT

Group	Father's Work				Working Mother
	Professional	Business	Skilled	Unskilled	
Low Group	4	9	7	13	10
High Group	11	9	7	7	9
Total Sample	15	18	14	20	19

Analyzing Anthropometric Measurements

Null Hypothesis I: At the .05 level of confidence there will be no significant difference found in anthropometry between high and low academic achievement motivated groups of early adolescent boys as indicated by average anthropometric measurements.

The procedure established in Chapter III was followed to obtain nine direct anthropometric measurements, a bone-age estimation and a derived somatotype score for each youngster. Of the nine anthropometric measurements muscle and bone measurements could not be compared directly group-to-group because these two measures are affected by the amount of fat present. Therefore a correction factor had to be applied.

Weight, height, body fat and bone-age measurements were compared directly using a one-way analysis of variance. The results are incorporated in Table 4.4

TABLE 4.4

A COMPARISON OF ANTHROPOMETRIC MEAN MEASUREMENTS OF THE TWO RESEARCH GROUPS

Group	Weight (pounds)	Height (inches)	Body Fat (mms.)			Bone Age (months)
			Triceps	Subscapular	Suprailiac	
Low Group	106.6	61.1	13.9	11.5	12.3	151.2
High Group	104.9	61.8	11.7	8.0	8.5	146.8
Total Sample	105.7	61.5	12.7	9.7	10.35	149.0
Significance Level	.77	.33	.21	.06	.113	.250
Null Hypothesis	Accept	Accept	Accept	Accept	Accept	Accept

Muscle and bone measurements were interpreted by the somatotype procedures of Parnell as outlined in Chapter III. Chi-square analysis was applied to the derived somatotype as was prescribed in Parnell. [1]

Three two-by-two tables were constructed to determine the individual relationships between fat, muscularity and linearity ratings. None was significant. Finally, a two-by-three table was constructed

[1]R. W. Parnell, Behavior and Physique (Edward Arnold,LTD., London, England, 1958) 112.

to measure the frequency that the fat was the largest somatotype rating. The same thing was done with muscularity and linearity. That table did yield significant difference at the .05 level of confidence. The difference seemed to stem from a combination of a more frequent occurrence of fat in the low group and muscle in the high group.

TABLE 4.5

AN INTERGROUP COMPARISON OF INDIVIDUAL SOMATOTYPE RATINGS

	F > L	L > F
Low Group	15	17
High Group	8	25

Derived $\chi^2 = 3.64$

χ^2 (.05, 1 df) $= 3.84$

Accept null hypothesis I

	F > M	M > F
Low Group	12	21
High Group	5	27

Derived $\chi^2 = 3.62$

χ^2 (.05, 1 df) $= 3.84$

Accept null hypothesis I

	L > M	M > L
Low Group	15	15
High Group	11	19

Derived $\chi^2 = 1.09$

χ^2 (.05, 1 df) $= 3.84$

Accept null hypothesis I

	F > both M and L	M > both F and L	L > both F and L
Low Group	14	5	14
High Group	5	12	11

Derived $\chi^2 = 7.14$

χ^2 (.05, 2 df) $= 5.99$

Reject null hypothesis I

Analyzing Physiometric Measurements

Null Hypothesis II: At the .05 level of confidence there will be no significant difference found in physiometry between high and low academic achievement motivated groups of early adolescent boys as indicated by average physiometric measurements.

The analysis of results of this section is commented upon in three sections: 1) the analysis of sensory-motor evaluations; 2) the analysis of physical examination measures; and 3) the analysis of biochemical comparisons. All differences between group means were tested at the .05 level of confidence using a one-way analysis of variance.

Sensory-Motor Evaluations

Chapter III indicated that visual and audiometric testing, strength, hand dominance, reaction time, and eye-hand coordination comprised the list of sensory-motor variables that were observed. One of the variables was dropped. Audiometric evaluations of all subjects yielded a "dead variable." There was so little variability present that audiometric screening was deleted as a research variable. [1]

Eye-hand coordination was the only variable in this sub-group of physiometric measurements in which there was a significant difference in means between research groups. All other variables were

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[1] Two boys had less than perfect hearing, one boy from each group. However, this measurement while no longer being a research variable, at least helped to describe the research sample.

accepted as stated in null hypothesis II. Specific means and their levels of significant difference are found in Table 4.6.

TABLE 4.6

A COMPARISON OF SENSORY-MOTOR MEAN MEASUREMENTS OF THE TWO RESEARCH GROUPS

Groups	Reaction Time (Seconds)	Eye-Hand Coordination (Seconds)	Grip Strength (Kilograms)	Hand Dominance (Kilograms)	Vision (0 = pass) (1 = fail)
Low Group	17.21	62.26	49.21	3.03	.33
High Group	16.74	55.65	52.15	2.61	.53
Total Group	16.97	58.90	50.70	2.82	.43
Significance Level	.18	.0005	.24	.40	.11
Null Hypothesis	Accept	Reject	Accept	Accept	Accept

Eye-hand coordination was significantly (α = .05) and positively correlated with reaction time, amount of fat, a health condition present, and health related school problems. Significant negative correlations existed between coordination and muscle, mother's age at delivery of the boy and I.Q. score. A summary of these preceeding correlations and a brief explanation are provided in Table 4.7.

