THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST AS VALIDATED BY THE FLEISHMAN BASIC FITNESS TEST

by

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ABSTRACT

The purpose of this investigation was to ascertain the degree to which the C.A.H.P.E.R. Fitness-Performance Test is a valid measure of motor fitness as determined by the Fleishman Basic Fitness Test. A second purpose was to determine whether abbreviated batteries with little or no loss of validity can be developed.

The subjects consisted of ninety grade six and seven boys enrolled at an elementary school in Vancouver.

T-score values for each of the C.A.H.P.E.R. and Fleishman items were computed. These values were used to establish the internal criterion (average T-score value of the six C.A.H.P.E.R. variables) and the external criterion (average T-score value of the ten Fleishman variables).

Intercorrelations between the six C.A.H.P.E.R. test items and their correlations with both the internal and external criterion were computed. The variables which yielded the best combined relationship with the criterion score were selected by the stepwise multiple regression method.

The validity of the C.A.H.P.E.R. Fitness-Performance Test was determined by its correlation with the Fleishman Basic Fitness Test.

Battery A, (the shuttle run, the 300 yard run, and the flexed arm hang) with an R of 0.961, was chosen as the

best three item predictor of the internal criterion. Battery B, (Battery A and the standing broad jump) with its R of 0.982, was found to be the best four item predictor.

Battery D (the standing broad jump, the shuttle run, and the flexed arm hang) was chosen as the best three item indoor battery. Its multiple R was 0.894. Battery F (Battery D and the one minute speed sit-up) had an R of 0.941 and was chosen as the best four item indoor predictor of the internal criterion.

Battery G, (the shuttle run and the 300 yard run) with its multiple R of 0.763, was chosen as the best two item predictor of the external criterion. With the addition of the standing broad jump, Battery H was formed. Its multiple R of 0.775, made this battery the best predictor of the external criterion.

Battery J, (the standing broad jump, the shuttle run, and the flexed arm hang) with its R of 0.752, was chosen as the best indoor predictor of the external criterion.

The high degree of validity of the C.A.H.P.E.R. Fitness-Performance Test as measured by the Fleishman Basic Fitness Test was substantiated by:

a) the multiple correlation coefficient of 0.790,

b) the zero-order correlation coefficient of 0.781.

Batteries G and H, however, predict the Fleishman Test almost as well as the complete C.A.H.P.E.R. Test.

The relatively high relationship between each of the following:

a) the one minute speed sit-up,

b) the shuttle run,

c) the 50 yard run,

d) the 300 yard run,

indicated that the C.A.H.P.E.R. Fitness-Performance Test contains measures of variance common to more than one test item.

DEDICATION

This study is dedicated to my wife,

Florence,

in appreciation of her sacrifices.

ACKNOWLEDGMENT

The writer wishes to express his sincere appreciation to his adviser Dr. H.D. Whittle for his constant encouragement and valuable advice.

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C.S.J.

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I. THE PROBLEM

The object of this study is two fold. Namely to determine:

a) the extent to which the C.A.H.P.E.R. Fitness-Performance Test is a valid test of motor fitness as measured by the Fleishman Basic Fitness Test;

b) whether an abbreviated battery with little or no loss of validity can be developed.

Assumption: Motor fitness is a quality which cannot be measured directly. Motor performance is therefore selected as the best and most readily measurable reflector of motor fitness. It is therefore assumed that motor fitness is related to achievement in performance tests involving muscular strength and endurance, cardiovascular-respiratory endurance, muscular power, flexibility, speed, agility, coordination and balance.

Limitations:

1. The time available for testing was limited to the class time of the subjects.
2. The total number of subjects was limited to those enrolled at the sample school.

3. The age ranged from 10 years 2 months to 13 years 6 months.
4. Although test directions are standardized, it was impossible to control completely motivational factors.
5. The order of test administration was limited by weather conditions.

II. JUSTIFICATION OF THE PROBLEM

There has been a growing interest within Canada and the United States for the need for a valid test of motor fitness. Many tests have been devised. Most of these tests have been constructed in universities in the United States and with norms based upon American populations. The Board of Directors of the Canadian Association for Health, Physical Education and Recreation (C.A.H.P.E.R.) decided that it was of special importance to develop in Canada a set of national performance norms for Canadian children. Thus they issued a directive to the C.A.H.P.E.R. research committee at their 1963 national convention, initiating the project which resulted in the construction of the C.A.H.P.E.R. Fitness-Performance Test.

The objective of this project was three-fold:

a) to establish fitness-performance norms on the selected test-items for Canadian boys and girls aged seven to seventeen;

b) to provide teachers with information about the current range of performance ability of each age-sex group;

c) to provide incentive for the personal fitness improvement of Canadian children.

As a result of the 1964 C.A.H.P.E.R. Research Committee meetings in Edmonton and Ottawa, the test items were selected and the administrative details were established.

The selection of test items depended upon:

a) the reliability and validity of the performance elements as predictors of motor fitness;

b) the ease of the administration of the test items in terms of:

1. the economy of time,
2. equipment and space required;

c) the appropriateness and adaptability of the test items for all ages and both sexes.

Consideration was also given to items which afforded international comparisons.

The validity of the C.A.H.P.E.R. test battery (1) was based upon the professional knowledge and experience of Canadian physical educational experts. Although correlational and factor analytic information was considered while selecting test items, no level of correlation to some criterion as the minimum standard was set by the committee. "It was felt that most items would be self-validating in the fact that

they sample a type of movement or performance which we wanted to assess." (2)

It is the purpose of this study to add information as to the empirical validity of the C.A.H.P.E.R. Fitness-Performance Test.

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CHAPTER II

REVIEW OF THE LITERATURE

Validity of a test may be defined as the accuracy with which the test measures that which it is used to measure, or as the degree to which it approaches infallibility in measuring that which it purports to measure (1)(2)(3). "A test is valid for a particular purpose or in a particular situation - it is not generally valid." (4)

Cureton suggests that there are two major aspects of validity: relevance and reliability (5). Relevance is concerned with the closeness of agreement between that which the test measures and the function that it is used to measure. Reliability is concerned with the accuracy and consistency of the test's measuring ability.

When a validity study is being made, logic as well as statistics should be applied. Face validity is a rational analysis of the task involved in the test situation (6). In such cases, the investigator validates a test descriptively, using logical explanations to show that the test does measure that which is required by the descriptive criterion (7). Face validity then, is the extent to which the test is convincing as a measure of that for which it is being used. It is a form of self-validation.

Content validity is the validation of a test's content by means of competent judgements. It is established by

showing that the test items are a sample of a universe in which the investigator is interested. This type of validity is ordinarily to be established deductively, by defining a universe of items and sampling systematically within this universe to establish the test (8). This has been the basis for the construction of many general motor ability and motor fitness tests (9). These two processes consist of analyzing the activity in terms of its fundamental elements. The researcher then investigates test items to measure these elements. The content validity is usually established deductively by systematically sampling the universe in which the tester is interested to establish the test. This is most satisfactory when the sampling of items is wide and judicious and when standardized groups are utilized (10)(11). Content validity, then, is concerned with how well the test performance represents the universe of criterion behaviour (12)(13). The above two methods were used for the selection and validation of the C.A.H.P.E.R. Fitness-Performance Test.

The combined judgement of experts is often used when it is difficult to find a suitable test for a criterion measure. Though this procedure is time consuming, it may prove more beneficial than comparing a new test with several older tests of questionable value (14).

The validity of a test may be determined experimentally by finding the correlation between the test and some independent criterion, such as another test of the same

factor in which results have already been established (15).

A criterion is a standard of judging that which is a known and accepted measure of whatever the author wishes to test (16). It may be another test which has proven its worth or it may be some score determined subjectively such as that provided by a rating (17). The criterion is the yardstick against which the test in question is to be measured. It is therefore most important that the criterion is appropriate.

This type of validation is called empirical or statistical validity. If the correlation between the test and the criterion is high, they measure essentially the same thing. This practice of validating a new test with an established criterion has not been widely used in physical and health education (18)(19).

It is usually very difficult to create or locate a suitable criterion measure. A motor fitness criterion is no exception. All criterion measures are partial measures in that they measure only part of the abilities or preliminaries underlying the actual performance (20). The problem then becomes one of choosing the most satisfactory criterion measure from among those measures which appear most obtainable.

Thorndike and Hagen list the following desirable qualities of a criterion measure:

a) relevance,

b) freedom from bias,

c) reliability,

d) availability (21).

The empirical validity of a test is . . . "expressed as a correlation coefficient, that is a numerical expression of the degree of relationship between two factors or abilities as measured on a given population." In this case, the coefficient expresses the degree of relationship between the criterion and the test (22).

The assurance of a new test is limited by the degree of agreement between the criterion test and the quality measured. The higher the correlation coefficient, the more truly does the test appear to be measuring the ability in question, that is, the more nearly it confirms the basic assumptions of face validity (23). Skill is required to interpret validity coefficients because there are many factors which may influence empirical validity.

Some tests lend themselves more naturally to validation studies than do others. Often good criteria are difficult to find. Such is the case in finding a suitable motor fitness criterion. Under these conditions a high relationship between the test and the criterion is unlikely.

The experimenter has no way of knowing from his experiment whether or not the test is a better measure of the desired characteristic than is the criterion.

