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THE DIMENSIONS OF PHYSICAL FITNESS— THE NATIONWIDE NORMATIVE AND DEVELOPMENTAL STUDY OF BASIC TESTS

by
EDWIN A. FLEISHMAN

Technical Report 4

Prepared under Contract Nonr 609(32)
for the
Office of Naval Research

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DEPARTMENT OF INDUSTRIAL ADMINISTRATION
AND DEPARTMENT OF PSYCHOLOGY
YALE UNIVERSITY
NEW HAVEN, CONN.

August, 1962

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FOREWORD

This report describes the fourth in a series of studies under the general project title "The Development of Criteria of Physical Proficiency." This project is supported by funds provided under Contract Nonr 609(32) between Yale University and the Office of Naval Research. Earlier reports have described the background and objectives of the program.

The national interest in developing and maintaining physical proficiency of our youth continues to be high. The President's Council on Youth Fitness, for example, has done an outstanding job of publicizing this problem and calling attention to the need for constructive programs in this area. There is, however, a continuing need for specific guidance on what tests to use to evaluate the physical proficiency of individuals and the success of particular programs. This kind of guidance can best be achieved when it is based on scientific research. There is today, a great deal of comment about the proportion of U. S. children who "fail" physical fitness tests, or who are inferior to children in foreign countries. Often these findings are based on too few tests or on unspecified standards. There are encouraging signs of more constructive approaches to this problem. What we really need to know is the range of physical fitness factors that need to be assessed, what specific tests provide the best measures of these factors, and what kinds of scores on these tests represent superior, average, or inferior achievements for different categories of individuals. Although no single program can provide all the answers to such questions, it is to these questions that our series of studies has been addressed.

The present study is a national study in every sense of the term. Our purpose was to achieve national norms and developmental data on selected tests. We have obtained cooperation from schools in Honolulu and Anchorage and California, to New England and Florida, and points in between. Many school systems were already overburdened with other state and national programs or with their own programs. Those that cooperated in our study deserve a special acknowledgment. We especially would like to express appreciation to the following key people who assisted or supported this effort in their school systems:

Mr. Robert H. Harper, Director, Health Physical Education and Safety, Akron; Principal, Sandia High School, Albuquerque; Mr. Elmer H. Roedel, Director, Health and Physical Education,

Allentown; Mr. Jess Cearley, Director of Physical Education, Health and Safety, Amarillo; Mr. Reinford L. Mattoon, Assistant Superintendent and Miss Mavis V. Conlee, Anchorage; Mr. Sidney Scarborough, Director of Physical Education and Mr. C. C. George, Jr., Atlanta; Mr. Frank W. Broad, Supervisor, Health and Physical Education, Bethlehem; Mr. Elmon L. Vernier, Director, Health and Physical Education, and Mr. Joseph Mueller, Baltimore; Supervisor of Physical Education, Biloxi; Supervisor of Physical Education, Birmingham; Mr. Joseph McKenny, Director and Miss Mary T. Gibbons, Assistant Director of Physical Education, Boston; Dr. William McColgan, Supervisor of Physical Education, Buffalo; Supervisor of Physical Education, Camden; Mr. C. H. Blanchard, Director, Physical Education and Athletics, Cheyenne; Mr. Rudolph L. Memmel, Supervisor of Physical Education, Cincinnati; Mr. George J. Kozak, Directing Supervisor, Bureau of Physical Welfare, and Miss Harriet Fitchpatrick and Mr. A. L. Millsom, Supervisor of Girls and Boys Physical Education, Cleveland.

Mr. W. H. Marquardt, Director, Physical Education and Athletics, Dayton; Mr. John A. Johnson, Director, Health, Physical Education, and Athletics, Des Moines; Mr. George M. Mead, Divisional Director, Health and Physical Education, Detroit; Mr. Arthur Friedman, Supervisor, Physical Education, El Paso; Mr. Willard E. Burke, Director, Health, Physical Education and Athletics, Eugene; Mr. James Bradshaw, Fresno; Mr. C. R. Anderson, Superintendent of Schools, Helena; Miss Kathryn Fossum, Director, Physical Education and Athletics, Honolulu;

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Education, Rochester; Supervisor of Physical Education, San Jose; Mr. R. Cravens, Granada Hills, California; Mr. C. H. Kellam, Director, Health and Physical Education, San Antonio; Mr. George R. Canrinus, Coordinator of Health, Physical Education, Athletics and Recreation, and Mr. Louis J. Haas, San Francisco; Mr. Douglas Evans, Director, Department of Physical Education, Sioux Falls; Mr. W. P. Patterson, Supervisor, Health, Physical Education and Driver Education, Tampa; Supervisor of Physical Education and Mrs. Virginia J. Mack, Worcester; Mr. Roy G. Groe, Wichita.

I am especially appreciative of the contribution of Mr. Gaylord D. Ellison, who served as Research Assistant on the project. I would also like to acknowledge the services of Mrs. Carolyn Talalay, project secretary; Miss Julie Merkt, departmental secretary; Mrs. Marie Avitable, typist; and Mr. Robert Fleishman and Mrs. Ruth Inbar, statistical assistants. Mr. John DeLucia and Mr. Earl Morris were of special assistance in the composition phases of the report.

Appreciation for their continued support in connection with the contract is extended to Dr. Glen Bryan, Head, and Mr. John Nagay, Assistant Head, Personnel and Training Research Branch, Psychological Sciences Division, Office of Naval Research.

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Edwin A. Fleishman, Ph.D.
Project Director

THE DIMENSIONS OF PHYSICAL FITNESS--THE NATIONWIDE NORMATIVE AND DEVELOPMENTAL STUDY OF BASIC TESTS

This report describes another in our series of studies concerned with the development of reliable measures of physical proficiency. The first report, by Nicks and Fleishman (1960) reviewed the literature on physical fitness factors and attempted to integrate these into a meaningful scheme. Emphasis in that review was on the range of separate factors that need to be assessed in any comprehensive evaluation of physical proficiency. Commonly used tests were described in terms of what general physical fitness factor they probably measured. It was concluded that commonly used test batteries do not cover the range of possible fitness factors and many of the tests used overlap with one another in the factors measured. Subsequent reports described two large-scale follow-up studies designed to clarify the nature of the physical proficiency factors measured by fitness tests and to explore new tests which might be better measures of these factors. The report by Fleishman, Kremer, and Shoup (1961) described a study carried out at the Great Lakes U. S. Naval Training Center, which included a factor analysis of the areas of strength and endurance measurement; the report by Fleishman, Thomas, and Munroe (1961) described the study carried out at the San Diego U. S. Naval Training Center, which included a factor analysis of tests in the speed, flexibility, balance, and coordination areas. Both of these studies defined the factors that need to be assessed in these areas of physical proficiency and provided recommendations for tests found most diagnostic of these factors.

While the previous work identified the tests most likely to give a comprehensive coverage of important physical fitness factors, we still need <u>standards</u> for evaluating the performance of <u>individual</u> boys and girls on the separate tests. The present report is concerned with this next logical step in this series. Tests found to be most reliable and diagnostic in our previous work were assembled into "batteries" and administered to high school students throughout the United States. In all, 13 tests found to cover 8 basic factors were administered to more than 20,000 boys and girls in 45 different U. S. cities from coast to coast. Specifically, this report a) describes how this nationwide study was carried out, b) presents normative tables (in percentile form) by test, sex, and age by means of which individual performance can be assessed, and c) presents

developmental curves for performance on the tests as a function of age and sex.

PROCEDURE

Development of the test battery

Tests were selected for inclusion in the national study on the basis of the results of our earlier studies. This involved a joint consideration of each test's reliability coefficient, ease of administration and scoring, ease of examiner standardization, availability of necessary equipment in the typical high school, and primarily, the degree to which each test sampled a particular physical fitness factor. In this latter connection we examined a) the size of the tests factor loading on its primary factor, as well as, b) how "pure" the test was in measuring this factor (indicated by near-zero loadings on the factors covered better by other tests). If two tests were approximately equal in meeting these standards, we chose the test most likely to be familiar to most physical education people.

Some duplication of factors measured was considered desirable for the present study and more tests were included than were necessary for the final battery to be recommended. In these cases, the normative study itself provided additional bases for deciding on the final battery. For example, some tests proved excellent in the experimental studies, where rigid control of administration was possible, but the question of their feasibility in actual physical education programs still remained.

Table 1 summarizes the tests selected for the normative study, the factors measured, their reliabilities, and primary factor loadings. The reader will note that many of these tests turn out to have familiar names. This is because our earlier work, happily, showed some of these to be superior to new, experimental tests we tried out. We intentionally chose familiar tests over unfamiliar ones, provided the data supported this. Two further points should be kept in mind, however. One is that many of the familiar tests have been modified in the light of our work, to provide better measures of a single factor and higher reliability. The reader should keep in mind the revised test procedures in interpreting the present norms. Second, while there are familiar tests here, there are many familiar tests

Table 1

Tests Included in the National Study

Test Name	Primary Factor Measured	Primary Factor Loading	Reliability
Extent Flexibility	Extent Flexibility	.49	.90
Dynamic Flexibility	Dynamic Flexibility	.50	.92
Broad Jump	Explosive Strength	.54	.90
Softball Throw	Explosive Strength	.66	.93
50 Yard Dash	Explosive Strength	.75	.86
Shuttle Run	Explosive Strength	.77	.85
Dodge Run	Explosive Strength	.69	.84
Hand Grip	Static Strength	.72	.91
Pull Ups	Dynamic Strength	.81	.93
Leg Lifts	Trunk Strength	.47	.84
Hold Half Sit-up	Trunk Strength	.45	.88
Cable Jump	Gross Body Coordination	.56	.70
Balance A	Gross Body Equilibrium	.72	.82

which are not included. Our previous research showed the particular tests included to be superior to other frequently used tests. Also, many frequently used tests were shown to duplicate factors measured by tests in the same battery. Thus, the Pull-Up test is preferred over Push-Ups because of its higher factor loading on the Dynamic Strength factor and its high reliability. Besides, adding Push-Ups to Pull-Ups yields no new information on a subject's Dynamic Strength since the performances on these two tests are highly correlated. (A possible reason for preferring Push-Ups to Pull-Ups is the absence of any equipment requirement; however, the administration of Push-Ups is more difficult to standardize.)

Test Descriptions

Appendix A provides the test instructions supplied the examiners. Table 1 presents the important statistical characteristics of these tests; our earlier reports have described them in more detail including photographs and illustrations. These earlier reports really present the rationale for their inclusion in a manner beyond our space limitations here. However, brief descriptive summaries follow. The tests are grouped according to the general factor they have been found to measure. Brief definitions of each factor are repeated here.

Extent Flexibility Factor: Ability to flex or stretch the trunk and back muscles as far as possible in either a forward, lateral, or backward direction.

Extent Flexibility Test (originally called Twist and Touch): The subject stands with his nonpreferred side toward the wall, arms length away (with fist), with his feet together and his toes touching a line drawn perpendicular to the wall. A horizontal scale extends 12 inches on either side of a line on the wall drawn perpendicular to the line on the floor and marked off from 0 inches to 30 inches (see Appendix A). The subject keeps his feet in place, twists back around as far as possible and touches the wall with his preferred hand, keeping the hand at shoulder height with the palm facing the floor. The tester helps the subject keep his feet in place by placing his own foot against the subject's foot. The subject's score is the maximum distance on the scale reached and held for at least two seconds.

Dynamic Flexibility Factor: The ability to make repeated, rapid, flexing movements in which the resiliency of the muscles in

recovery from strain or distortion is critical.

Dynamic Flexibility Test (originally called Bend, Twist, and Touch): The subject stands with his back to the wall and far enough from the wall so he can bend over without hitting the wall with his buttocks. His feet are shoulder width apart. An "X" is placed on the wall in chalk or tape directly behind the middle of the subject's back and at shoulder height. Another "X" is made on the floor between the subject's feet. On the signal "GO," the subject bends forward and touches the X between his feet with both hands and then straightens up and touches the X on the wall with both hands. This represents one cycle. The next cycle is the same except that the subject twists to his right and continues to alternate the side to which he twists in each successive cycle. The subject's score is the number of cycles completed in 20 seconds.

Explosive Strength Factor*: The ability to expend a maximum of energy in one or a series of explosive acts. This factor is distinguished from other strength factors in requiring mobilization of energy for a burst of effort, rather than continuous strain, stress, or repeated exertion of muscles. Although all tests on this factor have significant correlations with each other the different tests chosen emphasize different specific muscle groups or activities. Thus, tests involving legs, arm-shoulders, speed, and gross body movement are represented below.

Standing Broad Jump: The subject puts his toes up to a start line and then jumps as far forward as possible. He is told that if he falls backwards, the jump will not count. Score is the best jump out of three, as measured from the start line to the rear of the foot closest to the start line at impact.

Softball Throw: The subject throws a 12" softball, with preferred hand, as far as possible without moving his feet. Score is the best distance in three throws.

50 Yard Dash: (See Appendix A for details.) Subject is timed individually and his score is his time to the nearest tenth of a second.

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*The elaboration of our three Strength Factors (Explosive, Static, and Dynamic Strength) in terms of the physics-mechanics concepts of Energy, Force, and Power, applied to muscle systems may be found in the Fleishman, Kremer, and Shoup Report (1961).

Shuttle Run: Subject stands with one foot on the starting line, and at the command "GO!" runs the 20 yards to the second parallel line, touches the ground on the other side with either foot, and returns to the start line. He repeats this, until he has covered the 20 yards five times. On the last lap, upright standards and a finish tape are put up for the runner to break. Score is the average time recorded by two observors for one complete run.

Dodge Run: (Alternate to Shuttle Run.) On the signal "GO," the subject runs around six chairs arranged in the pattern shown on the diagram in Appendix A. The subject repeats the pattern twice before running back to the starting line. The subject's score is the length of time required to make the two trips and return to the starting line.

Static Strength Factor*: The maximum force which a subject can exert, even for a brief period, where the force is exerted continuously up to this maximum. In contrast to other strength factors, this is the force which can be exerted against external objects (e.g. lifting heavy weights, pulling against a dynamometer) rather than in supporting or propelling the body's own weight.