TABLE 4.7

VARIABLES CORRELATING WITH COORDINATION

Significant Correlates of Coordination*	Correlation Explanation
+.30 Reaction Time	Slow coordination time is associated with slow reaction time.
+.32 Health Problem	Slow coordination time is associated with the presence of a health problem.
-.27 Muscle	Slow coordination time is negatively associated with elevated muscle component ratings.
+.27 Fat	Slow coordination time is associated with elevated fat component ratings.
-.26 Delivery Age	Slow coordination time is associated with the younger age of the mother.
-.38 I.Q. Score	Slow coordination time is negatively associated with higher I.Q. scores.
+.31 Health Related School problems	Slow coordination time is associated with boys who complain that their schoolwork is affected by their health.

*for 66 degrees of freedom

r = .25 is significant at .05
r = .33 is significant at .01

Measurements of the Physical Examination

The pediatric staff of the Mott Children's Health Center recorded five variables during the physical examination: 1) pubertal status; 2) systolic blood pressure; 3) diastolic blood pressure; 4) cardiac efficiency as measured by the step test; and 5) whether or not a health problem was present at the time of the examination.

Only the occurrence of health problems differentiated the two groups at the .05 level of confidence. All other variables within this subset of physiometric measurements accepted hypothesis II as stated. Table 4.8 illustrates the specific means and acceptance levels of the variables measured during the physical examination.

TABLE 4.8

A COMPARISON OF PHYSICAL EXAMINATION MEAN MEASUREMENTS OF THE TWO RESEARCH GROUPS

Group	Pubertal Status	Systolic Blood Pressure	Diastolic Blood Pressure	Step Test Index	Health Problem 0 = absence of 1 = presence of
Low Group	2.60	117.33	70.73	83.80	.45
High Group	2.32	117.82	69.71	85.65	.20
Total Sample	2.46	117.58	70.21	84.49	.33
Significance Level	.25	.87	.64	.50	.03
Null Hypothesis	Accept	Accept	Accept	Accept	Reject

Health problems were positively and significantly correlated ($\alpha = .05$) with vision problems, gamma globulin amounts, diastolic blood pressure, coordination and reaction time, bone age and femur measurements. A significant, negative correlation was noted between health problems and muscle rating.

Results of Biochemical Analysis

Laboratory procedures outlined in Chapter III were applied to urine and blood specimens of each research subject. The results are analyzed in this section.

Complete Blood Count A complete blood count (CBC) was administered primarily to rule out pathological conditions as being a major source of biochemical variance. No pathology was found. In the CBC process nine variables were observed and recorded. Their analysis is found in Table 4.9. No significant differences were measured.

TABLE 4.9

A COMPARISON OF COMPLETE BLOOD COUNT MEAN MEASUREMENTS

OF THE TWO RESEARCH GROUPS

Groups	Hemoglobin grams/100ml	Hematocrit	White Blood Count cells/ mm3	White Blood Cell Differential					
				Bands %	Granulocytes %	Eosinophiles %	Basophiles %	Lymphocytes %	Monocytes %
Low Group	12.67	38.30	7841.41	2.33	54.85	2.15	.12	37.48	3.82
High Group	12.76	38.32	7973.53	2.02	54.35	2.24	.21	38.12	3.53
Total Sample	12.71	38.31	7913.43	2.18	54.60	2.19	.16	37.81	3.67
Significance Level	.70	.98	..77	.59	.81	.88	.47	.75	.61
Null Hypothesis	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept

Urinalysis A routine urinalysis was performed primarily to rule out pathological conditions as being a source of physiometric variance. No pathology was found. In the urinalysis process two variables were observed and recorded. Their analysis is presented in Table 4.10. No significant differences were measured.

TABLE 4.10

A COMPARISON OF URINALYSIS MEAN MEASUREMENTS OF THE TWO RESEARCH GROUPS

Groups	pH	Specific Gravity
Low Group	6.00	1.0232
High Group	6.12	1.0236
Total Sample	6.06	1.0234
Significance Level	.61	.66
Null Hypothesis	Accept	Accept

Serum Protein Levels The process of protein electrophoresis enabled the study of specific kinds of protein levels. Therefore, one-way analysis of variance was performed on the difference between the two research group means of measurement of: 1) total protein; 2) albumin; 3) $Alpha_1$ globulin; 4) $Alpha_2$ globulin; 5) Beta globulin; and 6) Gamma globulin. No differences were measured between the two groups on protein-variables as shown in Table 4.11.

TABLE 4.11

A COMPARISON OF PROTEIN ELECTROPHORESIS MEAN MEASUREMENTS OF THE TWO RESEARCH GROUPS

Protein Analyses	Low Group Mean	High Group Mean	Total Sample Mean	Significance Level	Null Hypothesis
Total Protein(grams/100 ml)	7.161	7.144	7.152	.84	Accept
Albumin(grams/100 ml)	4.15	4.13	4.114	.68	Accept
$Alpha_1$ (grams/100 ml)	.2079	.1929	.2003	.14	Accept
$Alpha_2$ (grams/100 ml)	.8888	.8880	.8884	.96	Accept
Beta (grams/100 ml)	.8667	.8868	.8769	.28	Accept
Gamma (grams/100 ml)	1.044	1.042	1.043	.94	Accept

Serum Glucose, Cholesterol and Uric Acid The documentation cited in Chapter II relative to these three variables indicated that the concentration differred significantly in the serum analysis of high and low motivated groups of adults. This was not the case in the present research sample.