Because a test may work well with one group and not so well with another, the validity coefficients may vary

markedly as the populations differ. The coefficient is likely to be higher when the group being examined exhibits great variability. A good test should discriminate well even when the group is highly homogeneous. The discriminatory power of a test is often established by comparing different groups such as the upper quarter of the group being tested with the lower group (24).

The usefulness of a test as a predictor depends not only on how well it correlates with a criterion, but also on how much additional information it will give us. Even when a test correlates very highly with the criterion variable, it may not be of much value. Some of the tests which are to be used in a battery may be measuring the same abilities as other tests, thus a duplication of measurement results. The extent to which this is true may be determined by a correlation of the suspected tests against one another. Such a correlation between two test items is known as an intercorrelation. In combining tests to form a battery, those with low intercorrelation coefficients and at the same time high correlation coefficients with the criterion (not less than .500) are selected because they measure different aspects of the desired criterion performance.

The validity of the total test battery may be computed by a multiple correlation procedure. This statistical procedure allows us to determine the best weight to give each of two or more motor fitness predictors and to calculate the

correlation coefficient that will result from this combination (25). The resultant weights are called regression weights and the resultant correlations are called multiple correlation coefficients.

Several of the above combinations may be tried. The resultant multiple correlation coefficients will indicate the relative validity of each combination with the criterion.

The experimenter then chooses a battery in terms of the highest multiple correlation coefficient or he selects the few most valid and least overlapping tests (26). Consideration must also be given to the administrative feasibility, costs, specialized equipment needed, and the relationship of the test to the program being used. A test battery may be quite desirable when considered in the light of its relationship with the essential criteria, but the use to which its results can be put, may not justify the effort and money involved.

Weiss and Scott (27) summarize the statistical validation process by giving the following procedures.

A test correlation with the criterion is computed. Those tests with high correlations are selected as the best prospects for the new test battery.

Every test is then correlated with every other test in the experimental battery with the purpose of eliminating duplication of measures of the same factor.

Multiple correlations are computed between the

criterion and two or more tests with the purpose of selecting analytically the least number of items to form a battery. This battery should not only be constructed on its high relationship with the criterion but also upon its ease and economy of administration. The Wherry-Doolittle multiple correlations method of test selection is often used.

This method is also used to develop a regression equation which indicates the relative importance of each item in the test battery. If the items are all of approximately the same weight or importance, the researcher may disregard weighting in setting up the scoring system. When the weightings in the regression equation are unequal, it is best to use the equation itself, to compute the total performance score. If this procedure is not followed, the total test scores will be less valid than is indicated by the multiple correlation coefficient.

Factor analysis technique is a valuable technique in any validity study, when it provides information as to what the test measures, and to a limited extent, how well it performs this measurement task. Factor analysis is a specialized mathematical technique that systematically studies the interrelationships between tests or other measures.

Through this technique, intercorrelations of a large number of tests are examined and if possible accounted for in terms of a much smaller number of more fundamental factors. Each test item is given a factor loading or weight

as a result of the test's correlation with each factor. This coefficient becomes the test's factorial validity (28). That is, the validity of a test as a measure of one of these factors is its correlation with that particular factor.

As factor analysis studies become more extensive and more carefully designed, their findings will increasingly converge, confirming the existence of identifiable motor fitness factors. Gradually a reference system of factors will be established from which different tests can be described (29).

The Fleishman Basic Fitness Test was constructed as a result of factorial analysis technique. First, a comprehensive review of the literature on previous factor analytic research on the dimensions of physical fitness was made. Considerable pre-testing of new and existing tests was then carried out. The most reliable tests from these pre-test studies along with the more familiar tests were included in two large-scale studies with United States Navy recruits. The correlations among all the tests administered were obtained and subjected to factor analysis studies. This provided a better definition of the factors that need to be assessed for a more comprehensive evaluation of physical proficiency and provided recommendations for tests which best diagnose these different factors. The tests found to be the most reliable and diagnostic of the different factors were assembled into batteries and administered to more than

20,000 boys and girls in 45 cities throughout the United States.

The validity of the final test battery was determined in terms of two criteria: the size of the test's factor loading on its primary factor, and how "pure" the test was in measuring this factor. This kind of validity has been called "construct validity." (30)

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CHAPTER III

METHODS AND PROCEDURE

The Subjects: The data for this study were obtained during October 1965, by testing the ninety boys enrolled in grades six and seven at Queen Elizabeth Elementary School, Vancouver, British Columbia. The age of the subjects ranged from ten years two months to thirteen years six months.

The Test Items: The raw data consisted of actual performance records made by the subjects on the C.A.H.P.E.R. Fitness-Performance and Fleishman Basic Fitness Test items. The C.A.H.P.E.R. Test consisted of the following items:[1]

1. one minute speed sit-up,
2. standing broad jump,
3. shuttle run,
4. flexed arm hang,
5. 50 yard run,
6. 300 yard run.

The Fleishman Test contained the following items:[2]

1. extent flexibility test,

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[1]See Appendix A, for full description of the C.A.H.P.E.R. Fitness-Performance Test items.

[2]See Appendix B, for full description of the Fleishman Basic Fitness Test items.

2. dynamic flexibility test,
3. shuttle run,
4. softball throw,
5. hand grip,
6. pull-ups,
7. leg lifts,
8. cable jump test,
9. balance - A test,
10. 600 yard run-walk.

The results from the C.A.H.P.E.R. and Fleishman test items were recorded by the examiner on the score cards[1,2] as recommended by the appropriate manuals.[3,4]

I. PREPARATION FOR ADMINISTRATION OF TESTS

The testing team included fourth-year physical education majors and senior physical education students. This team had been well prepared for the test administrations by

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[1]See Appendix C, for the C.A.H.P.E.R. Fitness-Performance Test's score card.

[2]See Appendix D, for the Fleishman Basic Fitness Test's score card.

[3]See Appendix A, for full description of scoring procedures for the C.A.H.P.E.R. Fitness-Performance Test.

[4]See Appendix B, for full description of scoring procedures for the Fleishman Basic Fitness Test.

their regularly scheduled Test and Measurement laboratory classes. During these classes, they were examined not only on their techniques of testing, but also on their knowledge of the two tests.

Strict supervision of the testing procedures was practiced throughout the testing periods. This strict supervision was made easier by the fact that:

1. no more than four boys were assigned to a test administrator,
2. equipment and areas for testing were prepared well in advance.

II. ADMINISTRATION OF TESTS

The C.A.H.P.E.R. Fitness-Performance Test and the Fleishman Basic Fitness Test were administered during the regular physical education period on two consecutive Tuesdays and Thursdays. The time allottment for each test period was 80 minutes. The two test periods, A and B, were organized as follows:

Test Period A: During this period the following data were obtained:

1. The six measures of the C.A.H.P.E.R. Fitness Test;
2. Three measures of the Fleishman Basic Fitness Test:
   a) extent flexibility,
   b) dynamic flexibility,
   c) hand grip.

Test Period B: During this period the Fleishman items noted below were measured:

1. shuttle run,
2. pull-ups,
3. leg lifts,
4. cable jump,
5. balance - A,
6. softball throw,
7. 600 yard run-walk.

Because of weather conditions, exceptions to the above procedure were experienced by the Tuesday group. Their testing procedure is given in Appendix F. Consideration in test selection was made, so that no motor fitness factor would be measured twice during the same period.

Before the subjects attempted any test item, instructions were read from the appropriate test manual. (see Appendices A, and B.) Each test was then demonstrated. Although each of the subjects had practiced the test items during earlier physical education periods, they were again allowed practice attempts. During this time, corrections were made to guarantee an acceptable level of performance.

The following test items were not practiced:

1. hand grip,
2. pull-ups,
3. flexed arm hang,
4. 50 yard run,

5. 300 yard run,

6. 600 yard run.

Because of fatigue factors, it was decided that practice attempts on the above items just before performance might be detrimental.

III. STATISTICAL TREATMENT OF DATA

The Criteria: In this study, both the internal and external criterion were established in the same manner. The internal criterion was the average composite score of the six C.A.H.P.E.R. Fitness-Performance Tests. The external criterion was the average composite score of the ten Fleishman Basic Fitness Tests.

Before the composite scores could be determined, it was necessary to convert the C.A.H.P.E.R. and Fleishman raw scores into comparable values. This was accomplished by computing T scores for each raw score (1).

Intercorrelations of the C.A.H.P.E.R. Test Items: To determine the validity of the test items, it was necessary to intercorrelate each T scored C.A.H.P.E.R. test item with each of the other C.A.H.P.E.R. test items and with the two criterion scores. This was accomplished through the calculation of zero-order correlation coefficients using the Pearson-product moment method (2).

Selection of Tests for the Battery: Having calculated the intercorrelation coefficients of the tests with each other and their respective validity coefficients i.e., the correlation of each test with its internal and external criterion score, the next step in the treatment of the data was the calculation of maximal multiple correlations between combinations of tests and the two criterion scores.

The tests were chosen in terms of those with the highest validity coefficients and their contribution of additional variance to the dependent variable, the internal or external criterion. Tests with criterion correlations of 0.600 or better were therefore selected as the best prospects for the abbreviated test battery.