Hand Grip: A Narragansett Co. grip dynamometer is placed in the subject's palm, dial up, fingers curled over so that part of the fingers between the second and third knuckles are touching the grip. The subject holds his arm down at his side, away from his body, and is not allowed to rest his forearm against his body. At the command "squeeze," he is told to squeeze the dynamometer once, sharply, as hard as possible. He is given three "squeezes," with at least 30 seconds between trials. Score is the best of his three squeezes.

Dynamic Strength Factor*: The ability to exert muscular force repeatedly or continuously over time. It represents muscular-endurance and emphasizes the resistance of the muscles to fatigue. The common requirement of tests measuring this factor is for the muscles to propel, support, or move the body repeatedly or to support it for prolonged periods.

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* See previous footnote.

Pull-Ups: This the familiar "pull-ups" test with some modification. At the start, the subject hangs from the bar with palms facing toward the body. At the "start" signal he pulls himself up until his chin is over the bar and lets himself down until his arms are fully extended to complete the cycle. The subject continues until unable to do any more. He is cautioned against kicking and twisting, or stopping in any one position for more than two seconds. Observors stop excessive swaying. Score is the number of pull-ups completed.

Trunk Strength Factor: This is a second, more limited, dynamic strength factor specific to the trunk muscles, particularly the abdominal muscles.

Leg Lifts: The subject lies flat on his back, hands behind his neck, with his elbows held to the floor by a partner. He then raises his legs until they are vertical, and then returns them to the floor. He is told to do as many of these lifts possible in 30 seconds, after the signal "GO." He is required to keep the small of his back and the base of his spine on the floor. A stiff one-two motion is used with the legs straight at all times. Score is the number of times the legs are elevated to a vertical position in the 30 seconds.

Hold Half Sit-Up: The subject lies on the floor with a partner straddling his legs, hands on the subject's knees. The subject's hands are behind his neck, elbows spread, but his hands do not touch the back of his neck. (This is to avoid additional support furnished by such "bracing.") On the signal "Start," the subject sits up until the upper half of his body is half-way to a sitting-up position (roughly a 40 degree angle with the floor). He is to hold this position as long as he possibly could. Emphasis is placed on keeping the body rigid, with chest out, stomach in. Every effort is made to keep the subject trying. Score is the number of seconds subject remains in position, before dropping.

Gross Body Coordination Factor: This factor is highly tentative as separate from other factors. One study (Hempel and Fleishman, 1955) identified what seemed to be such a factor and found Cable Jump a good measure of it. Later studies have proved the difficulty of confirming such an ability factor (see Fleishman, Kremer, and Shoup, 1961), however. The present Cable Jump was included for normative purposes.

Cable Jump: The subject is required to hold in front of him a short rope held in each hand. He attempts to jump through this rope without tripping, falling, or releasing the rope. Score is the number of successful jumps out of five attempts.

Gross Body Equilibrium Factor: The ability of an individual to maintain total body equilibrium, despite forces pulling him off balance, where he has to depend mainly on non visual (e.g. vestibular and kinesthetic) cues. Although general to balance tests where the eyes are kept open, it is best measured by balance tests conducted with the eyes closed. The best measure of this factor, Balance Test A (formerly called One Foot Lengthwise Balance - Eyes Closed) was not administered in sufficient schools to provide complete enough data for our normative purposes. For the present we describe the test procedure and present interim norms on a combined group of 17-18 year old boys. (The means for the 17 and 18 year olds were identical.) While the number in this particular group is only 200, they were all entering U. S. Naval Recruits, and thus represent a good geographic cross section.

Balance Test A: The subject balances on rail (1 1/2 inches high, 3/4 inches wide, and 24 inches long), with his hands on his hips, using the preferred foot. The long axis of the rail is parallel to the long axis of his foot (see Appendix A). When the subject has his balance he says "Go," and the examiner starts a stop watch. The trial ends when the subject touches the floor with any part of his body, or when he removes either hand from his hips. He is given one trial with the eyes open. The subject's score is total length of time he holds his balance for two trials.

The Study Sample

Table 2 lists the 45 cities which participated in the study. The map in Figure 1 shows their geographic distribution. It should be stressed that all of our data (with one exception) are from public high schools in cities with populations over 25,000. No attempt was made to include schools from rural districts. Our population is an urban one.

The attempt was made to include all cities ranked in the first 20 in population, plus representation from cities in population ranges down to 25,000. All cities of population over 500,000 were contacted. A chart was constructed listing all cities according to population category (25,000-50,000, 50,000-100,000, 100,000-250,000, 250,000-500,000) within the following geographical areas: Northeast, Middle Atlantic, Southeast, Midwest, Southwest, Far West, Rocky Mountain. Within these categories cities were picked randomly for inclusion in the initial pool. Thus, the attempt was to

Table 2

School Systems Participating in the National Study

Akron, Ohio	Granada Hills, California
Albuquerque, New Mexico	Helena, Montana
Allentown, Pennsylvania	Honolulu, Hawaii
Amarillo, Texas	Houston, Texas
Anchorage, Alaska	Indianapolis, Indiana
Atlanta, Georgia	Jacksonville, Florida
Baltimore, Maryland	Los Angeles, California
Bethlehem, Pennsylvania	New Haven, Connecticut
Biloxi, Mississippi	New York, New York
Birmingham, Alabama	Pittsburgh, Pennsylvania
Boston, Massachusetts	Richmond, Virginia
Buffalo, New York	Rochester, New York
Camden, New Jersey	St. Louis, Missouri
Cheyenne, Wyoming	San Antonio, Texas
Chicago, Illinois	San Diego, California
Cincinnati, Ohio	San Francisco, California
Cleveland, Ohio	San Jose, California
Dayton, Ohio	Seattle, Washington
Des Moines, Iowa	Sioux Falls, South Dakota
Detroit, Michigan	Tampa, Florida
El Paso, Texas	Wichita, Kansas
Eugene, Oregon	Worcester, Massachusetts
Fresno, California	

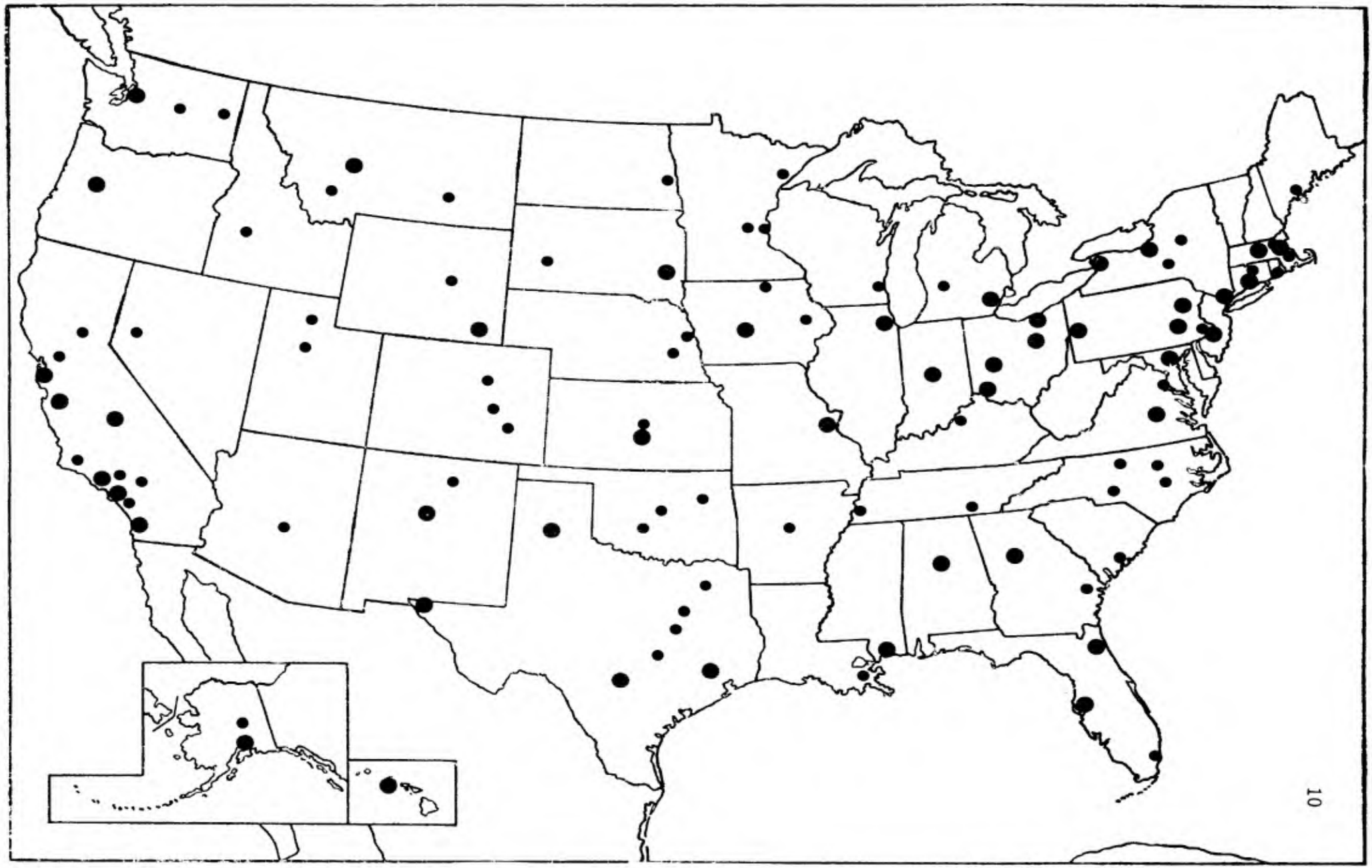

Figure 1: Participating Cities (Red Dots); Other Cities Contacted (Black Dots)

obtain a wide distribution of geographic area and city size in our sample, with a disproportionate emphasis on larger cities. Since a probability sample was not possible within the limits of our budget, the attempt was made to saturate the urban areas. With these limitations in mind, we believe that the norms developed are most applicable to the majority of youngsters in the U.S. today--those in public schools within our urban areas. This does not preclude the applicability of these norms to nonstudents, students in private schools, or those in rural areas--as long as the base-line for these norms are clearly understood. Further, while we may suspect that farm youths may differ, as a group, from city youths, the direction of these differences, on specific tests, is not known. This would make an important follow-up study. However, we have some evidence that the norms developed here are generally applicable, and not much deviant from those which might have been obtained had our sample included rural areas. Thus, a comparison of our 17-18 year old norms with those we obtained from U. S. Navy recruits at the Great Lakes and San Diego Naval Training Centers indicate comparable results. Since these Navy groups represented good cross-sections on geographic, rural-city, and socio-economic dimensions, we have increased confidence in the present norms. Furthermore, where comparisons are possible, with other national studies (e.g., AAHPR norms), our results are in line.

While a good cross-section of U.S. cities seems to have been achieved (indeed, almost complete representation of our largest cities), there is still the question of sampling bias within particular cities. Every effort was made to select high schools within cities, which were regarded by school administrators as representing the "best cross-section" of students in their city. Where a school was predominantly upper, middle, or lower socio-economic group, school officials indicated this on the prescribed data forms. Table 3 summarizes the socio-economic and city-size distribution of the participating cities.

Administration

The mechanics of conducting this study is of some interest and has, necessarily, been over-simplified in the above overview. Because of the time and work demands involved in administering the complete battery to the same students, the battery was divided into subunits called "kits." This was done so that no one wchool would be required to administer more than five different tests. Five such kits were developed to include overlapping combinations of these tests. Most tests were involved in two different kits. One exception was Hand Grip,

Table 3

Socio-Economic and City Size Distribution of Participating School Systems

City Size (population)	Number of Cities
over 1,000,000	4 (out of 5 in U.S.)
500,000 to 999,999	12 (out of 16 in U.S.)
250,000 to 499,999	10
100,000 to 249,999	10
under 100,000	9
Total	45

	Socio Economic Status* (of individual schools)				
City Size	A	B	C	X	Total Schools
over 1,000,000	-	3	1	5	9
500,000 to 999,999	1	5	4	13	23
250,000 to 499,999	1	6	2	11	19
100,000 to 249,999	1	2	1	10	15
under 100,000	1	3	2	8	14
	4	19	10	47	80

* A, students from predominantly upper socio-economic group;
  B, middle socio-economic group;
  C, lower socio-economic group;
  X, students in schools representing a "good cross-section" of socio-economic groups.

which was included in all kits. This was done since it was assumed that many schools did not have the required dynamometer. A surprising number did! The distribution of these five kits was another variable randomized among the cities within the geographic and city size categories. All cities of over a million population received two kits.

Appendix B gives further details about these procedures. This Appendix shows the initial contact letters, with the detailed instructions provided, and follow-up attempts. These normative studies were begun in the Spring of 1960. Of the original 77 cities contacted, 30 agreed to supply data either that semester or in the fall, or did so after a further plea from us in the fall (see Appendix B). Actually, a separate file of individual correspondence was set up for each school that replied. Some replied they would be glad to participate at a later time. Early in 1961 a further attempt was made to elicit cooperation from cities not finding it possible to participate earlier. In addition, a second round of initial contacts were made. From census and other figures a second list of cities was drawn up with special attention given to substituting cities "equivalent" to those cities in the original list which did not participate. The assignment of "kits" to the second list was done to fill in data where it was needed most. Of this second "go 'round" of 30 cities, 15 participated. The amount of correspondence involved with all these cities was voluminous since there were specific problems and questions inevitable to individual school systems. In many cases, individual concessions and provisions were made to obtain data from these cities. The final sample of cities represented in Figure 1 and Table 2 is a result of these sustained efforts. The map in Figure 1 shows all the cities contacted at some stage of the study. The black dots represent those cities which, for one reason or another, could not participate. The map shows that the concentration of cities in our sample is roughly proportional to the population densities of the different areas of the U.S. By and large, the cities which cooperated did so enthusiastically, with a great deal of interest and involvement at all levels.