TABLE 4.12

A COMPARISON OF MEAN SERUM GLUCOSE, CHOLESTEROL AND URIC ACID MEASUREMENTS BETWEEN THE TWO RESEARCH GROUPS

Groups	Serum Glucose (mg/100 ml)	Cholesterol (mg/100 ml)	Uric Acid (mg/100 ml)
Low Group	99.64	204.15	40.97
High Group	102.01	200.03	39.53
Total Sample	100.84	202.06	40.24
Significance Level	.34	.59	.51
Null Hypothesis	Accept	Accept	Accept

The correlations of glucose, cholesterol and uric acid values in this research sample differ from those reported in the literature.

Besides being correlated with n Achievement, serum uric acid (SUA) in adults is reported to be positively related to serum glucose, cholesterol, weight, intelligence and birth order. The only correlation common to this study is weight. The correlations significant to SUA in the present study seem to be a factor of maturation such as: pubertal status, bone age, height, weight, calf, humerus, grip strength, and hemoglobin.

TABLE 4.13

SIGNIFICANT CORRELATES OF SERUM URIC ACID

Correlation	Variable
+.54	Pubertal Status
+.46	Height
+.40	Bone Age
+.38	Grip Strength
+.34	Weight
+.27	Humerus
+.26	Hemoglobin
+.25	Calf
+.25	Bands (a type of White Blood Cell)

r of .25 = significance at .05 level of confidence
r of .33 = significance at .01 level of confidence

Fewer claims have been made in the literature of the relationship of glucose and cholesterol levels in the blood to achievement motivation. Neither serum variable related closely with motivation in this sample. Specific correlations of each are reported in Table 4.14.

TABLE 4.14

SIGNIFICANT CORRELATES OF CHOLESTEROL AND BLOOD SUGAR

Cholesterol Correlates	Blood Sugar Correlates
+.53 Vitamin A	+.40 Vitamin A
-.32 Bands (a type of White Blood Cell)	+.36 Hemoglobin
-.27 Diastolic Blood Pressure	
+.26 Total Protein	

r of .25 = significance at .05 level of confidence
r of .33 = significance at .01 level of confidence

In this study none of the variables significantly correlated with serum uric acid, glucose or cholesterol rejected null hypothesis II when subjected to a two-group, one-way analysis of variance.

Other Biochemical Variables Vitamin A and thyroxine levels in serum were analyzed and the amino acid ratio was calculated from the urine specimen. The literature did not report these variables as having been studied for relationships to achievement motivation. Of the three variables, only thyroxine was measured to have a difference at the .05 level of confidence.

TABLE 4.15

A COMPARISON OF MEAN VITAMIN A AND THYROXINE MEASUREMENTS AND AMINO ACID RATIOS OF THE TWO RESEARCH GROUPS

Groups	Vitamin A (mcg/100 ml)	Thyroxine (mcg/100 ml)	Amino Acid Ratio Amino Acid:Creatinine
Low Group	45.45	4.31	.544
High Group	42.41	4.69	.600
Total Sample	43.91	4.50	.572
Significance Level	.36	.045	.06
Null Hypothesis	Accept	Reject	Accept

The significant correlations of thyroxine and amino acid did not coincide nor did any of their correlates yield a significant difference between groups when their group means were analyzed.

TABLE 4.16

SIGNIFICANT CORRELATES OF THYROXINE AND AMINO ACID

Thyroxine Correlates	Amino Acid Correlates
+.32 Total Protein	+.31 Specific Gravity of Urine
+.32 Albumin	+.28 pH of Urine
+.26 Segs (Types of white	-.27 Vitamin A
-.26 Bands blood cells)	-.26 Hematocrit
-.26 Pubertal Status	+.25 Triceps

r of .25 = significance at the .05 level of confidence
r of .33 = significance at the .01 level of confidence

Analyzing Health History Measurements

Null Hypothesis II: At the .05 level of confidence, there will be no significant difference found in health histories between high and low academic achievement motivated groups of early adolescent boys as indicated by average health history measurements.

Results of this section of Chapter IV are subdivided into three section: 1) the analysis of perinatal information; 2) the analysis of childhood health problems; and 3) the analysis of eating habits. Differences between group means were tested at the .05 level of confidence using a one-way analysis of variance (ANOVA).

Perinatal Health Information

Variables examined in this subset of health history information include: the age of the mother when she gave birth to the boy in our sample, an examination of the occurrence of birth complications, and the weight of the baby at birth. The variables were established to primarily indicate some of the physical factors surrounding the birth of each research subject. Factors other than direct physical factors could be speculated by using some of the information provided in this section in conjunction with the descriptive data on family size and birth order.

The information supplied in Table 4.17 permits certainty, at the .05 level of confidence, in making these statements about the research sample:

1. The mothers of boys in the higher motivated group tended to be older.
2. Boys in the higher motivated group were larger babies at birth.
3. There were fewer birth complications associated with the deliveries of boys from the higher group.