The usefulness of a test as a predictor depends not only on how well it correlated with the internal criterion, but also on how much new information it provided in the form of variance not already measured. Tests with intercorrelations lower than 0.500 will have the best chance of contributing previously unmeasured variance.

The statistic used for the selection of test items for the abbreviated batteries was the stepwise multiple regression method, a computer adaptation of the Wherry-Doolittle method (3). In this method tests are selected analytically and added one at a time until a maximum multiple correlation coefficient is obtained. "The variable added is

that one which makes the greatest improvement in 'goodness of fit'." (4)

An important property of the stepwise procedure is the fact that variables which have been found to be significant in earlier stages may be found to be insignificant after several other variables have been added. When this occurs, the insignificant variable is removed from the regression equation before additional variables are added. Only significant variables, then, are included in the final regression.

The purpose of this statistical procedure was to select the tests which yielded the best combined relationship with the criterion score.

If an appreciable reduction in the number of test items can be accomplished without a sacrifice in validity it should be so done. Thus abbreviated batteries as predictors of:

1. the internal criterion,
2. the external criterion,

were computed.

A zero-order correlation, using the Pearson product-moment method, was computed as validity coefficients between the complete C.A.H.P.E.R. Fitness-Performance Test and the external criterion.

Table I shows the value that r must be (when N is 90 and df is 88) to be significant at the .05 level, and the .01 level (5).

TABLE I

ZERO-ORDER CORRELATION COEFFICIENTS
AT THE 5% AND 1% LEVELS
OF SIGNIFICANCE

Degrees of Freedom (N-2)	.05	.01
88	.207	.270

N = 90

The statistical significance of a multiple correlation is dependent upon the number of variables involved. Table II, an interpolation from Garrett (6), is presented for ready interpretation. Predictive indices were utilized to indicate the better than pure chance relationship of the various obtained multiple correlations.

Since the N is constant in this study, Table II presents a convenient means of estimating the relative significance of the different multiple correlation coefficients.

TABLE II

MULTIPLE CORRELATION COEFFICIENTS (R) AT THE 5% AND 1% LEVELS OF SIGNIFICANCE

Number of Items in the Battery	.05	.01
1	.207	.270
2	.257	.316
3	.291	.347
4	.318	.372
5	.342	.394
6	.362	.413

N = 90 in all cases

df = 88

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CHAPTER IV

RESULTS AND DISCUSSION

The primary purpose of this investigation was to determine the degree of validity of the C.A.H.P.E.R. Fitness-Performance Test as measured by the Fleishman Basic Fitness Test. The secondary purpose was to select a test or group of tests which are valid measures of motor fitness.

The necessary data were obtained by administering the C.A.H.P.E.R. and Fleishman tests to the ninety grade six and seven boys at Queen Elizabeth Elementary School.

In this study, the validity of the C.A.H.P.E.R. Fitness-Performance Test and the selected batteries was ascertained primarily by their effectiveness in predicting their own composite score and the Fleishman composite score. The predictive value of these batteries and the C.A.H.P.E.R. test were analyzed by means of regression equations.

I. ANALYSIS OF INTERCORRELATION AND VALIDITY COEFFICIENTS

The data presented in Table III, indicates that the intercorrelation coefficients range from 0.146 for the standing broad jump-flexed arm hang, to 0.722 for the 50 yard-300 yard runs. The standing broad jump is contained in four of the six lowest intercorrelations with its highest intercorrelation coefficient being 0.496 with the shuttle run.

TABLE III

INTERCORRELATIONS AND TEST-CRITERION CORRELATIONS OF THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST BATTERY

	1	2	3	4	5	6
C	0.798	0.625	0.866	0.646	0.805	0.834
1		0.365	0.652	0.569	0.476	0.588
2			0.496	0.146	0.417	0.435
3				0.458	0.698	0.655
4					0.368	0.415
5						0.722
6						

Key to variables:

C. Criterion (average T-score of the C.A.H.P.E.R. items)

1. One minute speed sit-up
2. Standing broad jump
3. Shuttle run
4. Flexed arm hang
5. 50 yard run
6. 300 yard run

As shown by Table 1, to be significant at the .01 level, the correlation coefficient must be at least .270. The standing broad jump-flexed arm hang intercorrelation of .146 is the only zero-order coefficient not significant at this level.

The flexed arm hang, is contained in four of the seven lowest intercorrelation coefficients, with its highest coefficient being 0.569 with the minute speed sit-up. As these two test variables contain the lower intercorrelation coefficients, it is likely that they will contribute motor fitness variance which is not well-measured by the other test variables. This along with the fact that they have validity coefficients of 0.625 and 0.646 respectively, justifies further consideration of these items as possible motor fitness tests for an abbreviated C.A.H.P.E.R. Fitness-Performance Test battery.

The other four test items: the one minute speed sit-up, the shuttle run, the 50 yard run and the 300 yard run, have validity coefficients ranging from 0.798 to 0.866. Their intercorrelation coefficients range from 0.476 to 0.722 indicating that some items contain measures of variance which are common to one or more other test variables. It is quite possible that one or more of these tests may be omitted from the abbreviated battery with little or no loss of validity.

II. SELECTION OF SHORT BATTERIES AS PREDICTORS OF THE C.A.H.P.E.R. TEST

An analysis of Table IV shows that the multiple correlation coefficient, (R) is increased considerably when the three hundred yard run was added to the shuttle run, which has the highest zero-order correlation with the criterion score. Their combined coefficient of 0.935 is satisfactory for predictive purposes, but the addition of the flexed arm hang, raises the multiple R to 0.961 an even more valuable predictive correlation. With the addition of the standing broad jump, we obtained an even higher predictive index with an R of 0.982. Since the addition of the one minute speed sit-up did not increase the multiple R to any extent, the process of adding test variables was terminated.

The two groups of tests, namely tests 3, 4 and 6; and tests 2, 3, 4 and 6, will hereafter be known as Battery A and B. They were selected as the two batteries which best measured that which the C.A.H.P.E.R. composite score is assumed to measure. That is, as test batteries, it is reasonable to assume that, with the high correlation coefficients of 0.961 and 0.982 respectively, these two batteries best predict motor fitness as measured by the C.A.H.P.E.R. Fitness-Performance Test. Table II indicates that it is necessary to have a multiple R of .347 for a three-item battery and of .372 for a four-item battery to be significant

at the .01 level. Thus the multiple correlation coefficients obtained by Batteries A and B were sufficiently high to be used for predictive purposes.

The high correlation coefficients obtained by Batteries A and B further substantiate the hypothesis that there is a duplication of measurement by the items contained in the C.A.H.P.E.R. Fitness-Performance Test.

TABLE IV

THE INCREASE IN THE MULTIPLE CORRELATION COEFFICIENT WITH ADDITIONAL VARIABLES

Variables	Motor Fitness Test	Correlation with Criterion[1]	Multiple Correlation Coefficient	Increase of the Multiple R
3	Shuttle run	0.866	0.866	
6	300 yard run	0.834	0.935	0.069
4	Flexed arm hang	0.646	0.961	0.026
2	Standing broad jump	0.625	0.982	0.021
1	One minute speed sit-up	0.798	0.991	0.009

[1]Criterion (average T-score of the C.A.H.P.E.R. items)

TABLE V

OTHER MOTOR FITNESS TEST BATTERIES WHICH ARE SATISFACTORY AS PREDICTORS OF THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST

Battery	C.A.H.P.E.R. Variables	Multiple Correlation with Criterion[1]	R^2
C	2,4,6	0.948	0.898
D	2,3,4	0.946	0.894
E	1,2,4,6	0.963	0.928
F	1,2,3,4	0.970	0.941

Key to variables:

[1]Internal Criterion (average T-score of the C.A.H.P.E.R. test items)

1. One minute speed sit-up
2. Standing broad jump
3. Shuttle run
4. Flexed arm hang
5. 50 yard run
6. 300 yard run

Although the batteries presented in Table V are most satisfactory as predictors of the C.A.H.P.E.R. Fitness-Performance Test, no three or four variable battery has the predictive power of either Battery A or B. However Battery D and F may prove more flexible than the former two batteries because they contain items all of which can be performed indoors. Batteries A and B contain the 300 yard run which is more suited to the larger outdoor area.

Table II indicates that, for a three-itemed battery to be significant, an R of .291 at the .05 level, and an R of .347 at the .01 level are necessary. It also indicates that an R of .318 and .372 are necessary for a four-itemed battery to be significant at the .05 and .01 levels respectively.

All batteries presented in Tables IV and V are highly significant.

Because Batteries A,B,D and F were such excellent predictors of the internal criterion, their multiple regression equations are given in Table VI.

TABLE VI

REGRESSION EQUATIONS FOR PREDICTING THE INTERNAL CRITERION

Battery	Regression Equation
A	$X_C = .3625X_3 + .1946X_4 + .3177X_6 + 6.2591$
B	$X_C = .1809X_2 + .2875X_3 + .2191X_4 + .2779X_6 + 1.7272$
D	$X_C = .2263X_2 + .4264X_3 + .2642X_4 + 4.153$
F	$X_C = .2046X_1 + .2072X_2 + .3355X_3 + .1923X_4 + 3.018$

Key to variables:

X_C - Internal Criterion (average T-score of the C.A.H.P.E.R. items)

X_1 - One minute speed sit-up

X_2 - Standing broad jump

X_3 - Shuttle run

X_4 - Flexed arm hang

X_5 - 50 yard run

X_6 - 300 yard run

III. ANALYSIS OF THE C.A.H.P.E.R. CORRELATION COEFFICIENTS WITH THE EXTERNAL CRITERION

Table VII indicates that the validity coefficient of each C.A.H.P.E.R. test item with the external criterion, the Fleishman Basic Fitness Test's composite score, ranges from 0.436 with the flexed arm hang to 0.717 with the shuttle run. The intercorrelations for each of the test variables are presented in Table III.