As indicated by the letters in Appendix B, each school system was originally asked to administer the tests to 400 students with the focus on 17 year olds. To allow greater flexibility and to take advantage of the response, the study was enlarged to include data from students between 12 and 18. The largest number of students tested were in the 17 year old group, and these provide the most stable norms. Data based

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As indicated by the letters in Appendix B, each school system was originally asked to administer the tests to 400 students with the focus on 17 year olds. To allow greater flexibility and to take advantage of the response, the study was enlarged to include data from students between 12 and 18. The largest number of students tested were in the 17 year old group, and these provide the most stable norms. Data based

on ages 12 and 13 are more fragmentary and conclusions regarding these ages are more tentative.

The tests were administered by the physical education instructors in the individual schools according to the detailed instructions provided them. These instructions had received considerable pretesting. The few questions raised by each school system were clarified quickly, and these clarifications were incorporated in subsequent "kits." The data returned were checked for "reasonableness," possible inconsistencies, and obvious miscarriage of proper procedures. In a few cases of markedly deviant distributions an entire set of scores on a particular test was excluded. In most of these cases it was clear that a wrong type or incorrectly calibrated dynamometer was used or that the wrong time-limit for a test was applied. Individual examiner differences cannot be excluded as a source of error in such data, regardless of the care taken in standardization. However, it is also true that in actual practice such tests will not be given by "standardized" research personnel but by physical training instructors. Thus, while we must try to reduce such examiner variance, we will have to live with a certain amount of it. The degree of consistency in our data from different sources gives us confidence that the examiner error is slight relative to the obtained differences between age groups and sex, and among subjects within these groups. Further evidence of the utility of our data is the "normal curve" shapes of the total distributions of scores obtained for each of our tests within the male-female and age breakdowns. This confirmed our pretest results with these tests. Exceptions were the Cable Jump and Balance Tests, and we are convinced the skewed distributions obtained are a function of the tests, not the sampling or administration. Additional confidence in these data stems from the remarkable regularity of the curves plotting age against performance. These developmental curves will be presented later.

RESULTS

Normative Tables

The primary end products of this effort are reduced to the summary normative tables which follow. Each table summarizes the data for a single test. The center column presents the percentiles. To the left of this column are the scores, by age, for males and to the right the scores, by age, for females. To evaluate subse-

Test: Extent Flexibility

Boys							Girls				
Age							Age				
13	14	15	16	17	18	Percentile	14	15	16	17	18
25	26	35	34	36	37	99th	29	35	34	31	35
23	24	35	31	35	35	98th	28	31	31	30	33
22	24	34	30	33	35	97th	28	30	30	28	30
21	23	31	28	31	33	95th	27	29	29	27	29
20	23	27	24	28	30	90th	26	27	26	24	26
19	22	25	24	25	28	85th	26	25	24	23	23
19	22	24	23	24	26	80th	25	24	23	21	22
18	20	22	22	23	25	75th	25	23	21	20	21
17	18	20	21	22	23	69th	24	21	19	19	20
15	16	19	20	20	20	60th	23	19	17	17	18
14	15	17	18	18	18	50th	21	17	15	16	17
13	14	16	16	17	16	40th	20	15	14	14	15
11	12	14	15	15	15	31st	17	13	12	12	14
10	11	13	14	14	14	25th	14	12	12	11	13
8	9	12	13	13	12	20th	12	11	11	9	12
7	8	11	11	12	11	15th	11	9	9	8	11
5	7	9	10	10	9	10th	10	8	7	6	8
4	6	7	8	7	7	5th	7	5	4	4	6
2	4	5	6	6	4	3rd	6	3	3	2	4
1	3	3	5	6	2	2nd	4	1	2	1	4
0	1	1	4	5	1	1st	3	0	1	0	3

Scores are number of inches reached

Test: Dynamic Flexibility

Boys						Girls				
Age						Age				
14	15	16	17	18	Percentile	15	16	17	18
26	28	26	25	27	99th	25	23	20	20
25	26	24	24	25	98th	23	21	18	19
24	25	24	23	24	97th	21	19	17	17
23	24	23	22	23	95th	20	18	17	16
22	22	21	21	21	90th	18	17	16	15
21	21	20	20	20	85th	17	16	15	15
20	20	19	19	19	80th	16	15	15	14
20	19	19	18	19	75th	16	15	14	14
20	19	18	18	18	69th	15	14	14	13
19	18	17	17	17	60th	15	14	13	13
18	17	16	16	16	50th	14	13	13	12
17	16	15	16	15	40th	13	12	12	12
16	15	14	15	14	31st	13	12	12	11
16	14	13	14	14	25th	12	11	11	11
15	14	12	14	14	20th	12	11	11	10
14	13	11	13	13	15th	11	10	10	10
13	13	10	13	12	10th	10	10	10	9
11	12	9	11	11	5th	9	9	9	8
10	11	9	10	10	3rd	8	8	8	7
10	10	8	9	9	2nd	7	6	7	6
9	9	7	8	8	1st	5	3	6	6

Scores are "number of cycles"

Test: Standing Broad Jump

Boys							Girls						
Age							Age						
13	14	15	16	17	18	Percentile	13	14	15	16	17	18
7'3	8'2	8'5	8'10	8'9	8'11	99th	6'9	6'9	6'9	7'0	7'3	7'9
7'2	8'1	8'4	8'8	8'7	8'9	98th	6'5	6'5	6'7	6'7	6'11	7'6
7'0	8'0	8'2	8'6	8'5	8'8	97th	6'3	6'4	6'6	6'5	6'10	7'4
6'10	7'6	8'0	8'4	8'3	8'4	95th	6'1	6'2	6'2	6'3	6'8	6'11
6'9	7'2	7'9	8'0	7'11	8'1	90th	6'0	6'0	5'10	6'0	6'2	6'8
6'6	6'11	7'7	7'8	7'10	7'11	85th	5'10	5'11	5'8	5'10	5'11	6'5
6'3	6'9	7'5	7'7	7'8	7'9	80th	5'9	5'10	5'6	5'8	5'10	6'3
6'2	6'8	7'3	7'6	7'7	7'8	75th	5'8	5'9	5'4	5'7	5'9	6'1
6'1	6'6	7'2	7'5	7'5	7'5	69th	5'6	5'7	5'3	5'6	5'7	5'11
5'10	6'4	6'11	7'3	7'3	7'3	60th	5'3	5'4	5'1	5'4	5'5	5'9
5'8	6'2	6'10	7'1	7'1	7'1	50th	5'1	5'2	4'11	5'1	5'3	5'6
5'5	6'0	6'6	6'11	6'10	6'11	40th	5'0	5'0	4'9	4'11	5'1	5'3
5'3	5'7	6'3	6'7	6'8	6'9	31st	4'9	4'10	4'6	4'9	4'11	5'0
5'2	5'5	6'1	6'5	6'6	6'7	25th	4'7	4'9	4'5	4'8	4'10	4'11
5'0	5'3	5'11	6'4	6'4	6'6	20th	4'6	4'7	4'3	4'6	4'8	4'9
4'10	5'0	5'10	6'1	6'2	6'4	15th	4'3	4'4	4'2	4'4	4'6	4'8
4'8	4'9	5'6	5'10	6'1	6'2	10th	4'0	4'1	4'0	4'2	4'4	4'6
4'6	4'7	5'1	5'6	5'9	5'10	5th	3'7	3'8	3'10	3'11	4'1	4'3
4'3	4'5	4'10	5'4	5'6	5'7	3rd	3'5	3'6	3'7	3'9	3'11	4'0
4'1	4'3	4'8	5'2	5'4	5'4	2nd	3'2	3'2	3'4	3'8	3'10	3'10
3'9	4'1	4'7	4'9	5'0	5'1	1st	3'0	3'0	3'2	3'5	3'9	3'8

Scores are distance jumped in feet and inches

Test: Softball Throw

Boys								Girls						
Age								Age						
12	13	14	15	16	17	18	Percentile	13	14	15	16	17	18
140	180	183	225	224	229	233	99th	105	113	126	120	134	121
138	170	180	216	217	219	216	98th	95	112	116	114	114	116
135	165	177	209	212	213	212	97th	94	110	109	108	110	113
130	160	170	199	204	204	205	95th	92	103	100	100	103	109
126	148	164	190	193	195	197	90th	80	92	90	90	91	93
120	143	161	183	187	187	192	85th	72	86	84	84	85	86
114	138	144	177	181	181	186	80th	66	79	77	78	81	82
108	134	152	172	175	177	182	75th	63	74	73	74	78	78
103	129	149	165	170	172	179	69th	60	71	69	70	74	74
98	121	146	157	163	164	172	60th	56	65	63	64	69	71
94	109	134	150	155	156	164	50th	52	59	58	58	64	62
88	102	127	145	148	149	158	40th	49	56	54	53	60	63
85	95	120	142	140	142	150	31st	46	51	50	49	55	60
83	92	117	135	135	137	144	25th	44	48	48	47	53	54
80	88	110	132	131	132	139	20th	42	42	46	45	50	51
77	83	106	128	130	126	132	15th	41	40	44	42	47	47
73	77	102	122	117	118	125	10th	37	37	41	40	43	43
68	70	95	110	106	107	111	5th	33	35	36	36	38	38
66	67	80	103	99	99	108	3rd	32	33	32	33	35	34
65	66	75	101	95	94	105	2nd	31	31	30	30	33	32
63	64	70	97	86	86	98	1st	30	30	26	26	31	31

Scores are in feet

Test: 50-Yard Dash

Boys							Girls				
Age							Age				
13	14	15	16	17	18	Percentile	14	15	16	17	18
6.3	6.2	6.1	5.9	5.9	5.8	99th	6.9	7.0	7.0	7.0	7.0
6.5	6.3	6.2	6.0	6.0	5.9	98th	7.1	7.1	7.1	7.0	7.2
6.6	6.4	6.3	6.1	6.1	6.0	97th	7.2	7.2	7.2	7.1	7.3
6.7	6.5	6.4	6.2	6.1	6.1	95th	7.4	7.5	7.3	7.1	7.3
7.0	6.7	6.5	6.3	6.3	6.2	90th	7.6	7.8	7.5	7.4	7.6
7.1	6.8	6.6	6.4	6.4	6.3	85th	7.8	7.9	7.7	7.6	7.8
7.3	6.9	6.7	6.5	6.5	6.4	80th	8.1	8.0	7.8	7.8	8.0
7.4	7.0	6.8	6.6	6.5	6.4	75th	8.3	8.1	7.9	7.9	8.0
7.5	7.2	6.9	6.7	6.6	6.5	69th	8.4	8.2	8.0	8.0	8.1
7.6	7.5	7.0	6.8	6.7	6.6	60th	8.5	8.3	8.2	8.1	8.3
7.8	7.7	7.2	6.9	6.8	6.7	50th	8.6	8.5	8.4	8.3	8.6
8.0	7.9	7.3	7.1	6.9	6.8	40th	8.7	8.7	8.6	8.5	8.8
8.2	8.0	7.5	7.2	7.0	6.9	31st	9.1	9.0	8.8	8.7	9.1
8.3	8.2	7.6	7.3	7.1	7.0	25th	9.3	9.1	8.9	9.0	9.2
8.5	8.3	7.8	7.4	7.2	7.1	20th	9.4	9.2	9.1	9.1	9.3
8.6	8.4	8.0	7.6	7.3	7.2	15th	9.5	9.4	9.4	9.3	9.5
8.7	8.5	8.2	7.8	7.5	7.3	10th	9.6	9.6	9.7	9.5	9.7
8.8	8.6	8.5	8.1	7.7	7.5	5th	10.2	10.2	10.2	10.0	10.1
9.0	8.9	9.1	8.4	7.9	7.7	3rd	10.5	10.5	10.7	10.2	10.3
9.5	9.5	9.5	8.7	8.0	7.8	2nd	10.8	10.8	10.8	10.4	10.5
9.9	9.9	9.8	8.9	8.2	8.0	1st	11.2	11.2	11.2	10.9	10.9

Scores are in seconds

Test: Shuttle Run

Boys								Girls						
Age								Age						
12	13	14	15	16	17	18	Percentile	12	13	14	15	16	17	18
19.5	19.5	18.6	18.5	17.5	17.6	17.6	99th	20.0	21.0	20.1	19.8	20.5	20.1	19.7
20.5	19.6	18.7	18.6	17.9	18.1	18.0	98th	20.4	21.1	20.5	21.0	20.7	20.3	20.1
20.6	19.7	18.9	18.8	18.1	18.2	18.1	97th	20.6	21.2	21.0	21.3	20.7	20.5	20.3
20.7	20.0	19.0	19.0	18.3	18.5	18.3	95th	21.0	21.4	21.2	21.5	21.1	20.8	20.6
21.2	20.3	19.3	19.3	18.6	18.9	18.7	90th	21.5	21.7	21.5	22.1	21.5	21.3	21.3
21.5	20.7	19.7	19.6	18.8	19.1	19.0	85th	22.0	21.8	21.7	22.3	22.0	21.8	21.9
21.8	21.0	20.0	19.7	19.0	19.3	19.2	80th	22.4	22.0	22.0	22.5	22.3	22.1	22.2
22.1	21.3	20.1	19.9	19.1	19.5	19.3	75th	22.6	22.2	22.2	22.8	22.6	22.3	22.5
22.4	21.6	20.2	20.0	19.3	19.7	19.5	69th	22.8	22.3	22.4	23.1	22.9	22.7	22.7
22.6	22.0	20.4	20.3	19.5	20.0	19.8	60th	23.1	22.7	22.7	23.5	23.3	23.1	23.2
23.3	22.5	20.8	20.5	19.8	20.3	20.1	50th	23.5	22.8	23.1	23.9	23.7	23.4	23.5
24.0	23.0	21.2	21.0	20.1	20.7	20.4	40th	23.9	23.2	23.6	24.3	24.1	23.8	24.2
24.4	23.3	21.4	21.2	20.4	21.1	20.8	31st	24.6	23.5	23.8	24.7	24.5	24.2	24.7
24.6	23.5	21.6	21.4	20.8	21.3	21.1	25th	24.8	23.9	24.0	25.1	24.8	24.5	25.1
25.1	23.8	21.8	21.6	21.1	21.5	21.5	20th	24.9	24.2	24.4	25.4	25.1	24.9	25.5
25.4	24.1	22.0	21.8	21.5	21.9	21.9	15th	25.5	24.5	24.7	25.7	25.4	25.2	26.0
26.5	24.9	22.2	22.0	22.1	22.6	22.5	10th	26.0	25.0	25.0	26.2	26.0	25.7	26.3
29.0	25.5	23.0	23.2	23.8	23.7	23.4	5th	26.5	25.4	25.5	27.2	26.5	26.6	26.9
30.0	26.5	25.5	24.2	25.4	25.4	24.5	3rd	27.5	26.0	26.5	27.4	27.6	27.3	27.2
31.0	27.0	26.5	24.5	28.9	29.0	29.1	2nd	28.0	27.5	27.5	27.6	28.5	28.2	27.8
32.0	27.5	27.5	24.9	29.5	29.7	29.8	1st	28.5	29.0	28.5	27.9	29.2	28.9	28.9