TABLE 4.17

A COMPARISON OF PERINATAL INFORMATION OF THE TWO RESEARCH GROUPS

Group	Mother's Age at Delivery (years)	Birth Weight (ounces)	Birth Complications (0 = no complications) (1 = complications)
Low Group	25.21	115.59	.2424
High Group	28.32	125.00	.0588
Total Sample	26.79	120.36	.1493
Significance Level	.017	.032	.035
Null Hypothesis	Reject	Reject	Reject

The older delivery ages of mothers in the upper group is somewhat underemphasized because there are more first-born boys in the higher motivated group. The same underemphasis is present in the birth weight analysis because usually first-born babies are smaller at birth than successive siblings.

Significant correlations of the perinatal variables include three measures that have ANOVA differences between groups: 1) I.Q.,

2) coordination time, and 3) muscularity. Specific correlates of perinatal variabels are listed in Table 4.18.

TABLE 4.18

SIGNIFICANT CORRELATES OF THE PERINATAL VARIABLES

Mother's Age at Delivery	Birth Weight	Birth Complications
-.47 Oldest Sibling	+.40 Humerus	+.42 Slow Coordination time
+.33 Muscularity	-.29 Birth Complications	+.33 Head Injuries
+.32 I.Q.	+.27 Calf	+.30 Basos (White Blood Cells)
-.28 Slow Coordination Time	+.25 I.Q.	

r of .25 = significance at the .05 level of confidence
r of .33 = significance at the .01 level of confidence

Childhood Health Information Variables in this section represent health conditions in childhood from twenty weeks to the time of the study's physical examination. Serious illness, head injuries, allergic conditions, number of sick days taken from school, and the frequency that a school problem was mentioned by the boy as having a health base were the factors observed. Of the five variables, only the last one analyzed was found to be different from one group to the other. And the possibility that there was either malingering involved in the boy's reporting of a health-based school problem, or some ego-protecting rationalizations on the part of the mothers cast some doubt on the validity of that variable.

TABLE 4.19

A COMPARISON OF CHILDHOOD HEALTH INFORMATION OF

THE TWO RESEARCH GROUPS

Groups	Serious Illness 1 = yes, 0 = no	Head Injury 1 = yes, 0 = no	Allergy Asthma 1 = yes, 0 = no	Sick Days 1 = 5 days 2 = 5-10 days 3 = 10-15 days 4 = 15 days	Health Related School problem 1 = yes, 0 = no
Low Group	.303	.212	.151	1.91	.333
High Group	.206	.059	.265	1.56	.029
Total Sample	.254	.134	.209	1.73	.179
Significance Level	.37	.067	.261	.11	.001
Null Hypothesis	Accept	Accept	Accept	Accept	Reject

The occurrence of boys complaining about health problems affecting school work was not reflected by correlations of school/health problems to variables that may be manifestations of these problems, such as, vision and hearing problems, number of sick days taken from school per year, any of the childhood health conditions, or health problems identified by the examining pediatrician. Coordination was the only variable with ANOVA differences that correlated with school/health problems.

TABLE 4.20

SIGNIFICANT CORRELATES OF REPORTS OF HEALTH RELATED SCHOOL PROBLEMS

Correlation	Variable
+.34	Eosinophiles (a type of white blood cell)
+.31	Slow coordination
-.29	Strength
-.28	Diastolic Blood Pressure
-.26	White Blood Cells
-.25	Oldest Sibling

r of .25 = significance at the .05 level of confidence
r of .33 = significance at the .01 level of confidence

Food Likes and Dislikes In this section was analyzed the results of rating meat, vegetables, fruit and milk on a 1 to 4 rating scale (1 = like all, 2 = likes most, 3 = likes some, 4 = dislikes all). The coarseness of the measurements may have accounted for the lack of significant differences between groups. The specific analyses are found in Table 4.21.

TABLE 4.21

A COMPARISON OF FOOD LIKES AND DISLIKES BETWEEN

THE TWO RESEARCH GROUPS

Group	Meats	Vegetables	Fruits	Milk
Low Group	1.73	2.30	1.52	1.42
High Group	1.62	2.26	1.71	1.15
Total Sample	1.67	2.28	1.61	1.28
Significance Level	.50	.85	.29	.09
Null Hypothesis	Accept	Accept	Accept	Accept

Discussion and Summary

Anthropometric Analysis

The null hypothesis of no significant anthropometric differences between groups was rejected at the .05 level of confidence using a 3 x 2 chi-square table. An examination of cell frequencies prompts the belief that the rejection was due primarily to elevated fat rating in boys from the lower achievement motivated group and the elevated muscularity rating of the higher motivated boys.

Anthropometric analysis of data collected from the sample is not in complete accord with Cortes and Gatti. [1] Their results, on eighteen-year-old boys, showed a positive relationship ($p < .0001$) between muscularity and n Achievement. The present study agrees with this finding. Cortes reported a negative chi-square relationship at the .0001 level of confidence between n Achievement and ectomorphy. The current study found no significant association between the two variables. However, the study did find a negative association between endomorphy and n Achievement ($p < .05$), an association found to be positive by Cortes and Gatti.