TABLE VII

CORRELATION OF THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST VARIABLES WITH THE FLEISHMAN BASIC FITNESS TEST

C.A.H.P.E.R. Variables	Fleishman Criterion[1]
1. One minute speed sit-up	0.580
2. Standing broad jump	0.513
3. Shuttle run	0.717
4. Flexed arm hang	0.436
5. 50 yard run	0.658
6. 300 yard run	0.667

[1]Criterion (average T-score of the Fleishman items)

It is quite likely that the flexed arm hang will, because of its low validity coefficient of .436, contribute little as a predictor of the external criterion, the Fleishman Basic Fitness Test. It is not likely that any predictive battery will contain all three of the running items because of their high intercorrelation coefficients. These intercorrelation coefficients range from .655 to .722.

IV. SELECTION OF SHORT BATTERIES AS PREDICTORS OF THE EXTERNAL CRITERION

Table VIII shows that the multiple correlation (R) is increased considerably when the variance from the three hundred yard run is combined with that of the shuttle run. It also shows that these two test variables have the highest zero-order correlation with the external criterion. It is not surprising, therefore, that these items are the first tests chosen by the stepwise multiple regression selection process.

Their combined multiple correlation coefficient of 0.763 as a predictor or validity coefficient of an external criterion is quite satisfactory. The addition of the standing broad jump raises the multiple R to 0.775. Additional test variables were found to have no significant effect on the multiple correlation coefficient.

TABLE VIII

THE INCREASE IN THE MULTIPLE CORRELATION COEFFICIENT WITH ADDITIONAL VARIABLES

Variables	Motor Fitness Test	Correlation with External Criterion[1]	Multiple Correlation Coefficient	Increase of the Multiple R
3	Shuttle run	0.717	0.717	
6	300 yard run	0.667	0.763	0.046
2	Standing broad jump	0.513	0.775	0.012

[1]External Criterion (average T-score of the Fleishman items)

Since the shuttle run and the 300 yard run had a combined multiple correlation coefficient of 0.763, they were chosen as the best two-item battery for predicting the Fleishman Test. This battery will hereafter be known as Battery G. The addition of the standing broad jump produced the best three-item battery, hereafter known as Battery H. This battery has a multiple correlation coefficient of 0.775. Battery J in Table IX, was chosen as the best three-item indoor battery having a multiple correlation of 0.752.

TABLE IX

OTHER MOTOR FITNESS TEST BATTERIES WHICH ARE SATISFACTORY AS PREDICTORS OF THE FLEISHMAN BASIC FITNESS TEST

Battery	C.A.H.P.E.R. Variables	Multiple Correlation with External Criterion	R^2
I	2,4,6	0.735	0.540
J	2,3,4	0.752	0.566
K	1,2,4,6	0.746	0.556
L	1,2,3,4	0.758	0.574
M	1,2,4,5,6	0.771	0.594
N	1,2,3,4,5	0.781	0.610

Key to variables:

External Criterion (average T-score of the Fleishman items)

1. One minute speed sit-up
2. Standing broad jump
3. Shuttle run
4. Flexed arm hang
5. 50 yard run
6. 300 yard run

By checking Table II, it was found that all batteries presented in Tables VIII and IX were significant at the .01 level.

Regression equations for the three selected batteries are presented in Table X.

TABLE X

REGRESSION EQUATIONS FOR PREDICTING THE EXTERNAL CRITERION

Battery	Regression Equation
G	$X_C = .2580X_3 + .1813X_6 + 28.036$
H	$X_C = .0855X_2 + .2263X_3 + .1649X_6 + 26.167$
J	$X_C = .1186X_2 + .2794X_3 + .0840X_4 + 25.903$

Key to variables:

X_C - External Criterion (average T-score of the Fleishman test items)

X_1 - One minute speed sit-up

X_2 - Standing broad jump

X_3 - Shuttle run

X_4 - Flexed arm hang

X_5 - 50 yard run

X_6 - 300 yard run

V. CORRELATION OF THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST WITH THE EXTERNAL CRITERION

The data presented in Table XI show that the C.A.H.P.E.R. Fitness-Performance Test has a substantial relationship with the Fleishman Basic Fitness Test (1) by both the zero-order and multiple correlation coefficients.

The batteries presented in Tables VIII and IX have multiple correlation coefficients ranging from 0.735 to 0.781. These coefficients predict the external criterion, the Fleishman Basic Fitness Test, almost as well as the complete C.A.H.P.E.R. Fitness-Performance Test.

The small degree of difference between the values of the correlation coefficients further indicates that the items contained in the C.A.H.P.E.R. Fitness-Performance Test may be measuring variance which is common to more than one test item.

TABLE XI

ZERO-ORDER AND MULTIPLE CORRELATION OF THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST WITH THE FLEISHMAN BASIC FITNESS TEST

Type of Correlation	Coefficient
Zero-order	0.781*
Multiple	0.790*

*Significant at the .01 level

The Research Committee of the Canadian Association for Health, Physical Education and Recreation agreed in February 1964, that flexibility

> ". . . was very special to the joint or joints and that no single test could purport to measure general flexibility." (2)

Flexibility was therefore eliminated as an area to be measured by the C.A.H.P.E.R. Fitness-Performance Test. Measures of co-ordination (3) and balance (4) were opposed on similar grounds.

It is likely that the inclusion of good measures of these three areas would improve the C.A.H.P.E.R.-Fleishman correlation coefficients. It should also improve the useful-

ness of the C.A.H.P.E.R. Fitness-Performance Test as a measure of motor fitness.

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3. Ibid., p. 11.

4. Ibid., p. 5.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The object of this study was: a) to ascertain the degree to which the C.A.H.P.E.R. Fitness-Performance Test is a valid test of motor fitness as measured by the Fleishman Basic Fitness Test; b) to determine whether or not abbreviated batteries with little or no loss of validity can be developed.

The subjects consisted of ninety boys enrolled in grade six and seven at Queen Elizabeth Elementary School, Vancouver, British Columbia. Their scores on the six C.A.H.P.E.R. Fitness-Performance test items and the ten Fleishman Basic Fitness test items provided the necessary data.

I. TREATMENT OF THE DATA

The final batteries were selected through the application of the following procedures:

1. T-score values were determined for the scores from the six C.A.H.P.E.R. and ten Fleishman items which were used in the construction of the internal criterion and external criterion respectively.
2. The composite scores of the internal criterion (average T-score value for the six C.A.H.P.E.R.

variables), and external criterion (average T-score value for the ten Fleishman variables) were determined.

3. The intercorrelations between the six C.A.H.P.E.R. test items and their correlations with the internal and external criterion were computed.
4. The stepwise multiple regression method of test selection was applied to select the variables which yielded the best combined relationship with the criterion score.
5. The validity of the C.A.H.P.E.R. Fitness-Performance Test was determined by its correlation with the Fleishman Basic Fitness Test.

II. BATTERIES WHICH PREDICT THE INTERNAL CRITERION

Battery A, consisting of:

a) the shuttle run,

b) the 300 yard run,

c) the flexed arm hang

was chosen as the best three item battery. The multiple correlation of 0.961 makes it a most useful predictor of the internal criterion.

Battery B included the following items:

a) the shuttle run,

b) the 300 yard run,

c) the flexed arm hang,

d) the standing broad jump.

This battery was the best four item predictor. The multiple correlation coefficient was 0.982.

Batteries D and F were selected as the best indoor batteries having multiple correlation coefficients of 0.894 and 0.941 respectively. Battery D consisted of:

a) the standing broad jump,

b) the shuttle run,

c) the flexed arm hang,

while Battery F consisted of:

a) the one minute speed sit-up,

b) the standing broad jump,

c) the shuttle run,

d) the flexed arm hang.

Although the flexed arm hang and the standing broad jump have the lowest validity coefficients, they are contained, at least in part, in all the preceding batteries. It was hypothesized that since these items contained the lowest intercorrelation coefficients, they would likely contribute variance which was not well-measured by other variables. This hypothesis seems to have been substantiated.

III. BATTERIES WHICH PREDICT THE EXTERNAL CRITERION

Batteries G and H, with their multiple correlation coefficients of 0.763 and 0.775 respectively, were chosen as

the best two and three item predictors of the external criterion. Battery G consisted of:

a) the shuttle run,

b) the 300 yard run,

while Battery H consisted of:

a) the shuttle run,

b) the 300 yard run,

c) the standing broad jump.

Battery J, which consisted of:

a) the standing broad jump,

b) the shuttle run,

c) the flexed arm hang,

was chosen as the best three item indoor battery. It has a multiple correlation coefficient of 0.752.