Scores are in seconds

Test: Dodge Run

Boys							Girls				
Age							Age				
13	14	15	16	17	18	Percentile	14	15	16	17	18
16.0	15.5	14.7	14.6	14.6	14.9	99th	15.2	15.5	15.5	16.1	16.5
16.1	15.6	14.9	14.8	14.9	15.2	98th	15.3	15.9	16.2	16.7	16.9
16.2	15.7	15.1	15.0	15.1	15.5	97th	15.5	16.1	16.9	17.0	17.1
16.3	15.8	15.4	15.2	15.3	15.6	95th	15.7	16.4	17.1	17.2	17.4
16.5	16.2	15.8	15.7	15.7	15.9	90th	16.5	16.9	17.6	17.6	17.9
16.6	16.4	16.1	16.1	16.0	16.2	85th	16.8	17.4	18.0	17.9	18.3
16.9	16.7	16.4	16.2	16.2	16.4	80th	17.3	18.0	18.3	18.1	18.6
17.2	16.8	16.6	16.4	16.4	16.7	75th	17.8	18.2	18.6	18.3	18.9
17.4	17.0	16.8	16.7	16.6	16.8	69th	19.0	18.6	18.8	18.5	19.1
17.7	17.4	17.1	17.0	17.0	17.2	60th	19.3	19.1	19.2	18.9	19.5
17.9	17.7	17.5	17.4	17.4	17.4	50th	19.5	19.5	19.6	19.4	19.9
18.3	18.2	17.8	17.7	17.9	17.9	40th	20.2	20.1	20.1	19.8	20.3
18.5	18.4	18.2	18.1	18.3	18.6	31st	20.7	20.7	20.3	20.2	20.7
18.7	18.5	18.6	18.4	18.6	19.1	25th	21.6	21.1	20.6	20.5	21.1
19.0	18.8	18.8	18.7	18.8	19.2	20th	22.2	21.6	21.0	20.9	21.4
19.3	19.2	19.2	19.1	19.2	19.4	15th	22.8	22.3	21.4	21.3	22.0
19.5	19.8	19.5	19.7	19.6	19.8	10th	24.0	23.2	21.8	21.8	22.3
20.5	20.5	20.3	20.4	20.4	20.8	5th	24.7	24.3	22.7	22.5	23.3
21.0	21.0	20.7	20.9	21.0	21.9	3rd	24.9	24.9	23.1	23.3	24.3
21.5	21.5	21.0	21.4	21.4	22.8	2nd	25.5	25.5	23.4	23.5	25.1
22.5	22.0	21.7	21.9	22.3	23.3	1st	27.0	27.0	24.4	24.9	25.5

Scores are in seconds

Test: Hand Grip

Boys							Girls				
Age							Age				
13	14	15	16	17	18	Percentile	13	14	15	16	17	18
105	125	139	157	165	163	99th	65	83	84	90	99	101
102	120	130	149	156	156	98th	63	78	79	86	93	98
100	118	128	147	149	149	97th	62	76	77	83	90	96
95	115	121	140	144	144	95th	60	67	74	79	86	91
85	108	115	130	134	138	90th	58	60	69	76	79	86
80	105	111	126	129	134	85th	57	57	66	71	77	80
78	96	108	121	125	129	80th	55	56	62	69	75	78
75	93	106	118	120	125	75th	53	54	60	67	72	76
70	89	103	115	118	120	69th	50	52	59	66	69	73
67	84	98	110	115	117	60th	45	48	57	63	67	70
65	78	93	106	109	114	50th	42	43	55	59	63	67
57	75	88	101	106	109	40th	35	40	52	57	59	64
52	65	85	97	101	105	31st	33	38	49	55	57	59
50	59	81	93	98	101	25th	30	37	47	51	56	57
46	55	78	89	96	98	20th	28	36	46	49	56	56
43	50	76	86	92	96	15th	26	35	42	47	50	53
41	46	69	81	88	90	10th	24	32	39	45	47	49
39	41	61	76	82	86	5th	20	25	36	38	43	46
37	39	56	71	78	83	3rd	17	23	32	35	38	41
35	37	48	68	76	81	2nd	15	20	28	34	37	39
33	34	36	62	69	77	1st	10	15	20	31	31	37

Scores are in "pounds pressure"

Test: Pull-Ups

Boys								Girls					
Age								Age					
12	13	14	15	16	17	18	Percentile	13	14	15	16	17	18
9	14	16	20	20	20	21	99th	5	5	6	6	5	5
8	13	14	17	18	18	20	98th	4	4	5	5	4	4
8	12	13	15	17	17	19	97th	3	3	4	4	3	3
7	11	12	14	16	16	17	95th	2	3	4	4	2	2
6	9	10	13	14	14	15	90th	2	2	3	3	2	2
5	8	10	11	12	13	13	85th	1	1	3	3	1	2
4	6	8	10	12	12	12	80th	1	1	2	2	1	2
4	5	7	10	11	11	11	75th	1	1	1	1	1	1
2	4	7	9	10	11	10	69th	0	0	1	1	0	1
2	3	6	9	9	10	9	60th	0	0	1	0	0	0
2	3	5	7	8	9	9	50th	0	0	0	0	0	0
1	2	4	6	7	7	8	40th	0	0	0	0	0	0
1	2	3	5	6	6	7	31st	0	0	0	0	0	0
0	1	2	4	5	5	6	25th	0	0	0	0	0	0
0	0	1	4	5	5	5	20th	0	0	0	0	0	0
0	0	1	3	4	4	4	15th	0	0	0	0	0	0
0	0	1	3	3	3	3	10th	0	0	0	0	0	0
0	0	0	1	1	2	1	5th	0	0	0	0	0	0
0	0	0	0	1	1	1	3rd	0	0	0	0	0	0
0	0	0	0	0	1	0	2nd	0	0	0	0	0	0
0	0	0	0	0	0	0	1st	0	0	0	0	0	0

Scores are "number of pull-ups"

Test: Leg Lifts

Boys						Girls						
Age							Age					
14	15	16	17	18	Percentile	13	14	15	16	17	18
28	29	32	30	30	99th	23	24	24	24	25	27
27	28	30	29	29	98th	21	20	23	23	24	25
27	28	29	29	29	97th	20	19	23	23	24	24
26	27	28	28	28	95th	19	18	22	22	23	23
25	25	26	26	26	90th	18	17	20	20	21	21
24	24	25	25	25	85th	16	16	19	19	20	20
23	23	24	25	25	80th	14	15	18	19	19	19
23	22	24	24	24	75th	13	15	17	18	18	18
22	22	23	24	24	69th	13	14	16	17	17	17
21	21	22	23	23	60th	12	13	15	16	16	16
20	20	21	22	22	50th	10	12	14	15	15	14
18	19	20	21	21	40th	9	11	13	13	13	12
17	18	19	20	20	31st	8	10	11	12	12	10
16	17	19	19	19	25th	7	9	11	10	10	9
15	16	18	18	19	20th	6	9	9	9	9	8
14	15	17	18	18	15th	5	8	8	8	8	7
13	15	16	16	17	10th	4	6	7	7	6	6
11	13	15	15	15	5th	3	5	4	5	4	4
8	12	14	13	14	3rd	2	4	3	4	3	3
7	10	13	12	13	2nd	1	3	2	3	2	2
6	8	12	10	11	1st	0	2	1	2	1	1

Scores are "number of leg lifts"

Test: Hold Half Sit-Up

Boys						Girls					
Age						Age					
14	15	16	17	18	Percentile	13	14	15	16	17	18
302	262	292	227	212	99th	242	280	157	162	107	104
297	227	232	182	162	98th	217	267	124	124	99	96
262	192	202	151	143	97th	197	237	99	103	94	78
152	167	164	138	124	95th	159	222	92	92	79	63
136	136	133	116	111	90th	122	140	64	65	63	56
114	111	117	101	103	85th	99	92	55	55	56	46
98	86	105	95	97	80th	97	79	46	47	46	41
85	78	100	85	87	75th	82	66	61	60	39	36
78	71	84	78	78	69th	71	56	36	35	35	30
69	61	67	68	68	60th	66	48	29	32	27	22
60	58	62	61	60	50th	56	39	24	23	21	17
55	52	57	56	55	40th	46	30	19	17	16	12
47	42	50	48	47	31st	37	26	14	12	11	8
45	41	45	45	42	25th	29	19	11	10	9	7
42	36	41	40	40	20th	26	14	9	8	7	6
38	31	36	36	34	15th	21	10	7	5	5	4
31	27	30	29	28	10th	12	8	4	3	3	3
28	19	23	23	23	5th	7	6	2	2	2	2
20	17	18	20	18	3rd	4	4	1	1	1	1
18	14	14	17	14	2nd	2	2	1	1	1	1
16	12	9	10	8	1st	0	0	0	0	0	0

Scores are in seconds

Test: Cable Jump

Boys						Girls			
Age						Age			
14	15	16	17	18	Percentile	15	16	17	18
5	5	5	5	5	99th	5	5	5	5
5	5	5	5	5	98th	5	5	5	5
5	5	5	5	5	97th	5	5	5	5
5	5	5	5	5	95th	5	5	5	5
5	5	5	5	5	90th	5	5	5	5
5	5	5	5	5	85th	5	5	5	5
5	5	5	5	5	80th	5	5	5	5
5	5	5	5	5	75th	5	5	5	5
5	5	5	5	5	69th	5	5	5	5
5	5	5	5	5	60th	5	5	5	5
5	5	5	5	5	50th	5	4	4	4
5	5	5	5	5	40th	4	4	4	4
4	5	5	5	5	31st	4	3	4	4
4	4	4	4	4	25th	4	2	3	3
4	4	4	4	4	20th	3	2	2	2
3	3	3	3	3	15th	2	1	2	1
3	2	2	2	2	10th	1	0	1	0
1	1	1	1	1	5th	0	0	0	0
1	0	0	0	0	3rd	0	0	0	0
0	0	0	0	0	2nd	0	0	0	0
0	0	0	0	0	1st	0	0	0	0

Scores are number of successful jumps
(out of 5 attempts)

Test: Balance A

Boys	
Age	
17-18	Percentile
20	99th
19	98th
17	97th
16	95th
15	90th
12	85th
11	80th
10	75th
9	69th
9	60th
8	50th
7	40th
6	31st
6	25th
5	20th
5	15th
4	10th
4	5th
3	3rd
2	2nd
2	1st

Scores are in seconds

quent examinees, one need only turn to the table for a particular test, find the examinee's score in the appropriate age column, and then read across to the center percentile column. The percentile score tells the proportion of previously tested subjects, in a comparable age-sex category, that the examinee exceeded on that test. Thus, if a 17 year old boy can do 16 Leg Lifts, he exceeds only 10% of the national sample of his age group, but if he can do 26 he exceeds 90%.

The remaining discussion in this section is to assist the reader in interpreting these tables, to point out the limitations and cautions that need to be kept in mind. There are also features specific to individual tests which may be helpful in interpreting the norms for that test.

Although more than 20,000 students were tested not all students received all the tests since the tests were divided into kits (see above). Furthermore, the breakdowns by category naturally reduced the numbers in any individual group considerably. For most of the tests, more than 2,000 students within the age 16, 17, and 18 groups were tested. The numbers drop off as one proceeds down toward the 12 year olds. As can be seen in some of these tables, data for 12, 13, or 14 year olds are not included for certain tests. This occurred because the numbers of cases for these subgroups were too small and/or were untypically distributed geographically. This was more true for girls than for boys. Wherever possible data for these younger age groups were included as interim norms although the norms for the 16-18 year old groups should be more stable. However, confidence in the norms for ages 12-15 is increased when we examine how systematically their mean scores fall on the developmental curves described in the next section.

Again, the reader should be cautioned against direct comparisons with previous norms, without considering the particular test scoring and administration procedure used here. These procedures are based on our previous factor analyses and have resulted in some modifications from some existing practices. In general, these modifications reduce overlap between the tests, increase test reliability, and emphasize the main factor measured. These modifications affect the scores obtained in some of the tests which sound "familiar." It is encouraging to note that the small changes which do occur are in the direction which would be anticipated from the modified procedures.

Specifically, in Broad Jump, measurements are taken only on jumps done correctly. Thus, the measure is always to the heel (since the body has landed forward) and not to whatever part of the body touches the gound if the subject falls backward. This tends to get into the score a greater emphasis on the subject's "Explosive Strength" relative to other factors. The older type score tends to be a little lower than ours. The present Softball Throw procedure requires stationary feet, to emphasize arm-shoulder involvement and to minimize possible "leg" and "coordination" factors. So these scores tend to be a little lower than allowing a less controlled throw. Our Shuttle Run is longer than some other Shuttle Run Tests. This was done because our research showed this provided a higher reliability and better factor measure than the shorter run.

The present Pull-Up test requires an "underhand grip" rather than an "overhand grip." While this procedure is somewhat "easier," in that more pull-ups can be done this way, it does provide a measure with more "discriminating power." That is, there is a greater spread of scores. To illustrate this point, we may find five subjects unable to do more than one pull-up by the overhand grip; their scores would be the same. With the "underhand grip" we may find that two of these boys can do four pull-ups, one boy can do three, another two, and the other only one. The new procedure has allowed a finer differentiation among these boys in their Dynamic Strength, which was masked by the more difficult "overhand" procedure. Of course, the test must be controlled as outlined in Appendix A.