The discrepancies which seem to exist between the two studies may be explained to a certain extent by the difference in research samples. Cortes and Gatti used eighteen-year-old boys. At this age, somatotype components are quite clear. However, twelve and thirteen-year-olds are generally into, or have not yet started the pubertal

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[1] J. F. Cortes and F. M. Gatti, "Physique and Motivation," Journal of Consulting Psychology, Vol. XXX, No. 5, 408-414 (October, 1966).

growth spurt. For this reason a boy's somatotype now, may change dramatically within six months to a year. Parnell illuminates the difficulty of somatotyping early adolescents:

> At eleven years a few boys, but roughly one-quarter of girls, are already starting their pubertal spurt. From the onset of puberty until the end of this phase, general acceleration of growth occurs, but the spurt in fat precedes that in muscle and bone development, rather more noticeably in boys. These facts inevitably complicate the procedure of phenotyping adolescents. [1]

The fact that boys in the lower group were slightly, but not significantly, older and had a more advanced skeletal age could possibly have accounted for some elevation in the fat component. An elevated fat value would reduce the linearity component of body build and have some effect on the bone and muscle measurements. Therefore, it is possible that this sample of boys may redistribute their fat and linearity components, but the difference in muscularity between the two research groups may become even more pronounced. For if the higher motivated group already exhibits a muscle component greater than the lower group, even though it does not have quite as much physical maturity as measured by skeletal development, pubertal status and age, then the difference has a greater chance of increasing as the skeletal and pubertal status of the high group catch up to the low motivated boys.

Physiometric Analysis

Sensory-Motor Evaluations The null hypothesis of no significant physiometric differences between groups was rejected at the .05 level

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[1] Op. cit., Parnell (1958) 32.

of confidence on the basis of sensory-motor evaluations. Vision and hearing testing, grip strength, hand dominance, reaction time and eye-hand coordination comprised the list of sensory-motor variables observed. Only eye-hand coordination task completion time differences were significant ($p < .0005$).

Another important observation was that of the ten variables which yielded significant differences between the high and low motivated groups, coordination was significantly correlated with eight of them: 1) I.Q. score, $r = -.38$ (fewer seconds to complete the coordination task, higher I.Q. score); 2) health related school problem, $r = .31$; 3) delivery age of the mother, $r = .28$; 4) a health problem present but unchecked at the time of physical examination, $r = .37$; 5) birth complications, $r = .42$; 6) fat rating, $r = .27$; and 7) muscle rating, $r = -.27$. Coordination was the focal point for significant intercorrelations of variables having significant differences between the two research groups.

Physical Examination Results The pediatric staff of the Mott Children's Health Center recorded five variables during the physical examination: pubertal status, systolic and diastolic blood pressure, cardiac efficiency, and whether or not a health problem was present at the time of the examination. Only the last variable mentioned failed to accept the null hypothesis.

None of the health problems found in the sixty-seven boys was serious. They would not seriously impair the boy's ability to function in school. However, the fact that correctable defects were present left a question of the level of parental interest in this one part of the boy's development. Nearly half (forty-five percent) of

the lower motivated boys had a health problem at the time of the physical, twenty percent of the boys in the other group had a health problem.

Biochemical Analysis Routine urinalysis and complete blood counts, as well as specific analysis of twelve other blood and urine variables produced but one variable which rejected the null hypothesis at the .05 level of confidence. The variable rejecting the null hypothesis was thyroxine. The level of thyroxine in the blood was significantly different between groups, but was not correlated significantly with any other group differentiating variable.

The amino acid ratio difference was significant ($p < .06$) which suggests some relationship with individual amino acids and motivation. However, the test provided during this study was merely a screening test based on the ratio of total amino acid present in the urine to the amount of creatinine excreted.

Serum uric acid (SUA) differences, substantially documented in the literature, were not found to be present in this study. Given the results of this study, the only rationale available is that the difference in SUA levels between high and low motivated people occurs sometime beyond the age of twelve or thirteen. Documented differences in SUA studies have subjects no younger than eighteen years old. This rationale has some credence on examination of those variables significantly correlated with SUA. Significant correlations of SUA all are factors of maturation: 1) pubertal status, $r = .54$; 2) height, $r = .46$; 3) bone age, $r = .40$; 4) grip strength, $r = +.38$; 5) weight, $r = .34$; 6) humerus, $r = .27$; 7) hemoglobin, $r = .26$; 8) calf measurement, $r = .25$. Therefore, SUA levels in the sample of this study seemed more dependent on maturation than motivation.

Health History Analysis

Perinatal Health Information The null hypothesis of no significant health history differences between groups was rejected at the .05 level of confidence on the basis of perinatal health information. A series of one-way analyses of variance provided information to make the following statements about the research sample: 1) mothers of boys in the higher motivated group tended to be older; 2) boys in the higher motivated group tended to be larger at birth; and 3) there were fewer complications associated with the birth of boys in the upper group. The first two statements are contrary to expectation when coupled with the additional knowledge that there were more first-borns in the higher group than the lower group. First-borns are generally smaller at birth than successive siblings and the mother would logically be older during successive deliveries.