IV. VALIDATION OF THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST

These three batteries predict the external criterion almost as well as does the complete C.A.H.P.E.R. Fitness-Performance Test which has a multiple correlation coefficient of 0.790. As expected, its zero-order validity coefficient of 0.781 is slightly smaller.

V. CONCLUSIONS

It may be concluded that:

1. The C.A.H.P.E.R. Fitness-Performance Test as a test of motor fitness has a high degree of validity as measured by the Fleishman Basic Fitness Test.
2. Batteries A and B, with validity coefficients of 0.961 and 0.982 respectively, are more than adequate predictors of the C.A.H.P.E.R. Fitness-Performance Test.
3. Batteries D and F, with validity coefficients of 0.894 and 0.941, are adequate as indoor batteries predicting the C.A.H.P.E.R. Fitness-Performance Test.
4. Batteries G and H, with validity coefficients of 0.763 and 0.775 respectively, are nearly equivalent to the complete C.A.H.P.E.R. Fitness-Performance Test as predictors of the external criterion.
5. Battery J, with a validity coefficient of 0.752, is an adequate predictor of the external criterion, the Fleishman Basic Fitness Test.
6. The C.A.H.P.E.R. Fitness-Performance Test contains measures of variance which are common to two or more test items. This conclusion is based upon

the fact that:

a) the intercorrelation coefficients between the one minute speed sit-up, the shuttle run, the 50 yard run and the 300 yard run were relatively high;

b) Batteries A,B,D and F gave a near perfect prediction of the C.A.H.P.E.R. Fitness-Performance Test;

c) Batteries G,H and J predicted the Fleishman Basic Fitness Test with almost the same degree of perfection as did the complete C.A.H.P.E.R. Fitness-Performance Test.

VI. RECOMMENDATIONS

On the basis of the findings obtained from the study the following recommendations are made:

1. A study using a similar sample should be made with the purpose of cross-validation.
2. Other validation studies on the C.A.H.P.E.R. Fitness-Performance Test should be made using various other established criterion with the purpose of adding additional information as to its validity.
3. A similar study should be made using elementary school-age girls.

4. Studies should be made with the purpose of improving content of the test.
5. A reliability study of the C.A.H.P.E.R. Fitness-Performance Test should be made.

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APPENDICES

APPENDIX A

DESCRIPTION OF THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST ITEMS

1. One Minute Speed Sit-Up

Equipment. Gym mat and stop watch or timer.

Starting Position. The subject assumes a back-lying position on the mat, hands interlaced behind his head. The knees are bent and the feet are held flat on the floor by a partner.

Performance. The subject sits up and touches both elbows to both knees. Then he returns to the starting position.

Scoring. The movement sit-up and return is counted as one execution. The total score is the number of complete executions performed in 60 seconds. Allow one trial. Count when elbows touch knees.

Reliability Controls. The partner kneels straddling the performer's feet. He places his hands on the calves of the subject's legs just below the knee to prevent the subject from sliding away and to maintain the starting position of the legs throughout the test. Only the shoulders have to touch the floor and the sit-ups need not be continuous.

2. Standing Broad Jump

Equipment. Ten foot tumbling mat is recommended and tape measure.

Starting Position. The subject assumes a position with the feet slightly apart and the toes behind the jumping line.

Performance. Flex at hips, knees and ankles, and using the arms to aid, jump as far forward as possible.

Scoring. Measurement is in terms of inches to the nearest inch from the take-off line to the heel of the foot nearest the take-off line.

Reliability Controls. The suggested take-off angle should be between 30 and 45 degrees. Two valid trials are allowed, the better trial recorded. If any part of the body touches behind the heels, the jump will be considered invalid. Two or three practice trials may be allowed.

3. Shuttle Run

Equipment. Two wooden blocks (2"x3"x3") and a stop watch calibrated to one-tenth of a second.

Starting Position. Lying face down, hands at the sides of the chest, forehead on the starting line.

Performance. On signal, jump to feet and run 30 feet

to the line. Pick up one block of wood, return to the starting line, and place the block behind this line. Return to the second line, pick up the second block of wood, and run back to the finish line. Carry the block through the finish line.

Scoring. Measurement is in terms of seconds to the nearest tenth of a second from the starting signal until the subject crosses the finish line.

Reliability Controls. The test should be taken in gym shoes or barefeet. A 'ready' warning signal is given prior to the starting signal. Two trials, with a rest between, are allowed and the better trial is recorded.

4. Flexed Arm Hang

Equipment. A doorway gym bar or horizontal bar placed 6 feet from the floor; a bench and a timer.

Starting Position. The subject reverse grasps the bar (palms toward face) and is assisted in pulling himself to the bar so that his eyes are at the level of the bar. The arms are fully flexed.

Performance. The subject holds himself in this hanging position as long as he is able.

Scoring. The total period of time that the subject can maintain the exact position is determined to the nearest

second.

Reliability Controls. The subject must keep the bridge of his nose at the bar. When the subject's head drops below the level of the bar the test is terminated. One trial is allowed. Tester counts the seconds out loud.

5. 50 Yard Run

Equipment. A 50 yard straightaway with markers (stakes) placed at the start and the finish; a stop watch calibrated to one-tenth of a second; a starting flag.

Starting Position. A racing crouch start or a standing position may be assumed.

Performance. On the starting signal ("Go!" and flag simultaneously) the runner sprints the 50 yard distance.

Scoring. The elapsed time from the starting signal to the passage of the runner's chest across the finish line is scored to the nearest tenth of a second.

Reliability Controls. The test is taken in gym shoes. Only one runner is tested at a time on a course but one tester may time two runners on adjacent courses with a split timer or two watches.

6. 300 Yard Run

Equipment. Same as for the 50 yard run.

Starting Position. A racing crouch start or a standing position may be assumed.

Performance. On the starting signal the subject runs straight up and around the stake marker and back over the 50 yard straightaway. The circuit is run 3 times to give the 300 yards.

Scoring. The elapsed time from the starting signal to the passage of the runner's chest across the finish line is scored to the nearest second.

Reliability Controls. The test is taken in gym shoes. Only one runner is tested at a time on a course but one tester may time two runners on adjacent courses with a split timer or two watches.

APPENDIX B

TEST INSTRUCTIONS FOR THE FLEISHMAN BASIC FITNESS TESTS

1. Extent Flexibility Test

Testing Arrangements.

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.

Instructions. After assuming the position described above, the student keeps his feet in place and extends his right arm straight out to side, at shoulder height. His palm faces the floor with fingers extended and together. From this position he twists clockwise (around his back), as far as possible, so that he touches the scale on the wall

with his right hand. During this movement, the examiner, or an assistant, places his foot alongside the student's right foot to keep the student's feet in place.

Have the student make one practice try to get the feel of it, and correct any errors in his procedure. The second try counts.

Scoring. Record the farthest point reached (in inches), and held (for at least two seconds), as measured on the scale.

Additional Guidance. For left-handed subjects, use the alternate scale and reverse the directions of movement.

2. Dynamic Flexibility Test

Testing Arrangements. 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 should be shoulder width apart. Directly behind the middle of his back, at shoulder height, mark an "X" on the wall (use chalk or tape). Mark another "X" on the floor between the student's feet.

A stop watch is needed.

Instructions. On the signal "Go" the student bends and touches the "X" between his feet with both hands and then rises, twists to the left, and touches the "X" on the wall with both hands. This counts as one cycle.

In the next cycle, the student repeats this, except he twists to his right, continuing to alternate the side to which he twists in each cycle.

The instructor should demonstrate three such cycles, emphasizing speed.

Scoring. Record the number of cycles completed in 20 seconds.

3. Shuttle Run

Testing Arrangements. Two parallel lines, 20 yards apart, should be marked off. This can be run on a track surface, but is suitable for floor, macadam, or other ground surfaces. (The norms are for an average of many surfaces.)

One observer is stationed at the start line and one at the finish line. The observer at the finish line has a stop watch. Ideally, there should be two observers with watches at the finish line. Although not absolutely essential, upright standards may be used during the last lap.

Instructions. It is preferable to have one student run at a time. At the start he stands behind the start line, with one toe at the line. He is told that at the command "Go" he is to run to the opposite line, 20 yards away, touch the ground on the far side of it with either foot, return to the start line, and repeat. He is told to cover the one way distance five times for a total of 100 yards. On his last

lap he is to go "all-out" to cross the finish line standing up. (If a tape is put up he is told to break the tape.) The object is to cover the distance as fast as possible.

The observers at each end note that the student has touched over the line. They also watch that the student does not get confused and a) stop short, not running five times, or b) treat the last lap as if he was to turn around again.

The examiner should demonstrate the turn-around movement, encouraging efficiency (that is, a small turning radius). Turns have been found to average under 6 feet in radius. If the student is doing something which grossly slows him up at the turns, the observer should encourage him to turn more quickly.

Scoring. The time to cover the 5 laps (5 x 20 = 100 yards) is recorded to the nearest tenth of a second. If two observers are used, record the average of the two watches.

4. Softball Throw

Testing Arrangements. This is, typically, an outdoor test requiring an open field approximately 100 yards long. A shorter field (80 yards) will do, especially if testing is being done with younger boys or only with girls. With girls the field need not exceed 50 yards. A 12" standard softball is thrown and field markings must be provided to allow measurement of distance thrown, to the nearest foot. A football field is ideal for this purpose.