In the case of Pull-Ups, we note that girls were administered this test in the same manner as were boys. This is not the usual procedure, since girls typically use a modified procedure which allows them to keep their feet on the floor. Our data provides evidence that some proportion of girls can do some pull-ups in the standard way, but they are rare. We are still skeptical of the commonly used Modified Pull-Ups Test as a measure of Dynamic Strength. For girls, Push-Ups may be the most appropriate substitute. In retrospect, it would have been desirable to include some alternative tests of this factor for girls.

The remaining tests are either new or unmodified from usual procedure.

A word is in order regarding the Cable Jump Test. In a previous study (Fleishman, Thomas, and Munroe, 1961), an attempt was made to isolate a "coordination" or "agility"

factor separate from other factors. No such separate factor appeared. Tests thought to sample this factor appeared on combinations of other identifiable factors such as Dynamic Flexibility, Explosive Strength, etc. In an earlier study (Hempel and Fleishman, 1955), a factor tentatively identified as coordination did appear and Cable Jump was one of the best definers of it. Thus, we reached back to this earlier work to provide a tentative "coordination" test. There are two problems here. One is that athletic coordination, in the sense used here, has not been dependably isolated as a factor distinct from combination of the other factors represented here. Secondly, if such a factor is eventually isolated, a better test than Cable Jump should emerge. For now, we include Cable Jump as an interim measure. As it turned out, Cable Jump proved "easier" than anticipated in that a large proportion of subjects got a perfect score.

No "corrections" for the subject's height and weight within age groups have been applied. It is our feeling that available "size" indices leave much to be desired and may introduce more error than correction. Moreover, within age groups, height and weight may be correlated positively with performance on one test, negatively with another, and be uncorrelated with most tests. Thus, height and weight are positively correlated with Hand Grip but negatively correlated with Pull-Ups and uncorrelated with the other tests (see Fleishman, Kremer, and Shoup, 1961). Norms developed within different "size" classifications, within age groups, frequently show no consistent differences between the different "size" categories. Of course, age is correlated with size, and the categorization into age accounts for most (but not all) of the differences in "size." For the present, until more suitable "corrections" are found, we feel the examiner should use the norms uncorrected for "size." In the case of Pull-Ups and Hand Grip an examiner could make some allowance for size in the case of particular individuals obviously "small" or "large" for their age. Larger subjects, within an age group, are likely to do slightly less well on Pull-Ups. Thus, a 50th percentile score for a large subject represents slightly better performance than a 50th percentile score for a subject small for his age. The reverse is true for Hand Grip. For the remaining tests no corrections are advised.

Physical Proficiency as a Function of Age and Sex -- Developmental Curves

The figures which follow plot for each test the mean scores obtained by boys of different ages and by girls of different ages. These curves may be considered "developmental curves" describing changes in different physical proficiency components through the adolescent and sub-adult period. As we can see, there is no universal developmental curve--it depends on the component test as well as on the sex. However, there are definite regularities among the curves, as well as some interesting, consistent differences.

Most of the curves for boys show a negatively accelerated function--an almost linear increase in performance up to some "critical" age, beyond which only small additional increases occur.* One clear exception is our measure of Static Strength, the Hand Grip Test. The relation between age and Static Strength is linear straight through ages 12 to 18, with a given increase in Grip Strength directly proportional to the increase in age. The boys' Hold Half-Situp Test is another exception. This test shows no increase with age from age 14 to 18. Had sufficient data been obtained for ages 12 to 13, however, we might have seen a more typical growth curve up to the portion represented in our graph. One test, Dynamic Flexibility, shows a systematic decrease in performance for boys up to age 16 when the curve levels out.

For the remaining boys' "growth" curves, we find that although the shapes are similar, there are differences in the critical ages beyond which performance levels out. For most tests, this critical age for boys is either 15 or 16.

When we examine the girls' developmental curves, we find some notable differences, especially among the tests of Explosive Strength. Thus, for the three running tests we find decreases in running speed up to age 15, some improvement through age 17, and then a decrease in performances to age 18. In the case of girls' Softball Throw and Broad Jump we find a relatively long "plateau" of no improvement before improvement occurs at age 16 or 17. The reader should keep in mind that the subjects represented in each of these curves are not necessarily the same (different combinations of tests were given in different schools). Hence, confidence in the gener-

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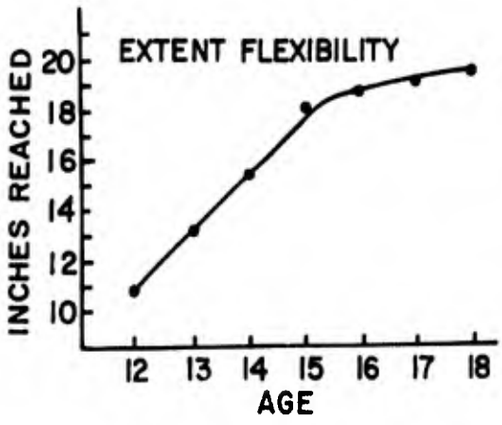
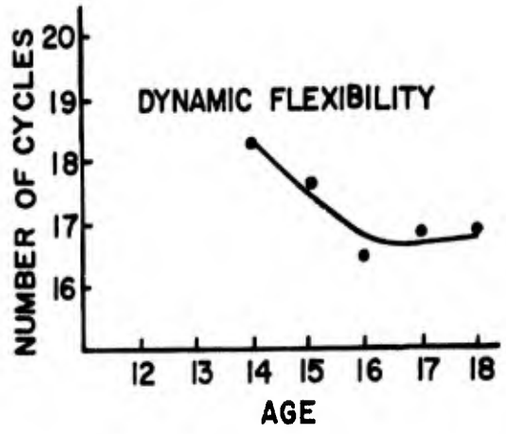
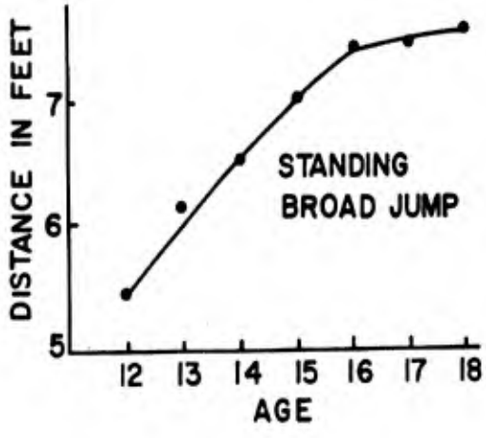
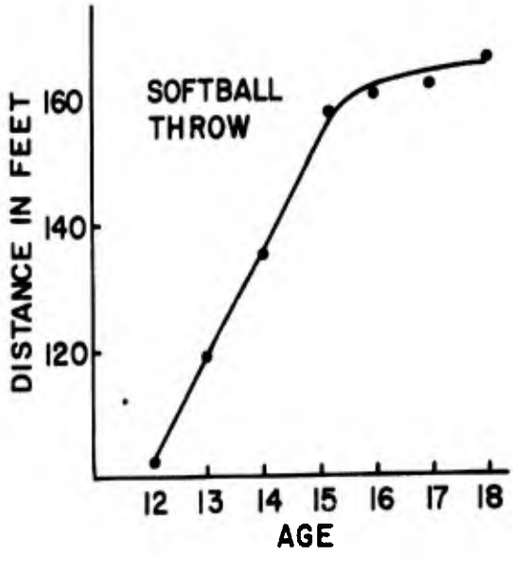
*Of course, a decrease in score on the three running tests is an increase in speed.