To explain these differences there is the temptation to speculate on the socio-economic status of the families of the two groups assuming that delayed pregnancies may have been the result of factors such as continued education of the mother or father, or both. There is a difference in the numbers of fathers in professional occupations (high group - eleven, low group - four), but occupational information is not sufficient to provide a comparison of socio-economic information on this basis. Although the limitation of complete socio-economic information plagues a fuller interpretation of some of the study's results, the community's economic homogeneity and the fact that all families were employed decreases this limitation.

The three perinatal health factors were closely associated with two variables that differentiated the groups the best: intelligence test scores and eye-hand coordination. Intelligence was correlated significantly ($p < .05$) with delivery age and birth weight (.32 and .25 respectively). Time measurements for complete an eye-hand coordination task were significantly correlated with delivery age and birth complications (-.28 and .42 respectively). The .42 correlation ($p < .001$) of coordination and birth complications leads to a suspicion of the possibility of some neurological deficit being measured as well.

Childhood Health Information The null hypothesis of no significant health history differences existing between groups was rejected at the .05 level of confidence on the basis of childhood health information. However, of the five variables chosen as an indication of a boy's health condition during childhood, only the frequency that a school problem was reported by the boy to have a health basis was significantly discrepant ($p < .001$) between groups. The between-group differences of frequencies of serious illness, head injury, allergy-asthma, and sick days from school were not significant.

Eating Habit Information On the basis of this group of health history information null hypothesis III failed to be rejected. Part of the reason that no significant differences were measured may have stemmed from an instrument with inadequate information collection and measurement.

TABLE 4.22

AN INTERCORRELATIONAL MATRIX OF THE VARIABLES WITH SIGNIFICANTLY DIFFERENT MEANS BETWEEN THE STUDY'S TWO RESEARCH SAMPLES

Variables	Significance Probability (ANOVA)	Intelligence Quotient	Coordination	School/Health	Delivery Age	Health Problem	Birth Weight	Birth Complications	Thyroxine	Fat	Muscle
Intelligence Quotient Scores. . .	.0005	1.00									
Coordination Time	.0005	-.38#	1.00								
Health Related School Problem . .	.001	-.18	.31*	1.00							
Mother's Age at Delivery.	.017	.32*	.28*	-.16	1.00						
Health Problem Present.	.030	-.20	.37#	.01	-.20	1.00					
Birth Weight.	.032	.25*	-.17	.01	.08	.05	1.00				
Birth Complications	.035	-.11	.42#	.13	.03	.15	-.29*	1.00			
Thyroxine Level	.045	.18	-.16	-.16	.11	-.01	-.04	.02	1.00		
Fat Rating.	.05	-.07	.27*	.00	.09	.13	.01	.17	-.01	1.00	
Muscle Rating	.05	.05	-.27*	.00	.33#	-.31*	.26*	-.10	.03	-.25*	1.00

*r significant at .05 #r significant at .01

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to compare and describe a sample of high academic achievement motivated early adolescent boys to a sample of low academic achievement-motivated boys on the basis of anthropometry, physiometry and health histories. Although similar studies had been conducted using adult samples, no information was available relative to the role of these physiological variables on achievement-motivation of children. The study seemed necessary, for if educators are to make knowledgeable decisions about children then information about a child's physical being should be included in the decision-making process.

The research sample of this study was selected from the total seventh-grade boy population (four hundred eighty-eight) of two suburban school systems near Flint, Michigan. The sample of sixty-seven boys represented thirty-four of the highest and thirty-three of the lowest motivated boys who were: 1) in seventh grade, 2) twelve or thirteen years old, 3) Caucasian, and 4) from employed, intact families. Motivation level was determined by scores on the Michigan State M-Scales (a standardized motivation measuring instrument) and cross-validated by teacher estimates of each boy's achievement motivation level. The M-Scale score separation between groups was nearly two standard

deviations and the highest teacher estimate of a boy in the low group was at the fiftieth percentile along the motivation continuum; the lowest motivation estimate of a boy in the high group was the eighty-second percentile.

Information necessary to compare the two sample groups on the basis of anthropometry, physiometry and health histories was collected primarily by the health science personnel of the Mott Children's Health Center in Flint. All boys were brought to the Center to receive their comprehensive physical and health evaluation. Routine and sophisticated measurements were taken according to standardized and documented procedures.

Based on the data collected the following conclusions can be made about the anthropometric components of this sample of boys:

1. Boys with an elevated fat component of body build tended to be lower in motivation.
2. Boys with an elevated muscle rating tended to be higher in achievement motivation.
3. The linearity component of body build had no significant measured relationship with motivation.
4. Advanced skeletal age had no significant measured relationship with motivation.
5. Neither height nor weight differences were measured between groups.

The following conclusions about the physiometric variables of the study's sample of boys can be reached:

1. Of the list of sensory-motor variables tested such as vision, hearing, strength, hand dominance, reaction time and eye-hand coordination, only the time taken to complete a eye-hand coordination task proved to be different between the two groups.
2. The time taken to complete an eye-hand coordination task was significantly longer in the lower group ($p < .0005$).
3. Eye-hand coordination significantly correlated with eight of the ten variables which rejected the null hypotheses.
4. The coordination difference between groups was surpassed by only one other variable: intelligence ($p < .0005$).
5. Of the list of physical examination variables measured such as pubertal status, systolic and diastolic blood pressure, cardiac efficiency, and whether or not a health problem was present at the time of the physical, only the latter was statistically significant.
6. Boys from the lower group had more untreated health problems present at the time of examination than upper-group boys.
7. No differences existed between groups in variables observed during urinalysis, complete blood count and protein electrophoresis.
8. Serum uric acid, cholesterol and glucose differences reported in adults did not appear in this sample of children.
9. Serum uric acid (SUA), while having no significant relationship with motivation, seemed more a correlate of maturation, as pubertal status, height, bone age, grip strength, weight,

humerus and hemoglobin measurements were all significantly correlated with SUA.