If a football field is not available, any field may be marked off in various ways with lines, stakes, or bricks placed every five yards. It has been found convenient to use bricks, with painted numbers, placed every five yards. These markings do not need to begin until 20 yards from the throwing line for boys, and until 10 yards out for girls. The line behind which the student must throw should be clearly marked. In any case, a tape measure is also needed.

Bricks or stakes may be used to mark the point of impact for each throw, until a final measurement is taken. In the case of successive throws by the same student, his brick or stake can be moved to the point of his best throw. At least two observers are required, one at the throwing area, and one in the field. Two observers, spotting point of impact, are preferable.

Instructions. The student throws the ball as far as he can, without moving his feet. He takes a position comfortable for him, as close to the restraining line as possible. He is not allowed any run-up, and is not allowed to shift the position of his feet during the throw. He is not required to keep his feet flat on the ground, of course, and his feet will move some in place. But neither foot is to leave the ground. (Typically, the right-handed student will end up on the toe of his right foot.)

He is told that he will get three throws and will be

scored according to his best throw. He may decide on a different position for his feet when he makes his next throw, but this is up to the student, and no specific guidance on this should be given. If the subject lifts either foot, his throw is not measured and counts only as one of his three throws.

All throws must be made overhand.

Scoring. The tape measure is used to measure the best of the three throws, to the nearest foot. If the throw is off line (to one side), the measured distance is perpendicular from the start line to the point of impact.

5. Hand Grip

Testing Arrangements. All that is required is a hand dynamometer.

Instructions. The dynamometer is placed in the palm of the student's preferred hand. The dial should be facing away from the palm. The larger half of the grip is in the meaty part of the palm, with the fingers curled over the smaller half of the grip. Part of the fingers between the second and third knuckles should touch the grip, but the fingers should not curl far enough around to touch the dial and interfere with the pointer's movement.

The student stands and holds his hand down his side, away from his body, palm facing his side. He is told that at

the command "Squeeze," he is to squeeze the dynamometer once, sharply and steadily as hard as he can.

A demonstration of the proper grip and arm position should be given. During the test trial the examiner should make sure the student's fingers do not hamper the dial, and that he does not rest or brace any part of his arm against his body.

During the first trial, correct any incorrect procedure. If the rules are violated, disregard the score, but count it as one squeeze. Emphasize the need for a short, sharp squeeze. If the student starts to squeeze slowly as soon as he takes the dynamometer it will actually decrease his score due to muscle fatigue.

Each student gets three trials separated by at least a full minute of rest. Without such rest he is likely to score lower each time he squeezes (much to his surprise!).

Scoring. Record the highest reading (the scale is read in pounds) of the three squeezes.

6. Pull-Ups

Testing Arrangements. All that is needed is a horizontal metal or wooden bar, approximately 1½ inches in diameter, and high enough so the student can hang off the floor with his arms and legs fully extended.

Instructions. The student jumps up and grips the bar

with his palms facing his body (the underhand grip). From his hanging position, at the signal "Start," he pulls himself up by his arms until he can place his own chin over the bar. He then lowers his body to a fully extended position.

The student is told to do as many pull-ups as possible and not to stop until he is no longer able to pull himself up. He is told not to pause more than two seconds, either at the top or bottom of each cycle, otherwise he will be told to stop. He is cautioned that if his arms are not fully extended or his chin not over the bar, he will be penalized.

The examiner counts the number of pull-ups aloud to the student each time he lowers himself fully. If he is to be penalized the examiner indicates credit for only "one half" to let the student know this.

Demonstrate, one correct pull-up. Kicking, twisting, or raising of legs should not be allowed. If the student starts swaying, the examiner should put his palm or forearm against the student's legs to stop the swaying.

Scoring. Record the number of times the student has pulled himself up correctly.

7. Leg Lifts

Testing Arrangements. This may be done on a mat, floor, or grassed area. A stop watch is needed.

Instructions. The student lies flat on his back with

his hands clasped behind his neck. A partner should hold the examinee's elbows to the ground. The student is told to raise his legs, keeping them straight, until they are vertical, and then to return them to ground. He is to do these leg lifts as fast as he can, doing as many as possible in 30 seconds.

The following points should be stressed:

1. Do not rock the body - the head, small of the back and base of the spine must remain on the ground. The exercise should be a stiff one-two motion.
2. Do not boost the body to get the legs vertical.
3. Elbows must remain flat on the ground.
4. Legs should be kept straight at all times.

Demonstrate the movement. Then instruct the student to try the exercise through two cycles to get the feel of it. Correct errors.

Emphasize the need to go "all-out during the short test period" without slowing down.

Then say "Ready: (pause) GO!" During the test make sure legs are raised to the vertical and instructions are followed.

Say "Stop!" exactly at 30 seconds.

It is best to have a separate observer count the leg lifts and another examiner doing the timing. This test can be given in a group, provided there are sufficient observers.

Scoring. Record the number of times the student raises his legs to a vertical position in the 30 seconds.

8. Cable Jump Test

Testing Arrangements. A 24 inch length rope is required.

Instructions. The student is told to hold the rope in front of him with one hand grasping each end. 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. He is not to hold the rope stretched out, but should let it hang loose. Holding the rope in this way, the student is required to jump over the rope without loosening his grip from it.

The object here is to measure a coordinated performance. It should be stressed to the student that he:

1. jumps over the rope, through his arms;
2. lands on his feet;
3. does not hit the rope with his feet, or lose hold of it while jumping, and
4. does not lose his balance when landing.

Unless the subject meets all of these requirements he has not made a correct jump.

Scoring. Record number of correct jumps out of five attempts.

9. Balance - A Test

Testing Arrangements. The balance rail is a piece of wood 1½" high, ¾" wide, and 24" long. This piece of wood is mounted to a base board as shown. A stop watch is needed.

Instructions. The student is told that he is to balance on the rail using the preferred foot, with the long axis of his foot parallel to the long axis of the rail. He is given a practice trial with his eyes open. He is told that his 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. He first places his hands on his hips and stands up on the rail. When the student has his balance and wants to start the trial, he says "Go." The administrator then begins timing the subject. He may not touch the floor with any part of his body, nor remove either hand from his hips.

After the practice trial, the procedure is repeated with the eyes closed. The examinee must close his eyes at the instant he says "Go." He is administered two separate test trials with eyes closed.

Scoring. The number of seconds the student maintains his balance for each trial is recorded separately and added together for a total score.

If he reaches 20 seconds without having lost his balance, he is told to stop, and a "20" is recorded for that

trial. If he opens his eyes, removes either hand from his hips, or touches the floor, stop the trial and record the time.

10. 600 Yard Run-Walk

Testing Arrangements. This is typically done outdoors, unless a large field house is available. The 600 yards can be marked off in several ways, provided the turns required are not too sharp. A square area, 50 yards on each side provides a good track, since three laps comprise the 600 yards. A football field, marked off appropriately, or a properly marked 440 yard track will work. With improvised tracks care must be taken to keep the students from straying outside the track, thus running too short or too long a course.

Stop watches are needed, the number depending on how many students are run together. For administrative and scheduling reasons, it will usually be necessary to run a number of students together. The most accurate procedure is to assign a separate observer to clock a particular student as he crosses the finish line. Where stop watches are scarce, the timer can call out the times as each student crosses the line, with the observer assigned to each student recording the score for that student. Groups of six examinees seem to work out well in practice.

Instructions. The students are told that the object is to cover the distance in the shortest possible time. He may intersperse his running with walking but he must try his best to finish as quickly as possible.

Scoring. Record the time, to cover the distance, in minutes and to the nearest seconds.

APPENDIX C

THE C.A.H.P.E.R. FITNESS-PERFORMANCE TEST

NAME _____ GRADE _____
FIRST LAST

SCHOOL _____ AGE _____

DATE OF BIRTH _____

DATE OF TEST _____

1.	ONE MINUTE SPEED SIT-UPS	_____	_____(NO.)
2.	STANDING BROAD JUMP	_____	_____(INS.)
3.	SHUTTLE RUN	_____	_____(SEC.)
4.	FLEXED ARM HANG	_____	_____(SEC.)
5.	50 YARD RUN	_____	_____(SEC.)
6.	300 YARD RUN	_____	_____(SEC.)

APPENDIX D

FLEISHMAN FITNESS TESTS

NAME _____

DATE OF TEST _____

1.	EXTENT FLEXIBILITY	_____	_____ (IN.)
2.	DYNAMIC FLEXIBILITY	_____	_____ (NO.)
3.	SHUTTLE RUN	_____	_____ (SEC.)
4.	SOFTBALL THROW	_____ YDS.	_____ FT.
5.	HAND GRIP	_____	_____ (LBS.)
6.	PULL-UPS	_____	_____ (NO.)
7.	LEG LIFTS	_____	_____ (NO.)
8.	CABLE JUMP	_____	_____ (NO.)
9.	BALANCE A	_____	_____ (SEC.)
10.	600 YARD RUN-WALK	_____ MIN.	_____ SEC.

APPENDIX E

AREAS OF FITNESS AS DEFINED BY FLEISHMAN

Explosive strength is the ability to exert maximum energy in one explosive act. It has also been called Energy Mobilization, Power and Velocity.