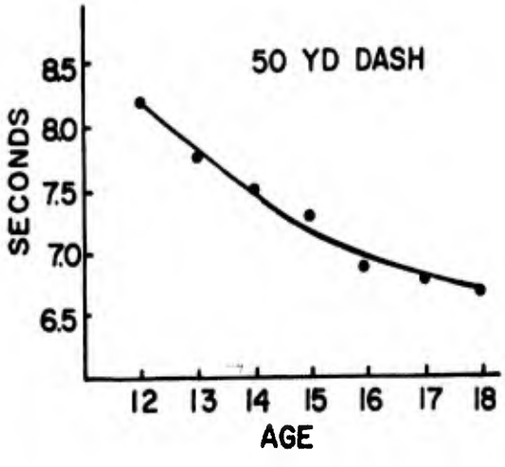
DEVELOPMENTAL CURVES
BOYS

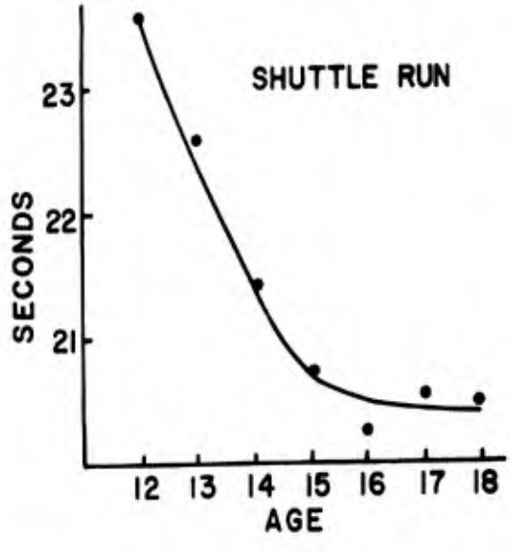




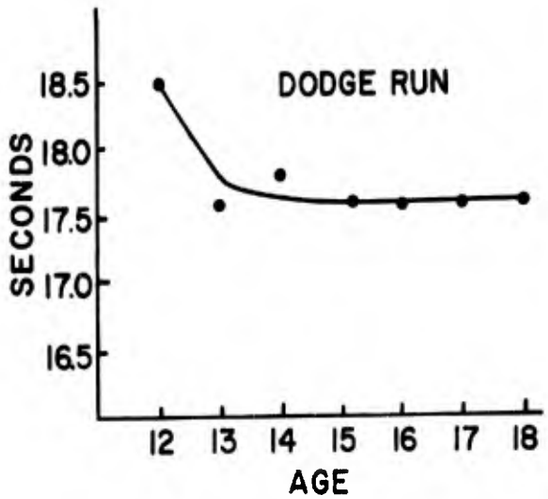


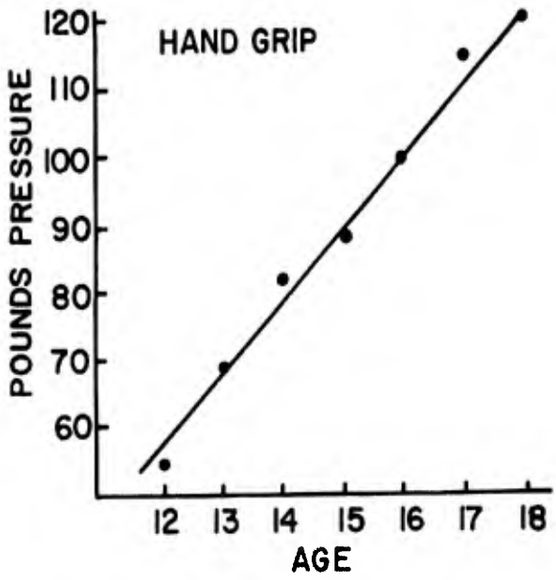


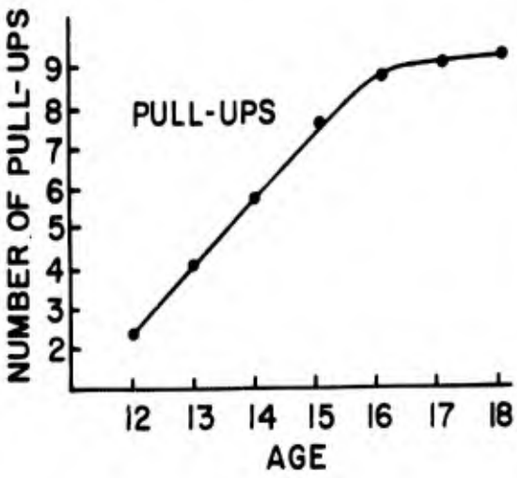


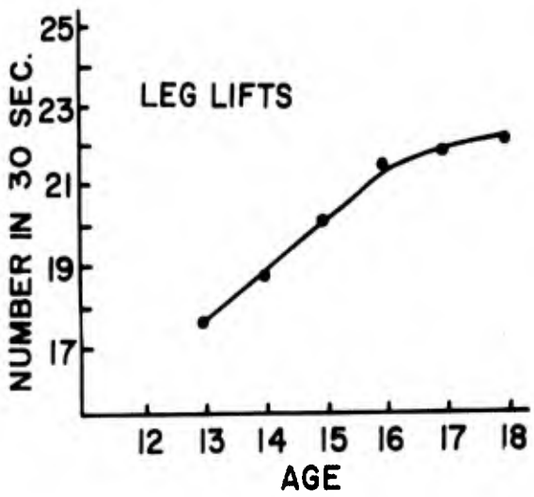


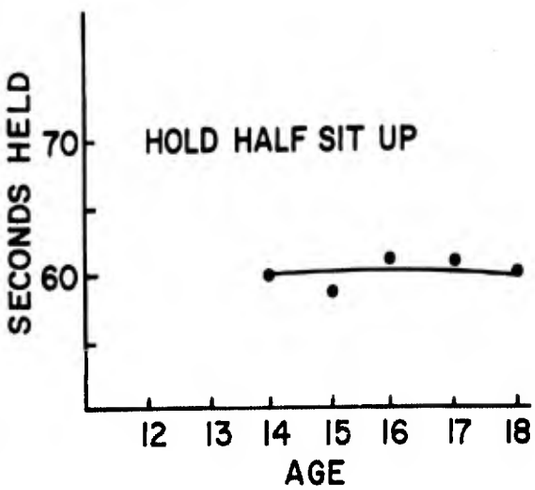
DEVELOPMENTAL CURVES
BOYS

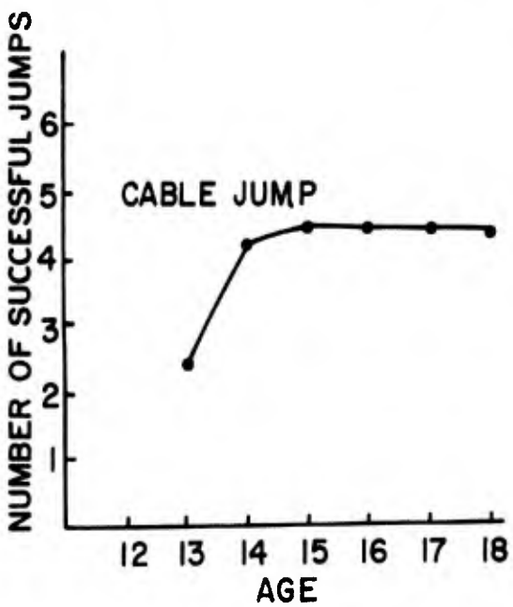




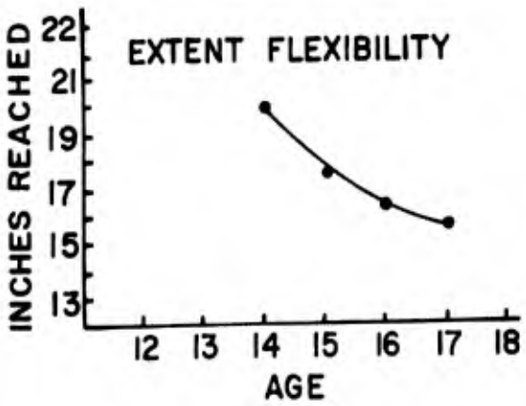


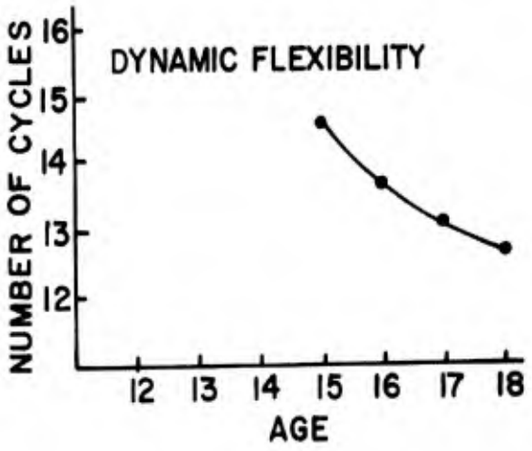


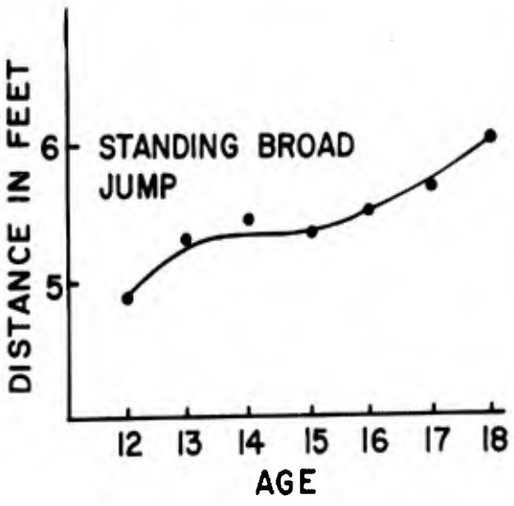


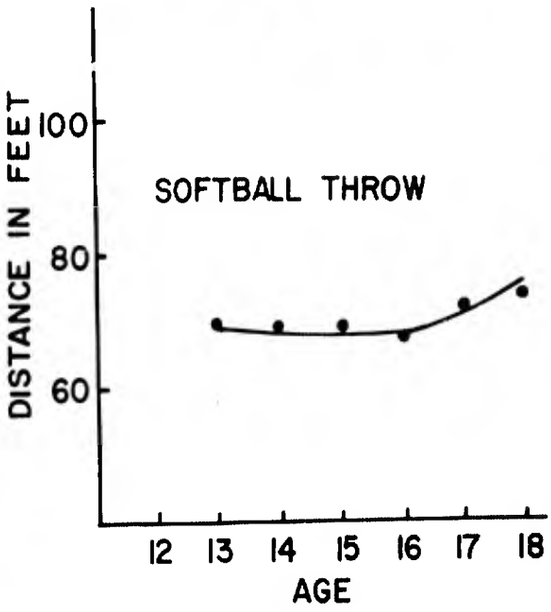


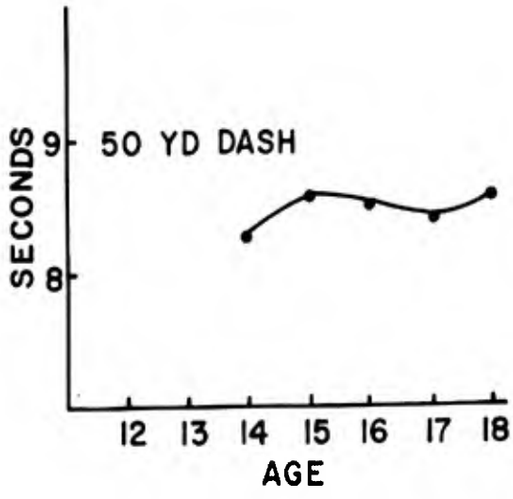
DEVELOPMENTAL CURVES
GIRLS

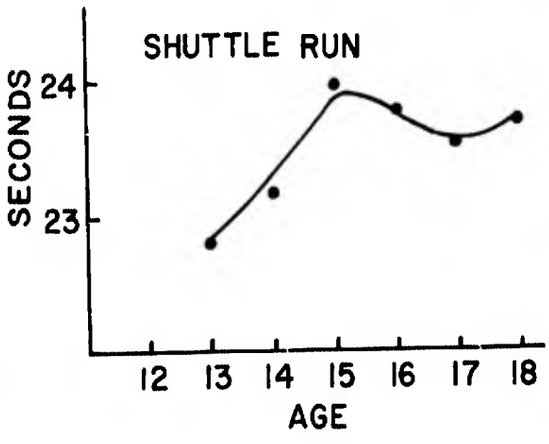




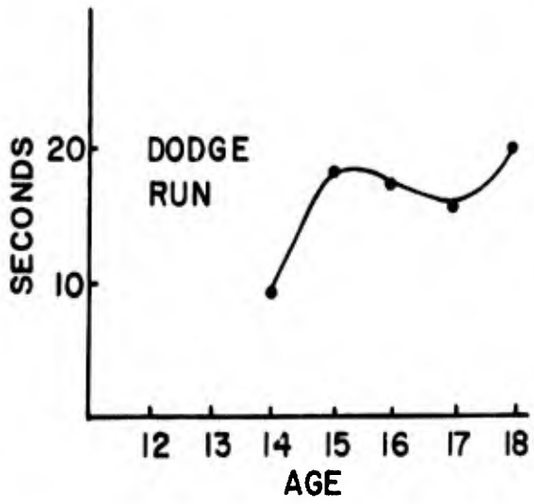


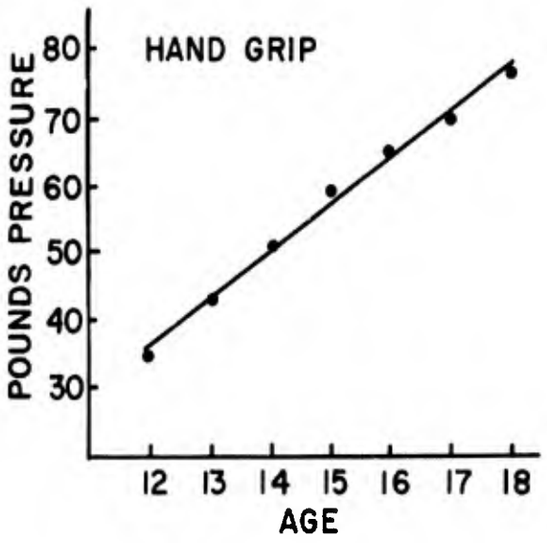


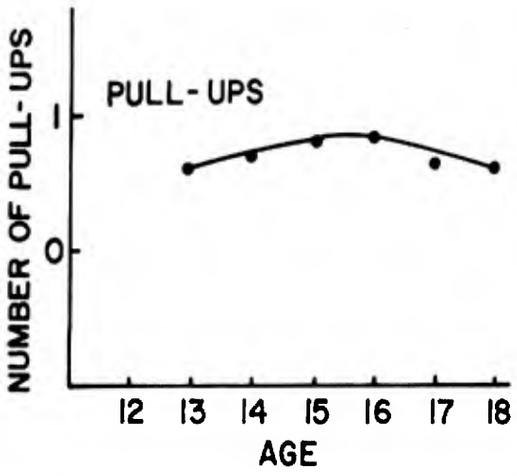


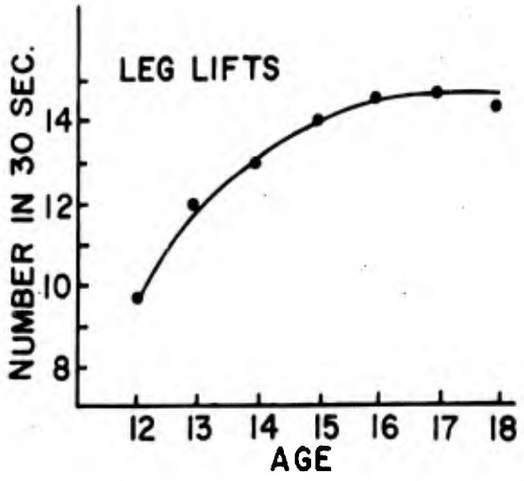


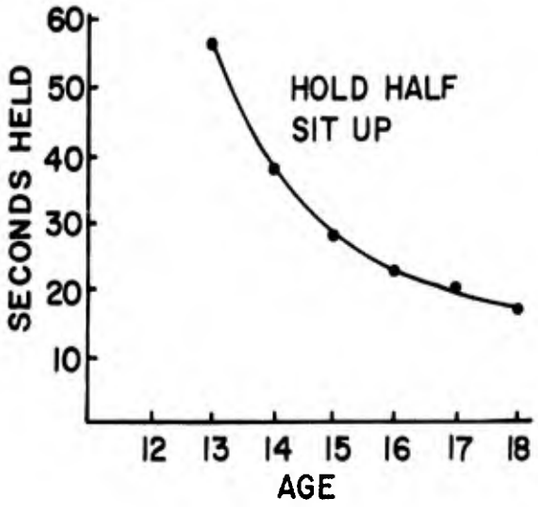
DEVELOPMENTAL CURVES
GIRLS

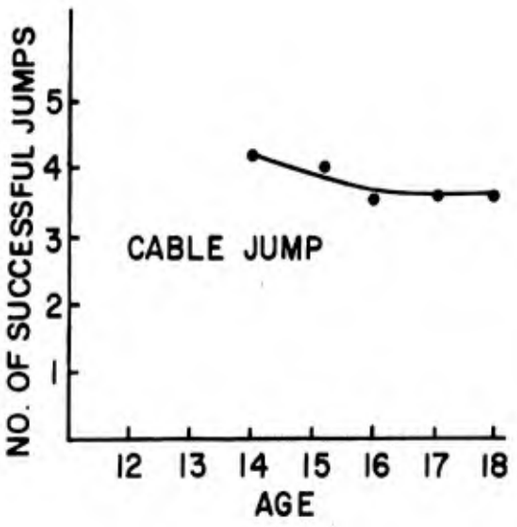












ality of these curves for these tests is increased. In contrast to the curves for boys, the girls' curves reflect definite developmental stages during which there is no improvement, or even performance decrement. It is likely that the maturational phases of female development are more apt to interact with physical performance in such tests than would be the case with boys. Another partial "explanation" lies in changes in interest patterns with age. Girls are more likely to show marked shifts away from athletic interests (and participation) at given stages in their adolescent periods, where boys are more likely to show more stability in these interests.

It is of interest that Static Strength (Hand Grip) for girls shows the same straight line function as was true for boys. We also note decreasing proficiency among girls' average performances on Dynamic and Extent Flexibility, as well as in Hold Half Situps. In contrast to this, girls improve on Leg Lifts up to age 16.

Thus, we see that for boys there is a general increase in proficiency with age on all tests except Dynamic Flexibility, but for girls the pattern is not so universal. For several components of physical proficiency girls show steady decreases in performance with age or show fluctuation curves characterized by stages of increased or decreased performance. More data, filling in the gaps at the 12 and 13 year levels for some of these tests, might help describe these functions more fully.

With regard to other sex differences, the reader may be interested in comparing boys and girls in absolute performance at different ages. We could have plotted the boys' and girls' curves on the same graph for each test. We preferred to keep these separate, to simplify the initial description of these functions. Since boys are considerably superior to girls on most tests, this would have extended our ordinates more than we preferred. However, the interested reader can combine these curves as he chooses.

There is no overlap, or crossing over of the boys' and girls' curves for most tests. An exception is Extent Flexibility, where boys tend to get more flexible (in how far they can stretch) while girls get less flexible. (The cross over point is age 15.) In the run tests, boys and girls are not much different at age 13, but become increasingly different thereafter. Where it is possible to compare slopes, the functions for boys are steeper than those for girls. In

general, one would conclude the obvious; that is, that the differences between boys and girls increase markedly as a function of age.

RECOMMENDED TEST BATTERIES

As indicated earlier, the normative and developmental study included more tests than would be recommended for a final battery. This allows more flexibility and also provides some additional criteria for selecting these tests. These additional criteria are primarily the steepness of the developmental curves (steeper curves provide more discrimination between age groups), ease of administration and standardization. The primary criteria, however, remain the factor loadings, reliabilities, and absence of overlap (with included tests) of the individual tests. Table 4 presents the reader with six alternative test batteries which differ in comprehensiveness.