10. An amino acid screening test yielded a difference ($p < .06$) which may suggest individual amino acid correlations with motivation.
11. Elevated blood chemicals, reported found in first-borns when studied as adults, were not found in first-born children of this study.

Health history information leads to these conclusions about the boys in the research sample:

1. Mothers of boys in the higher group were significantly older when their boys were born.
2. Boys in the higher motivated group were significantly larger at birth.
3. There were significantly fewer complications associated with the birth of boys in the upper group.
4. Boys reporting to their parents that a health problem affected their school work tended to be from the low motivated group.
5. Frequency of serious illness, head injuries, asthma or allergies, and sick days from school was not significantly different between the two groups.
6. Superficial examination of eating habits relative to meat, vegetables, fruit and milk revealed no significant difference between groups.

The results of this research seem to indicate that there are significant physiometric, anthropometric and health history differences between high and low academic achievement motivated early adolescent boys. Information currently provided by this study and others is inadequate to impute cause-effect relationships between the differentiating variables and achievement motivation. However, the present project does imply that physiological patterns of adults cannot be projected to children any more than adult educational patterns are completely applicable to children.

Implications for Future Research

On the basis of the experiences, results and conclusions of this study, the following research recommendations are made:

1. A follow-up study should be completed on this group of boys. The implication of this study is that a number of physiological differences relative to body build, blood chemistry and birth order as recorded in adults, are not present in children. Therefore, a study completed on these boys in five years, when the boys are high school seniors, should shed light on the effect of puberty as it relates to the physical factors of motivation. A study of this type would seem to be of interest to both the medical and educative communities.
2. There were inherent problems (as well as opportunities) in using twelve- and thirteen-year-olds as this study's research sample. Among the greater problems was the confounding factor of puberty. One of the purposes of the study was to see if differences in the physiology of adults were present in early adolescents, but twelve- and thirteen-year-olds exhibit

traits of prepubescence to adulthood. Therefore, this study should be replicated using a younger research sample. Eventually, when information such as this can be applied, it may be more useful with younger children than with junior high school students.

3. This study was an initial attempt to secure physical and health information so it eventually could be used to improve educational chances of children. The focus was on one portion of the entire process of education: achievement motivation. To pinpoint pertinent information to be realistically useable to educators many further studies must be conducted. Replication of this study with other populations, particularly lower socio-economic populations, may be productive. It is this segment of the population that may have the largest between-group discrepancies because of poor health habits and nutrition, inadequate prenatal and perinatal information, and lack of trained personnel to break the cycle of human failure that exists.

4. To replicate a study of this type it would be helpful to control more adequately for socio-economic variables. Also an important section of a child's make-up, his psychological state, was largely ignored. Although the variables such as health problems present were measured as a reflection of health, it may be equally a reflection of

the type of home conditions that exist. However, the environmental factors relative to these children were not adequately surveyed either.

5. Specific amino acid analysis may have some research potential because of the difference ($p < .06$) that existed between groups on a total amino acid screening test.
6. The difference in thyroxine levels of high and low achievement motivated boys may dictate the need for further study of thyroxine's relationship to achievement motivated behavior. Replication of the thyroxine level differences with a larger and different sample would be a logical first step toward clarification of this relationship. Later, a study of the effects of thyroxine level modification may have research potential.
7. An eye-hand coordination measuring instrument such as the one used in this project should be studied for its use as a device for measuring academic achievement motivation of younger children. The between-group difference ($p < .0005$) and the number of significant correlations with other differentiating variables suggests the possibility of this type of test's utility in determining achievement motivation.
8. Nutrition should be studied as a part of the physiological information gathering process as it relates to children. We know that specific foods do affect the biochemical states of an individual, however, this study did not elaborate upon the nutritional component. A nutritional study would seem to be more cause-than effect-oriented.

A post hoc observation of this study shows that the results may not be singularily conclusive, nor will they set the educational community afire with an immediate burning interest in pursuing the biochemical and health correlates of educational facets other than achievement motivation. Yet the educational and health science trends of working with the whole child seem indicative of a constant movement toward a melding of disciplines. The process may yield a new member of the educational team, cognizant of a child's development from the perspectives of both health and education. With this kind of increased sophistication in dealing with the total child, results of this study, its predecessors and those following may be translated into useful educational action for tomorrow's children.