Dynamic strength is the ability to exert muscular force to move or support the body's weight repeatedly over a given period of time.

Static strength is the ability to exert maximum force for a brief period of time against a fairly immovable object.

Extent flexibility is the ability to move or stretch the body, or some part thereof, as far as possible in various directions.

Dynamic flexibility is the ability to make repeated flexing or stretching movements. This area seems to be associated with both flexibility and speed of bodily movements.

Static balance is the ability to maintain bodily equilibrium while in some fixed position.

Dynamic balance is the ability to maintain equilibrium while performing some task.

Multi-limb coordination is the ability to coordinate the simultaneous movements of several limbs in operating various devices.

Gross body coordination is the ability to coordinate the more gross activity of the whole body. This may be the same factor others call agility.

Endurance is the ability to exert maximal effort over time and resistance to fatigue.

APPENDIX F

ALTERNATE TESTING PROCEDURES NECESSITATED BY WEATHER CONDITIONS

Test Period A: During this period the following data were obtained:

1. Five measures of the C.A.H.P.E.R. Fitness-Performance Test:
   a) one minute speed sit-up,
   b) standing broad jump,
   c) shuttle run,
   d) flexed arm hang,
   e) 300 yard run.
2. Four measures of the Fleishman Basic Fitness Test:
   a) extent flexibility,
   b) dynamic flexibility,
   c) hand grip,
   d) balance - A.

Test Period B: During this period the following data were obtained:

1. One measure of the C.A.H.P.E.R. Fitness-Performance Test:
   a) 50 yard run.
2. Six measures of the Fleishman Basic Fitness Test:
   a) shuttle run,

b) pull-ups,

c) leg lifts,

d) cable jump,

e) softball throw,

f) 600 yard run-walk.

APPENDIX G

KEY TO C.A.H.P.E.R. VARIABLES

1. One Minute Speed Sit-up
2. Standing Broad Jump
3. Shuttle Run
4. Flexed Arm Hang
5. 50 Yard Run
6. 300 Yard Run

APPENDIX G

T-SCORES FOR THE C.A.H.P.E.R. VARIABLES

Subject	1	2	3	4	5	6
1	46.441	48.203	48.139	44.979	49.821	52.951
2	39.161	45.093	52.518	48.832	58.624	43.328
3	61.911	63.755	49.234	59.290	38.082	58.725
4	38.251	48.203	40.476	43.328	42.484	39.478
5	57.361	46.648	57.991	48.832	54.223	54.876
6	62.821	35.761	53.612	66.445	65.961	58.725
7	40.981	62.200	45.950	37.824	57.157	56.801
8	54.631	46.648	39.382	62.042	51.288	45.252
9	48.261	45.093	51.423	47.181	45.419	37.553
10	50.991	59.089	53.612	53.235	43.951	49.102
11	53.721	45.093	55.802	53.786	51.288	49.102
12	44.621	52.868	45.950	42.777	45.419	52.951
13	43.711	37.317	47.044	69.747	41.017	37.553
14	55.541	55.979	57.991	68.096	55.690	51.027
15	55.541	55.979	60.180	55.437	52.755	51.027
16	54.631	49.758	59.086	53.235	43.951	45.252
17	54.631	51.313	48.139	46.630	48.353	45.252
18	42.801	38.872	40.476	38.374	45.419	47.177
19	60.091	66.865	68.938	54.336	58.624	56.801
20	51.901	51.313	43.760	62.592	24.876	47.177

Subject	1	2	3	4	5	6
21	52.811	55.979	45.950	54.336	48.353	47.177
22	34.611	38.872	49.234	38.374	45.419	45.252
23	58.271	49.758	62.370	53.786	48.353	52.951
24	55.541	68.420	65.654	48.281	61.559	52.951
25	61.001	68.420	54.707	46.630	58.624	54.876
26	45.531	29.541	42.666	44.979	39.550	41.403
27	56.451	60.644	73.316	71.949	63.026	64.500
28	45.531	46.648	35.003	39.475	43.951	54.876
29	67.371	59.089	64.559	59.290	57.157	64.500
30	61.001	48.203	51.423	51.034	41.017	45.252
31	40.071	49.758	53.612	46.630	55.690	52.951
32	61.001	41.982	44.855	80.205	52.755	51.027
33	64.641	51.313	65.654	53.235	73.298	64.500
34	64.641	43.537	64.559	53.235	55.690	62.575
35	57.361	57.534	61.275	67.546	52.755	56.801
36	53.721	35.761	59.086	53.786	46.886	60.650
37	68.281	54.424	67.843	59.290	67.428	70.274
38	56.451	37.317	49.234	45.529	42.484	58.725
39	45.531	51.313	45.950	51.584	43.951	45.252
40	49.171	40.427	50.328	42.777	51.288	45.252
41	61.001	73.086	66.748	65.895	54.223	54.876
42	48.261	63.755	48.139	55.437	51.288	47.177
43	41.891	57.534	31.719	38.374	45.419	49.102
44	68.281	59.089	64.559	52.134	58.624	60.650

Subject	1	2	3	4	5	6
45	48.261	48.203	44.855	37.273	46.886	54.876
46	50.991	40.427	52.518	55.987	61.559	58.725
47	55.541	43.537	41.571	52.685	51.288	54.876
48	56.451	51.313	44.855	48.832	43.951	49.102
49	39.161	48.203	44.855	47.731	45.419	47.177
50	54.631	46.648	49.234	57.088	58.624	52.951
51	48.261	38.872	47.044	54.886	38.082	39.478
52	53.721	55.979	51.423	65.344	51.288	49.102
53	49.171	46.648	44.855	43.328	48.353	54.876
54	28.241	23.320	18.583	32.870	24.876	10.607
55	51.901	52.868	48.139	52.685	42.484	41.403
56	44.621	49.758	52.518	47.181	52.755	49.102
57	43.711	54.424	53.612	42.777	58.624	54.876
58	35.521	49.758	33.908	46.630	43.951	52.951
59	52.811	54.424	40.476	56.538	57.157	52.951
60	42.801	41.982	44.855	44.979	51.288	51.027
61	41.261	55.979	52.518	38.374	51.288	54.876
62	49.171	51.313	52.518	43.878	52.755	47.177
63	25.511	59.089	36.088	35.622	41.017	31.779
64	47.351	46.648	43.760	38.374	51.288	47.177
65	41.891	40.427	41.571	44.979	38.082	41.403
66	43.711	45.093	47.044	42.777	46.886	47.177
67	18.231	35.761	32.614	32.320	29.278	26.005
68	43.711	51.313	44.855	42.227	46.886	37.553

Subject	1	2	3	4	5	6
69	56.451	48.203	59.086	69.747	65.961	62.575
70	53.721	51.313	52.518	37.824	52.755	49.102
71	45.531	40.427	43.760	38.374	29.278	18.306
72	39.161	29.541	51.423	61.491	67.428	62.575
73	58.271	55.979	39.382	60.941	52.755	49.102
74	32.791	48.203	51.423	42.777	51.288	47.177
75	45.531	45.093	40.476	62.042	51.288	51.027
76	54.631	66.865	50.328	48.281	52.755	66.424
77	36.431	45.093	27.340	33.971	24.876	39.478
78	46.441	48.203	55.802	41.677	63.026	64.500
79	58.271	54.424	56.896	60.391	55.690	56.801
80	40.981	46.648	40.476	43.878	52.755	49.102
81	60.091	41.982	48.139	39.475	49.821	43.328
82	65.551	41.982	49.234	55.437	36.615	49.102
83	59.181	57.534	63.464	58.189	67.428	52.951
84	50.991	62.200	67.843	58.189	61.559	64.500
85	52.811	87.082	68.938	42.777	70.363	68.349
86	50.991	55.979	47.044	41.677	46.886	47.177
87	59.181	48.203	48.139	46.080	49.821	47.177
88	55.541	60.644	55.802	40.025	61.559	39.478
89	20.051	37.317	33.908	38.374	30.746	29.854
90	47.351	46.648	45.950	42.227	38.082	51.027
Mean	34.911	63.156	11.930	32.122	8.088	66.533
S.D.	10.989	6.430	0.914	18.168	0.682	5.196

APPENDIX H

KEY TO FLEISHMAN VARIABLES

1. Extent Flexibility
2. Dynamic Flexibility
3. Shuttle Run
4. Softball Throw
5. Hand Grip
6. Pull-Ups
7. Leg Lifts
8. Cable Jump
9. Balance - A
10. 600 Yard Run-Walk

APPENDIX H

T-SCORES FOR THE FLEISHMAN VARIABLES

Subject	1	2	3	4	5	6	7	8	9	10
1	57.573	65.914	48.720	49.426	52.946	47.537	50.239	61.080	50.833	52.105
2	53.331	42.813	46.777	44.257	61.755	47.537	45.934	47.230	56.033	61.013
3	46.260	29.612	46.777	36.738	42.376	58.810	50.239	47.230	56.900	59.232
4	61.816	42.813	47.425	36.268	39.733	43.779	39.477	54.155	50.833	51.511
5	42.018	52.714	61.020	39.557	43.257	40.021	39.477	61.080	39.999	57.450
6	53.331	42.813	59.725	62.583	22.997	70.082	50.239	40.305	60.801	52.699
7	36.362	39.513	56.488	47.076	48.542	47.537	54.544	61.080	57.334	53.293
8	54.745	32.912	53.251	60.234	52.946	66.325	48.087	61.080	45.633	46.166
9	49.089	36.212	50.014	32.039	44.137	58.810	52.392	24.155	39.132	47.948
10	44.846	56.014	51.309	39.087	44.137	47.537	56.697	54.155	45.199	51.511
11	66.058	59.314	56.488	43.787	52.946	51.294	54.544	33.381	76.835	48.542
12	42.018	49.413	46.130	45.666	66.159	47.537	48.087	33.381	43.466	33.101
13	44.846	42.813	44.188	37.208	35.329	55.052	56.697	47.230	69.035	40.821