The minimal battery of six tests measures six different physical fitness factors isolated in the research. Inefficient test batteries are those with too many tests on one factor, and none from one or more of the other factors. (The Kraus-Weber and several other batteries in use are, in this sense, incomplete and inefficient.) The addition of more than one test per factor adds relatively little new information about a subject's abilities relative to the addition of tests from separate factors. Thus, Shuttle Run, once assumed to measure a separate factor, adds little to a battery with 50 Yard Dash. The successive batteries described in Table 4 attempt to add tests from different factors, which increase the coverage most efficiently in increasingly long batteries. According to our analysis, Battery FPF-D, consisting of nine tests, will provide measures of nine different factors. To distinguish these batteries from others in the literature, these particular combinations of new, modified, and familiar tests have come to be known as the Fleishman Physical Fitness Test Batteries, and hence the abbreviations FPF. Attaching the letter (A, B, C) should allow for better communication regarding the particular battery in use.

For completeness, we have included the 600 Yard Run-Walk Test in our tables as a measure of "Cardio-Vascular Endurance." It was not possible to include this particular measure in our studies, but there is sufficient evidence that this factor is worthy of separate measurement. Our previous study (Fleishman,

Table 4

Recommended Test Batteries for Evaluation of Physical Fitness Factors

	Factor Measured	Test	Recommended Choice for Batteries of Different Lengths					
			FPF-A 6 tests	FPF-B 7 tests	FPF-C 8 tests	FPF-D 9 tests	FPF-E 10 tests	FPF-F 11 tests
I	Extent Flexibility	Extent Flexibility	x	x	x	x	x	x
II	Dynamic Flexibility	Dynamic Flexibility	x	x	x	x	x	x
III	Explosive Strength	Shuttle Run or 50 Yard Dash	x	x	x	x	x	x
		Softball Throw					x	x
		Broad Jump						x
IV	Static Strength	Hand Grip	x	x	x	x	x	x
V	Dynamic Strength	Pull-Ups	x	x	x	x	x	x
VI	Trunk Strength	Leg Lifts	x	x	x	x	x	x
VII	Gross Body Coordination	Cable Jump		x	x	x	x	x
VIII	Gross Body Equilibrium	Balance A			x	x	x	x
IX	Cardio-Vascular Endurance*	600 Yard Run Walk				x	x	x

* Not included in present study.

Kremer, and Shoup, 1961) did investigate the role of muscular endurance in strength tests and found this to be identified with Dynamic Strength. For the present, however, Cardio-Vascular Endurance appears to be independent of Dynamic Strength.

Another point to re-emphasize is the inadequacy of current Dynamic Strength measures for girls. It may be that this factor is relatively less important for girls anyway. For the present we recommend Push-Ups be substituted for Pull-Ups or Modified Pull-Ups for girls. An improved measure of this factor for girls is worthy of future study. Similarly, a better test than Cable Jump needs to be developed and this is regarded as an interim measure.

Batteries FPF-E and FPF-F are recommended where sufficient time is available, and obviously they are most comprehensive. These batteries allow additional measurements on the important Explosive Strength factor with emphasis on additional specific features (e.g., arm-shoulder involvement).

SUMMARY

Thirteen tests, measuring eight physical fitness factors, were administered to over 20,000 students between the ages of 12 and 18 in 45 cities distributed throughout the U.S. The primary products of this effort are a) the normative tables by which individual performance can be evaluated by test, age, and sex and b) the "growth curves" which show the development of the different physical proficiency components during the adolescent and subadult period. Finally, recommendations are made for batteries of tests which provide a more comprehensive and efficient coverage of physical fitness factors than do commonly used batteries in this area. The present report builds on earlier studies in this series which attempted to isolate and define the ability factors in this area of motor skill and to specify the tests most diagnostic of these ability factors.

Any research program raises questions along with those it answers, and we have pointed these out along the way. These results should provide additional guidance to those engaged in physical fitness programs. The primary contribution lies in providing standards for the evaluation of individuals and programs in this area.

REFERENCES

Fleishman, Edwin A., Kremer, Elmar J., and Shoup, Guy W., The Dimensions of Physical Fitness--A Factor Analysis of Strength Tests. Office of Naval Research, Contract Nonr 609(32), Technical Report 2, Yale University, Departments of Industrial Administration and Psychology, August, 1961.

Fleishman, Edwin A., Thomas, Paul, and Munroe, Philip, The Dimensions of Physical Fitness--A Factor Analysis of Speed, Flexibility, Balance, and Coordination Tests. Office of Naval Research, Contract Nonr 609(32), Technical Report 3, Yale University, Departments of Industrial Administration and Psychology, September, 1961.

Hempel, Walter, E., and Fleishman, Edwin A., "A Factor Analysis of Physical Proficiency and Fine Manipulative Skill," Journal of Applied Psychology, 1955, 39, 12-16.

Nicks, Delmer, C., and Fleishman, Edwin A., What do Physical Fitness Tests Measure?--A Review of Factor Analytic Studies. Office of Naval Research, Contract Nonr 609(32), Technical Report 1, Yale University, Departments of Industrial Administration and Psychology, July, 1960. (Also published in Educational and Psychological Measurement, 1962, 22, 77-96.)

APPENDIX A

Test Instructions

Physical Fitness Project — Yale University

GENERAL INSTRUCTIONS

1. The enclosed instructions are self-explanatory. They include directions to subjects, equipment used, and special notes to the test administrators.

2. The instructions for hand grip are included in the hope you have a standard Narragansett Co. hand dynamometer or manuometer. If you cannot obtain one, this test will have to be omitted, but we would certainly like to have it if at all possible.

3. It may be possible for you to set up four or five "testing stations," if you have enough administrators; this would allow you to run subjects through more quickly. We have provided extra Test Record Forms to allow you flexibility in administering these tests.

4. To assist our record keeping please record scores for boys and scores for girls on separate Test Record Sheets. Indicate whether the sheet contains scores for boys or girls (see upper right corner of Test Record Sheet).

5. The letters A B C and X in the upper right corner are a rough statistical check for us. These refer to a rough estimate of the socioeconomic area of the school. If students represent a general cross section, circle the X. If the students in your school come from predominantly high income groups circle A, for middle-average income circle B. If your students are from predominantly lower income groups and poor neighborhoods circle C. In most cases X or B will be checked, but we will rely on you to circle A or C if most appropriate. In any case, circle only one letter. Obviously, this is for your use only.

6. The intention is to provide maximum motivation for subjects to do well. The fact that students in various areas will be compared, and that American students will be compared with those of other nations should help provide the stimulus to do as well as possible.

7. We are sure you can appreciate the need for standardization in such a project. Thus, it is extremely important that our instructions for each test be followed closely. You may have administered certain of these tests differently before. However, for our purposes these must be administered in a uniform way, as indicated, in order to allow meaningful comparisons.

8. Please feel free to make comments on the sheets; these should be of great value to us.

9. Place all Test Record Sheets in an envelope and send directly to:

   Dr. Edwin A. Fleishman, Physical Fitness Project
   103 Sheffield Hall, Yale University
   New Haven, Connecticut

10. Before mailing, please check over the sheets to make sure identifying data have been filled in.

Thank you for your cooperation.

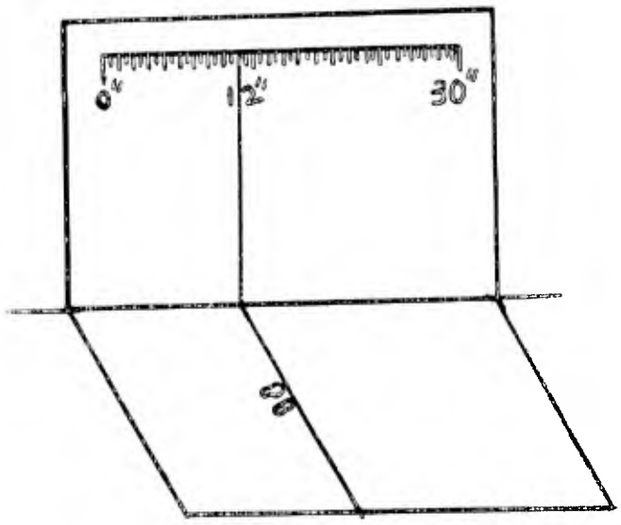
Extent Flexibility Test

Instructions

1. A measuring scale is drawn on a wall. The scale is 30" long and is marked off in half-inch intervals, from 0" to 30". This scale should be sufficiently wide to take advantage of differences in heights of the subjects.

2. Another line is drawn on the floor, perpendicular to the wall, in line with the 12" mark on the scale.

3. The right-handed subject stands with his left side toward the wall, toes touching the line on the floor, feet together and perpendicular to this line on the floor.



4. The subject stands far enough from the wall so that he can just touch the wall with his left fist when his arm is held horizontal from the shoulder.

5. The subject, keeping his feet in place, twists clockwise as far as possible so that he touches the scale with his right hand. (The tester places one of his feet alongside of the subject's feet to keep the subject's feet in place.)

6. The right hand is held so that the palm faces the floor, and is at shoulder height.

Score: Score is the farthest point reached (in inches) and held (for at least two seconds) as measured on the scale.

DYNAMIC FLEXIBILITY TEST

Instructions

1. The subject stands with his back to the wall and far enough from the wall that he can bend over without hitting the wall with his buttocks. His feet are shoulder width apart.

2. An "X" is placed on the wall in chalk or tape directly behind the middle of the subject's back and at shoulder height. Another "X" is made on the floor between the subject's feet.

3. On signal "GO," subject bends and touches the X between his feet with both hands and then rises, twists to his left, and touches the X on the wall with both hands. This is one cycle.

4. In the next cycle, the subject repeats except twists to his right, continuing to alternate the side to which he twists in each cycle. (Demonstrate)

Score: Number of cycles completed in 20 seconds.

STANDING BROAD JUMP

Instructions to Subjects:

This is a standing broad jump. Put your toes on the back end of the first line and jump as far as you can. If you fall backwards your jump will not count. You will be given three jumps and your best jump will be your score.

Administrator Note:

1. Subjects can do anything with their arms.

2. Watch heel closest to the starting line; that will be the heel that is measured.

Score: Best jump of 3, measured in feet and inches from back of first line to rear of back heel.

SOFTBALL THROW

Instructions to Subjects:

You are going to throw this 12" softball as far as you can without moving your feet. Throw it with either hand, picking the one with which you think you can do best. You will throw it three times and your score will be the best of three throws. Do not move your feet.

Administrator Note:

Observer in the field must watch carefully to measure this one. Observer at the throwing area, make sure feet do not move.

Score: Best of three throws (in feet to nearest 1/2 foot).

---

50 YARD DASH

Instructions to Subjects:

To start this exercise, get down in a starting position, one knee on the ground, with the tips of your fingers on the starting line. You will be given three commands: First, "Take your mark" at which you will get ready for the starting commands. Second, "Get set." With this raise your body off your haunches and get yourself balanced properly, as far forward as possible, for the start. Do not lean too far forwards - you may cause a false start. At the command "Go" start running. Run as fast as you can. The distance is fifty yards.

Administrator Note:

1. Watch the subject and make necessary corrections during his trial at taking the "Get set" position. Watch for false starts.

Score: Seconds (to the nearest tenth of second) for the one trial.

SHUTTLE RUN

Instructions to Subjects:

This is a shuttle run. To start this exercise, stand with one foot on the starting line. At the command "Go," run down the track to the line indicated, 20 yards away, touch the ground on the other side of the line with either foot, return to this line and do the same thing. You will cover this distance five times. On your last lap a finish tape will be put up for you to break. Remember to touch the ground on the other side of the line each time and watch for the finish tape. Run as fast as you can.

Administrator Note:

1. Watch that the subjects do not get confused and either stop short, not running the course five times or else treat the last "lap" as if they were to turn around.

2. Two times will be kept and the average used. One observer will start and time at the same time. All signals are verbal. Watch for false starts.

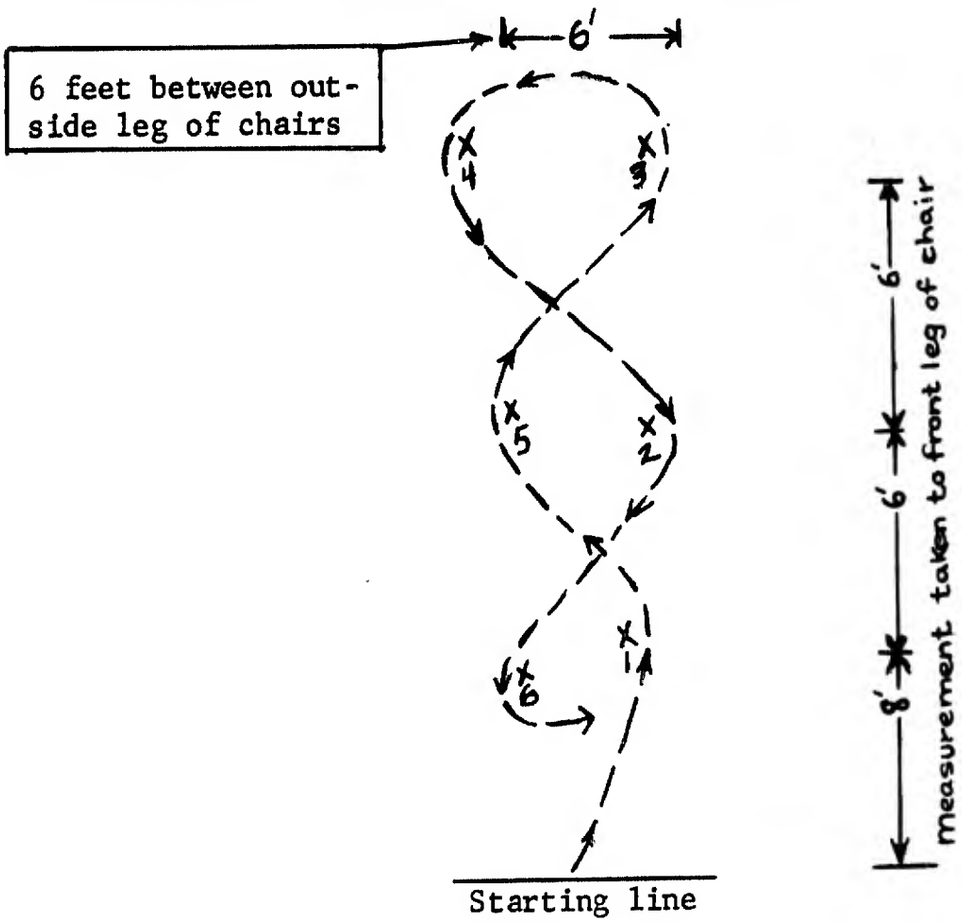
3. Encourage efficiency at the turn-around if subject is doing something which grossly slows him up. Clarity of instructions is vital to this exercise.