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APPENDIX A

MEANS AND STANDARD DEVIATIONS OF EACH RESEARCH VARIABLE

MEANS AND STANDARD DEVIATIONS OF

EACH RESEARCH VARIABLE

Variable	Mean	Standard Deviation
1. Age (months)	156.6119	4.5085
2. Intelligence Quotient	108.1493	16.0329
3. Number of Children in Family	3.8806	1.6071
4. First-Born *	0.3433	.4748
5. Father's Work	2.5970	1.1598
1 = professional 2 = business 3 = skilled 4 = unskilled		
6. Mother Works *	0.2985	.4576
7. Age of Mother at Delivery (yrs.)	26.7910	5.3379
8. Birth Weight (ozs.)	120.3657	17.8978
9. Birth Complication *	.1493	.3563
10. Serious Illness*	.2537	.4351
11. Head Injury *	.1343	.3410
12. Asthma/allergy *	.2090	.4066
13. Sick Days from School	1.7313	.8908
1 = less than 5 2 = 5 to 10 3 = 10 to 15 4 = more than 15		
14. Reported Health-Related School Problem *	.1791	.3834
15. Meat	1.6716	.6554
1 = likes all 2 = likes most 3 = likes some 4 = dislikes all		

	Variable	Mean	Standard Deviation
16.	Vegetables (same breakdown as meat)	2.2836	.8068
17.	Fruit (same breakdown as meat)	1.6119	.7321
18.	Milk (same breakdown as meat)	1.2836	.6648
19.	Weight (pounds)	105.7164	23.1850
20.	Height (inches)	61.4552	2.9984
21.	Biceps (cms.)	26.1343	2.9833
22.	Calf (cms.)	32.4851	2.9687
23.	Humerus (cms.)	6.2194	.3743
24.	Femur (cms.)	9.2642	.5922
25.	Triceps Fat (mms.)	12.7836	7.1436
26.	Subscapular Fat (mms.)	9.7239	7.8161
27.	Suprailiac Fat (mms.)	10.3582	9.8715
28.	Bone Age (months)	14.8955	1.5174
29.	Fat Rating	3.0075	1.5561
30.	Muscle Rating	3.8358	.7983
31.	Linearity Rating	3.6194	1.3959
32.	Reaction Time (seconds)	16.9701	1.4657
33.	Coordination (seconds)	58.9037	6.0996
34.	Pubertal Status	2.4627	.9824
35.	Systolic Blood Pressure	117.5821	11.5644
36.	Diastolic Blood Pressure	70.2090	8.7903
37.	Step Test Index	84.4925	14.0185
38.	Health Condition Present *	.3284	.4696
39.	Blood Sugar	100.8418	10.0080

	Variable	Mean	Standard Deviation
40.	Cholesterol	202.0597	31.2218
41.	Vitamin A.	43.9104	13.5148
42.	Thyroxine	45.0000	7.6607
43.	Uric Acid	40.2388	8.7077
44.	Total Protein	71.5224	3.3563
45.	Albumin	4.1385	.2231
46.	$Alpha_1$ Globulin	0.2003	.0404
47.	$Alpha_2$ Globulin	0.8884	.0690
48.	Beta Globulin	0.8769	.0751
49.	Gamma Globulin	1.0431	.0806
50.	Amino Acid Ratio	0.5722	.1248
51.	Hemoglobin	12.7179	.9257
52.	Hematocrit	38.3134	2.6385
53.	White Blood Count	7913.4328	1642.7267
54.	Bands (%)	2.1791	2.2389
55.	Segs (%)	54.5970	8.2028
56.	Eos (%)	2.1940	2.1665
57.	Baso (%)	0.1642	.4762
58.	Lymph (%)	37.8060	8.0932
59.	Mono (%)	3.6716	2.3011
60.	pH in Urine	6.0597	.9285
61.	Specific Gravity	1.0234	.0035
62.	Vision Problem *	0.4328	.4955
63.	Total Grip Strength (kilograms)	50.7015	9.9761
64.	Grip Dominance (kilograms)	2.8209	1.9694

* 1 = yes, 0 = no

APPENDIX B

EIGENVALUES DERIVED FROM FACTOR ANALYSIS

EIGENVALUES DERIVED FROM

FACTOR ANALYSIS

Eigenvalues		Eigenvalues		Eigenvalues	
1.	9.4777	26.	0.6520	51.	0.0440
2.	5.2676	27.	0.6258	52.	0.0346
3.	4.3028	28.	0.6116	53.	0.0284
4.	3.6973	29.	0.5509	54.	0.0222
5.	3.3888	30.	0.4965	55.	0.0180
6.	3.0036	31.	0.4680	56.	0.0155
7.	2.4878	32.	0.4344	57.	0.0122
8.	2.3843	33.	0.4120	58.	0.0080
9.	2.2651	34.	0.3830	59.	0.0066
10.	1.9992	35.	0.3781	60.	0.0038
11.	1.9370	36.	0.3106	61.	0.0015
12.	1.6905	37.	0.2896	62.	0.0010
13.	1.5894	38.	0.2807	63.	0.0003
14.	1.5208	39.	0.2434	64.	0.0000
15.	1.3498	40.	0.2263		
16.	1.2848	41.	0.9148		
17.	1.2209	42.	0.1676		
18.	1.1480	43.	0.1434		
19.	1.0870	44.	0.1355		
20.	1.0233	45.	0.1170		
21.	0.9629	46.	0.1110		
22.	0.9204	47.	0.0831		
23.	0.7988	48.	0.0717		
24.	0.7761	49.	0.0696		
25.	0.7092	50.	0.0546		