Subject	1	2	3	4	5	6	7	8	9	10
14	63.230	49.413	61.020	48.486	57.350	77.598	50.239	61.080	45.199	53.887
15	47.675	49.413	53.251	55.065	56.469	62.567	58.849	61.080	47.366	55.074
16	60.402	46.113	53.251	51.305	55.589	47.537	61.002	61.080	43.899	52.699
17	30.705	49.413	37.714	45.666	44.137	40.021	41.629	61.080	52.567	46.166
18	40.604	59.314	75.910	55.065	42.376	40.021	24.409	47.230	46.066	47.354
19	36.362	62.614	66.847	46.606	59.993	40.021	54.544	54.155	47.366	56.262
20	67.472	89.016	35.124	54.595	61.755	47.537	52.392	33.381	76.402	52.105
21	56.159	62.614	41.598	31.569	42.376	43.779	45.934	61.080	51.266	52.105
22	50.503	56.014	44.188	49.426	52.946	40.021	63.154	33.381	43.899	45.572
23	51.917	52.714	43.540	48.486	52.946	47.537	52.392	54.155	68.601	55.668
24	50.503	59.314	56.488	53.655	61.755	43.779	50.239	61.080	43.032	53.887
25	49.089	59.314	51.309	56.944	52.946	51.294	65.307	54.155	46.933	55.668
26	58.987	52.714	39.656	46.136	52.946	40.021	48.087	54.155	43.032	20.629
27	47.675	52.714	66.199	55.535	61.755	55.052	58.849	61.080	37.399	58.638
28	44.846	42.813	53.899	37.208	59.993	40.021	43.782	40.305	51.700	57.450
29	47.675	62.614	62.962	77.151	51.184	62.567	45.934	47.230	61.234	64.576

Subject	1	2	3	4	5	6	7	8	9	10
30	53.331	42.813	48.720	55.065	52.946	40.021	41.629	61.080	56.900	49.136
31	40.604	49.413	46.130	42.847	50.303	40.021	45.934	40.305	34.365	49.729
32	39.190	36.212	49.367	44.257	46.780	51.294	50.239	47.230	44.332	52.105
33	54.745	65.914	62.962	56.944	48.542	70.082	58.849	61.080	73.802	62.795
34	46.260	65.914	61.668	61.644	40.614	51.294	63.154	47.230	46.066	59.232
35	63.230	56.014	61.668	61.644	53.827	55.052	56.697	61.080	52.133	59.232
36	39.190	62.614	59.078	55.065	52.065	40.021	45.934	40.305	34.365	63.389
37	61.816	49.413	61.668	65.873	45.899	51.294	54.544	40.305	40.866	64.576
38	46.260	52.714	43.540	40.027	33.567	40.021	56.697	26.456	45.633	43.791
39	36.362	42.813	43.540	40.967	36.210	43.779	45.934	54.155	43.899	49.136
40	30.705	56.014	50.014	45.666	44.137	40.021	39.477	54.155	35.665	48.542
41	49.089	56.014	61.668	55.535	45.899	70.082	56.697	61.080	34.798	50.917
42	37.776	36.212	46.130	47.546	48.542	55.052	52.392	47.230	35.232	36.664
43	42.018	52.714	52.604	39.557	39.733	40.021	45.934	47.230	46.066	50.323
44	30.705	39.513	59.725	63.053	45.899	62.567	61.002	47.230	44.332	59.825
45	43.432	42.813	50.662	47.076	45.899	43.779	56.697	47.230	42.599	58.044

Subject	1	2	3	4	5	6	7	8	9	10
46	39.190	59.314	47.425	52.715	45.018	55.052	52.392	47.230	47.799	51.511
47	61.816	56.014	51.957	48.956	52.946	47.537	20.104	47.230	53.867	56.262
48	50.503	36.212	44.188	47.546	35.329	43.779	58.849	47.230	59.934	52.699
49	70.300	52.714	50.662	42.847	57.350	40.021	48.087	61.080	37.399	52.105
50	61.816	49.413	52.604	57.884	57.350	43.779	45.934	61.080	41.732	56.262
51	50.503	56.014	42.246	35.798	36.210	55.052	63.154	54.155	74.235	44.385
52	61.816	42.813	50.014	39.557	52.946	73.840	63.154	47.230	53.867	33.101
53	47.675	56.014	50.014	51.305	44.137	47.537	52.392	33.381	50.400	52.699
54	30.705	39.513	20.234	37.678	22.116	40.021	39.477	26.456	48.666	13.503
55	40.604	49.413	40.303	44.726	54.708	47.537	48.087	54.155	61.234	50.323
56	61.816	49.413	53.899	42.847	44.137	47.537	54.544	61.080	56.900	48.542
57	51.917	56.014	58.431	48.486	39.733	62.567	50.239	54.155	52.567	53.293
58	44.846	52.714	42.893	50.365	52.946	51.294	61.002	47.230	44.332	53.887
59	51.917	26.312	58.431	48.486	50.303	66.325	54.544	54.155	48.233	52.105
60	64.644	42.813	46.777	40.967	52.946	43.779	48.087	54.155	50.400	46.760
61	64.644	49.413	50.014	64.463	48.542	43.779	54.544	47.230	69.901	58.638

Subject	1	2	3	4	5	6	7	8	9	10
62	43.432	42.813	56.488	56.005	58.231	43.779	50.239	33.381	37.832	46.760
63	39.190	39.513	37.066	57.884	61.755	40.021	22.257	54.155	56.900	23.005
64	50.503	46.113	42.246	57.884	57.350	47.537	48.087	33.381	46.066	44.385
65	64.644	59.314	39.009	55.065	45.899	40.021	45.934	47.230	50.833	43.197
66	43.432	56.014	50.662	54.595	48.542	40.021	56.697	40.305	55.167	49.729
67	32.119	46.113	26.708	45.666	44.137	40.021	15.799	26.456	48.233	24.786
68	57.573	39.513	39.009	47.076	50.303	47.537	50.239	60.080	43.899	47.354
69	56.159	52.714	60.373	43.787	57.350	58.810	37.324	54.155	43.032	57.450
70	54.745	56.014	53.251	52.715	61.755	46.779	56.697	54.155	39.565	53.293
71	61.816	56.014	30.592	43.787	51.184	40.021	45.934	47.230	35.665	21.223
72	60.402	46.113	58.431	42.377	44.137	62.567	41.629	54.155	50.833	58.638
73	51.917	29.612	51.309	40.497	35.329	40.021	54.544	54.155	52.567	49.729
74	57.573	59.314	54.546	55.065	57.350	47.537	48.087	61.080	60.801	42.603
75	46.260	57.714	56.488	53.655	52.946	51.294	48.087	47.230	39.565	47.948
76	44.846	49.413	61.668	59.764	61.755	43.779	54.544	47.230	44.332	58.044
77	30.705	46.113	40.951	60.704	68.801	40.021	45.934	26.456	36.532	35.476

Subject	1	2	3	4	5	6	7	8	9	10
78	57.573	52.714	60.373	56.005	50.303	47.537	35.172	54.155	56.900	62.201
79	50.503	42.813	51.957	65.873	60.874	73.840	52.392	54.155	40.866	55.668
80	47.675	56.014	44.188	64.463	57.350	43.779	58.849	54.155	52.567	45.572
81	60.402	26.312	27.355	49.896	57.350	51.294	56.697	47.230	56.900	47.948
82	37.776	59.314	48.072	46.606	27.401	62.567	67.459	61.080	56.467	56.856
83	63.230	52.714	61.668	62.583	58.231	70.082	58.849	54.155	66.868	58.638
84	56.159	42.813	44.835	57.884	52.946	70.082	67.459	61.080	54.733	60.419
85	50.503	62.614	62.962	90.779	88.180	58.810	50.239	61.080	61.234	59.232
86	30.705	46.113	61.020	39.557	47.661	47.537	45.934	47.230	63.834	50.323
87	61.816	56.014	42.893	49.896	53.827	55.052	58.849	61.080	52.567	52.699
88	58.987	59.314	44.188	57.884	59.993	47.537	50.239	54.155	40.866	45.572
89	53.331	39.513	22.823	32.039	42.376	40.021	17.952	26.456	50.400	28.350
90	50.503	46.113	38.361	35.798	35.329	40.021	48.087	40.305	43.466	56.262
Mean	13.644	15.178	23.002	87.222	46.656	2.656	15.889	3.400	5.408	141.544
S.D.	7.072	3.030	1.545	21.280	11.353	2.661	4.646	1.444	2.308	16.838