Score: Average of two times for the one trial.

DODGE RUN

Directions:

1. The chairs are set up as shown. (x = chair)



2. The subject readies himself at the center of the starting line.

3. On the signal "Go," the subject runs around the chairs in the path shown on the diagram. Upon arriving at chair number 6, the subject does not go back to the starting line, but goes directly around chair number one again and repeats the path around all the chairs. When he arrives at chair 6 the second time, he goes directly to the starting line.

Score: Number of seconds required to make the two trips and return to the starting line.

HAND GRIP

Instructions to Subjects:

This is a test of your grip. I will place this hand dynamometer in the palm of your hand. Use the hand that you think is strongest. The larger part of the grip should be in your palm, the dial up, and your fingers curled over the smaller grip so the part of your fingers between the second and third knuckles are touching the grip. Do not curl your fingers too far forward because they may touch the dial and interfere with the needle. When I say "Squeeze" squeeze the dynamometer once, sharply, as hard as you can. Hold your hand down at your side away from your body. You will be given three trials.

Administrator Note:

Make sure fingers do not hamper the dial. Make sure subjects do not rest their forearms against their body. A short, sharp squeeze is what we want. If they start to squeeze when given the dynamometer they are liable to slowly move the needle. We do not want this.

Score: Best reading (pounds) of three squeezes.

PULL-UPS

Instructions to Subjects:

In this exercise, you will chin yourself as many times as possible. To start, hang from the bar with your palms facing towards your body. From the signal "Start" chin yourself as many times as you can. Keep going until we tell you to stop or until you cannot do any more. If you stop in one place for more than two seconds we will tell you to stop. Your arms must be fully extended and your chin must reach the bar during each cycle. I will count aloud to you and if your arms are not fully extended and your chin does not reach the bar I will count "one-half" instead of "one" so you know when you are being penalized. I will demonstrate one chin.

Administrator Note:

Watch the kicking and twisting. Make sure all palsm are facing the subjects; i.e. chinning bar is to be grasped "underhand." Use stopwatch to determine if subject is stopping in one position for longer than two seconds. If subject starts swaying, put palm of your hand against his legs to stop the swaying.

Score: Number of chins without stopping for longer than two seconds in any position.

LEG LIFTS

Instructions to Subjects:

To start this exercise, you will lie flat on your back and clasp hands behind your neck. Partners will hold your elbows on the deck. You will raise your legs, keeping them straight, until they are vertical and then return them to the deck. On the signal "Start" you will do this as fast as you can for 30 seconds. Do not rock your body and keep your head, small of back and base of spine on the deck. Do not "boost" your body to get your legs vertical. Your score will be the number of times you elevate your legs to the vertical in 30 seconds. Demonstration: Now before we start, try the exercise yourself two or three times to get the feel of it.

Administrator Note:

This is not a rocking exercise but should be a stiff one-two motion. Subjects should keep legs straight at all times. They may try to boost themselves with their buttocks; this should not be done. Elbows should be kept on the deck. No one should slow down, as the time period is quite short.

POSITION

Score: Number of times subject elevates legs to vertical position in 30 seconds.

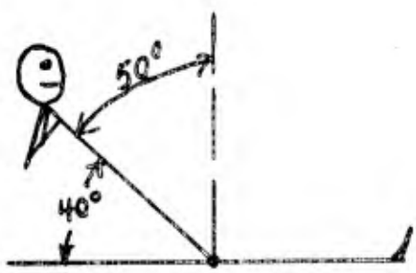
HOLD HALF SIT-UP

Instructions to Subjects:

To start this exercise, lie on the deck. Your partner will straddle your legs with his hands on your knees. Your hands will be behind your neck and elbows spread. Your hands should not be touching the back of your neck. On the signal "Start" sit up until the upper half of your body is half-way between a sitting up and floor position. There should be about a forty degree angle between the upper half of your body and the floor. Hold this position as long as you can. I will demonstrate this exercise to you (Demonstration). Now briefly assume this position; partners and observers will check it and note it. Remember to keep your head back, hands behind your neck (not touching your neck) and chest out. This is an endurance test; hold this position as long as you can. We will count the number of seconds and your partner will note the time when you drop.

Administrator Note:

Emphasize body rigidity. Do not allow the subjects to curve their torsos, either out or in. The 40 degree position should be difficult for them although not so difficult as leaning farther back. Hands behind necks, not touching necks, chests out, stomachs in - all are important. Correct any position discrepancies immediately. Elbows should be held back behind ears.



position

(side view)

Score: Number of seconds subject remains in that position.

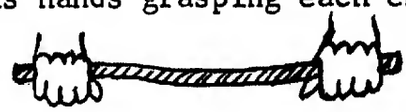
CABLE JUMP

Instructions to Subjects:

In this exercise, you are to hold this rope in front of you with one hand grasping each end, like this. You do not hold the rope stretched; let it hand loose. Your task is to jump over the rope while holding in both hands. We want you to land on both feet. You will be given five attempts at this. We are going to count the number of times you do it correctly.

Administrator Note:

The object here is to measure a coordinated performance. The basic equipment is a 24 inch length of rope. The subject holds the rope in front of him, with his hands grasping each end. The prescribed position is shown in the figure at the right. Note that approximately 4 inches of rope are covered by each hand, exposing about 16 inches between his hands. Just the ends of the rope protrude outside the closed fists.



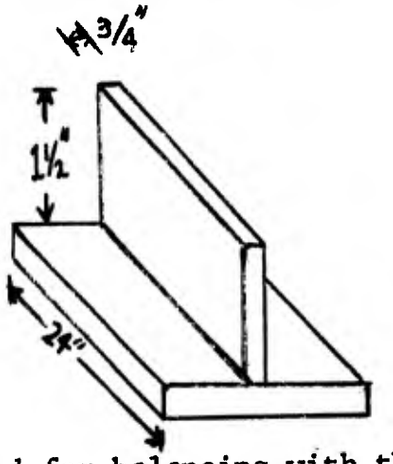
Holding the rope in this way, the subject is required to jump over the rope without loosening his grip from it. He is required to make 5 attempts. The subject: (1) jumps over the rope, through his arms; (2) lands on his feet; (3) does not hit the rope with his feet, or loose hold of it while jumping, and (4) does not loose his balance when landing. Unless the subject meets all of these requirements he has not made a correct jump.

Score: Number of correct jumps out of five attempts.

BALANCE TEST A

Instructions:

The balance rail is a piece of wood 1 1/2" high, 3/4" wide, and 24" long. This piece of wood is mounted to a base board as shown.



Two trial scores will be reported for balancing with the eyes closed. The subject will balance on the rail using the preferred foot with the long axis of the rail parallel to the long axis of his foot. The subject places his hands on his hips and stands up on the rail. When the subject has his balance and wants to start the trial, he says "Go." The administrator then begins timing the subject. The subject may not touch the floor with any part of his body, nor remove either hand from the hips. The subject's score is the length of time from when he says "Go" until he touches the floor with any part of his body or removes either hand from his hips. (The subject must keep his eyes closed throughout the test.)

Score: If the subject reaches 20 seconds without having lost his balance, the subject is told to stop, and a "20" is recorded in the appropriate column. If the subject opens his eyes, stop the test and record the time elapsed until the subject opened his eyes. The number of seconds the subject maintains his balance for each trial is recorded separately and added together for a total score; the subject is given a practice trial with eyes open.

APPENDIX B

Representative letters sent to

various school systems

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

Dear Sir:

The purpose of this letter is to enlist your cooperation in a nationwide study on physical fitness. The over-all objective of the study is to develop a brief, but comprehensive battery of physical fitness tests which will be useful in physical education programs. This research is being carried out at Yale University under contract with the Office of Naval Research.

After a number of large scale studies we have now reached the stage of collecting normative data on a national sample. In fact, it is our hope to compare our national norms with those from other countries. We are restricting the sample to young adults. In the present instance we are assembling data on high school seniors.

In order to minimize the obligation of any one school system, we have divided up the total number of tests to be administered into subunits. Thus, any one school would have approximately five tests to administer, but by proper sampling we will end up with comparable data in all of our tests. Any one student can complete the tests within one class period.

We would like to obtain data on at least 200 boys and 200 girls in your school system. We would be happy to receive more (and sometimes it is actually administratively easier to provide more) but this would serve our sampling needs in this matter. We will have to leave it to you to decide which schools are to participate. Our only plea is that, if possible, you pick a school with a representative cross section of socio-economic levels. If you are able to do this, circle the X in the blank next to S.E. group on the Test Record Sheet. If this is not possible, please indicate this in a rough way by circling A for upper, B for middle, and C for lower socio-economic group.

To assist in this matter we enclose a) the complete instructions for just those tests we would like administered in your school system and b) the Test Record Sheets on which all scores are to be recorded. These can be turned over to the particular physical education departments involved. Several packets are provided in case you prefer to distribute these to several schools. The individual departments are to return the completed Test Record Sheets directly to us. Additional instructions to them are provided with each packet.

As you can see, we have designed this program to provide a minimum of interference with your on-going activities. At the same time we know you will share the view that this is an important program which we hope will contribute to the national welfare.

Our goal is to have all the data in by March 1, but the earlier we can have it the better. It is our intention to provide the participating school systems with a complete report of the study.

We hope to hear from you soon.

Cordially,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

Dear Sir:

Recently we sent you some test materials hoping you might participate in our national physical fitness study. The response to our study has been very enthusiastic from all sections and we have had excellent cooperation.

We have not as yet heard from you, but we hope you will still be able to join us. Our study has been extended to include grades 10 and 11. If you do not include seniors in your physical education program, perhaps, you can provide us with data from sophomore or junior classes. We very much hope this now makes it possible for you to cooperate with us.

Again be assured that we will supply you with a complete report of the national study in which all participating schools will be acknowledged. We hope to hear from you soon.

Cordially,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

Dear Sir:

This is a follow-up to our request of last Spring regarding our national physical fitness project. At that time we sent you a kit of materials which included general instructions, test instructions, and data sheets to be returned to us. The tests were to be administered to high school seniors and we asked that at least 200 boys and 200 girls be tested in a "representative" school in your city. The response to this project has been most encouraging and it looks as though we will have an excellent national sample.

Your letter was one of several we received which indicated that you would participate if you could supply us the data during the Fall term rather than last Spring. In May we wrote you accepting your offer. This letter is to inquire when we might receive these data and to ask if you would like additional copies of the instruction and data forms sent you.

Our current aim is to get all of the data by November 15. We are looking forward to hearing from you soon.

Cordially,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

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This is a follow-up to our request of last Spring regarding our national physical fitness project. At that time we sent you a kit of materials which included general instructions, test instructions, and data sheets to be returned to us. The tests were to be administered to high school seniors and we asked that at least 200 boys and 200 girls be tested in a "representative" school in your city. The response to this project has been most encouraging and it looks as though we will have an excellent national sample.

Your letter was one of several which indicated you would like to participate but could not supply the data unless more time were available. In May I wrote you asking if you would hold the materials in the event we were to follow up our study in the Fall. This letter is to inquire if it is now possible for you to proceed during the Fall term to collect these data for us. We certainly would like to include a representation of your school system in our national sample. If you would like additional copies of the instruction and data forms, we would be happy to send them immediately.

Our current aim is to get all of the data by November 15. We are looking forward to hearing from you soon.

Cordially,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

Dear Sir:

Last Spring we sent you the enclosed letter regarding our nation-wide study of physical fitness in the hope that we might enlist your cooperation. The response to our requests has been extremely gratifying and we have received good participation from all areas of the country.

Your city was one of the few which did not reply and we hoped it was because our material arrived too late. Some cities replied that our materials arrived too late for the Spring term and they asked if they could defer testing until the Fall. Accordingly, our study has been extended through the Fall term and we hope this will now allow you to furnish us with data from your school system.

We are asking for data from 400 seniors in a "representative" high school. In case the materials we sent you have been misplaced by now, we enclose additional copies for your information and use. It is possible for each student to complete the tests in one class period.

We will be glad to furnish you with norms with which you can compare your own students. Incidentally, we have now extended the study to comparative samples in European cities.

There is tremendous interest in the project and we hope we will hear from you soon.

Cordially,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

Dear Mr.

This letter is to acknowledge receipt of your data for our Physical Fitness Project and to thank you and your staff for your cooperation. The response to and interest in our project has been most gratifying.

As you can imagine, the collation and analyses of the data, which is still coming in, is quite a job. However, when our project is complete, you will certainly receive a report of it.

Again, thank you for your help.

Cordially,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

Dear Sir:

Your school system was one of approximately 50 which participated in our nationwide normative study of physical fitness tests. Some schools participated in 1961, others in 1960. It has taken some time to assemble all these data and to reduce it to usable form. The report of this study will be published soon and this note is to assure you that your school system will be among the first to receive this report when it appears.

Again, we wish to thank you and your staff for your contribution to the success of this study.

Sincerely yours,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

YALE UNIVERSITY
DEPARTMENT OF INDUSTRIAL ADMINISTRATION
NEW HAVEN, CONNECTICUT

203 SHEFFIELD HALL

Superintendent of Schools
Attention: Supervisor of Physical Education
Board of Education

Dear Sir:

Your school system was one of those which participated in our nationwide normative study of physical fitness. The purpose of that study was to provide norms for those physical fitness tests found to be the "best" measures in our earlier research. Your schools provided data for some of the tests now included in the Fleishman Basic Fitness Test Batteries. The report of that study will be sent you early this summer. In the meantime, we enclose some earlier reports which describe the overall project and the work which led up to the study in which you participated. We hope you will circulate these to interested parties on your staff.

The report of the National Normative Study will be report number 4 in this series. Again, thank you for your interest and cooperation.

Cordially,

Edwin A. Fleishman

Edwin A. Fleishman, Ph.D.
PROJECT DIRECTOR

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