THE RELATIONSHIP OF OVERHAND THROWING ABILITY TO GENERAL MOTOR ABILITY IN COLLEGE FRESHMAN WOMEN

by

Robberta Mesenbrink

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Approved by

Gail M. Hennis

Director

APPROVAL SHEET

This thesis has been approved by the following committee of the Faculty of the Graduate School at the Woman's College of the University of North Carolina, Greensboro, North Carolina.

Thesis Director Gail M. Dennis

Oral Examination Committee Members Rosemary McGee

Mariam Thamblin

Majorie Leonard

May 10, 1963

Date of Examination

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CHAPTER I

INTRODUCTION

One of the problems confronting physical educators is classifying students into ability groups for the purpose of providing more effective teaching environments and maintaining and further developing each individual's skills. In a physical education program which does not employ any method of classification, the classes may be composed of students with diverse skills and abilities. It becomes impossible for even the best physical educator to plan a program which adequately meets the needs of the students in a class containing the best, the poorest, and the average physically skilled individuals.

> "The logic of the situation (classification) demands that students be separated according to their general ability and skill, and be given work arranged according to progressive learning experiences.... Education has no right to dull the curiosity of the skillful man by forcing him to react in a non-stimulating atmosphere of the ordinary."(1, p. 9)

According to Cozens, Cubberly, and Neilson(5) age, weight, and height have an almost negligible effect on the performance of college women. General motor ability test batteries have been developed for the purpose of classifying students according to their present abilities and are the best methods of classification to date. Most of the batteries require some measure of throwing ability, be it overhand, underhand, or sidearm, using basketballs, soccer balls, sandbags, or softballs; or they require a combination of throwing ability and motor ability such as the Edgren Ball Handling, the Repeated Throws, and the Wall Pass. Some

authors(3, 14) support the validity of the overhand throw in measuring ability and especially the validity of the effectiveness of the overhand throwing pattern as measured by the distance a particular object is thrown.

The importance of classifying students of physical education has long been realized. The task recently has been to determine the most economical and, at the same time, the most effective method of classification. The current motor ability batteries, though they appear to be reliable indicators of ability, require hours of student and staff time for administration. Even more time must be devoted to setting up the equipment and to compiling the results. Since facilities differ so radically from school to school, a battery may take much longer to administer in one locale than in another more adequately endowed. If it were possible to design one test which adequately measured motor ability and which could be used by the majority of physical educators regardless of available facilities and equipment, the classification of students would become an easy task and would probably enhance the development of progressive physical education programs designed to meet individual needs. The overhand throw tests, since they are valid and reliable indicators of general ability, would appear to be worthy of consideration.

CHAPTER II

STATEMENT OF THE PURPOSE

It was the purpose of this study to investigate the relationship between overhand throwing ability and general motor ability and to determine whether this relationship was significant enough to warrant the use of an overhand throwing test or tests in classifying college women into skill groups. It was also the author's intention to determine whether the throwing test, provided it was substantially correlated to general motor ability, could be more economical in student and staff time, cost, and use of facilities and equipment as opposed to the administration of motor ability tests.

This study was undertaken with the hope that it would add in some small measure to the never-ending search for an adequate, yet economical method of classifying incoming college women into worthwhile physical education programs best suited to their individual physical needs.

CHAPTER III

REVIEW OF THE LITERATURE

THE CONCEPT OF GENERAL MOTOR ABILITY

The evolution of the term "general motor ability" has been one of various and sundry terminology. As the concept emerged such terms as general athletic ability, motor capacity, motor educability, and motor ability were used in describing it; and each of these terms carried with it a different connotation. Further, the proponent of each concept developed different skills' tests or revised existing tests to support his cause.

In 1927 Brace(4) defined motor educability as "inherent motor skill" and developed a test based upon this definition. He was striving to statistically define the innate motor capacity of the individual, disregarding past experience. His test proved to be inadequate for that purpose. McCloy later revised the Brace test(4, 11), calling it the Iowa Brace Test. He designed it for both sexes in the upper elementary grades, junior high school, and senior high school but received no better results than did Brace. McCloy did, however, better define the term motor educability and attributed to it the ten major factors of muscular strength, dynamic energy, ability to change direction, flexibility, agility, peripheral vision, good vision, concentration, understanding of the mechanics of techniques, and absence of disturbing or inhibiting emotional factors.

In 1954 Adams(4) designed the Adams Sport-Type Motor Educability

Test after concluding from a study of literature that there were two types of motor educability tests, the sport-type and the stunt-type; and that these were not significantly related. He studied forty-nine sport-type tests and selected four which had a multiple correlation of .79. His tests, designed for college men, consisted of the wall volley test, the lying tennis ball catch, the ball bounce, and the basketball shooting test.

McCloy compared general motor ability and general motor capacity when he devised a general motor capacity test that was to define the limits to which an individual's motor skills could be developed through proper training and education. The general motor ability score (gma) is the possible maximum ability score which may be predicted from the general motor capacity score; "the general motor capacity score is the 'practical maximum' of general motor ability"(23, p. 59). The general motor achievement is equal to one hundred times the general motor ability divided by the general motor capacity; or, the general motor achievement score is the percentage of developed ability compared to the maximum capacity of the individual.

> "It should be noted that the General Motor Achievement Quotient is an <u>achievement</u> quotient, or a quantitative statement of the relationship that exists between his developed motor ability and his innate motor capacity."(23, p. 59)

The GMAQ has had relatively limited use in the girls' program, because its validity for girls is not as high as it is for boys.

Clarke(4) concluded after a study of motor ability and its ramifications and tangents, that there was no such thing as "general athletic ability" since that implied skill in all sports' areas. In order to

measure such an abstraction one would have had to take every conceivable skills' test, and the establishment of norms would have been virtually impossible or at least of too great an expense to be practical.

Clarke(4) defines general motor ability as consisting of arm-eye coordination, muscular power, agility, muscular strength, muscular endurance, circulo-endurance, speed, body balance, and foot-eye coordination. Muscular strength is the maximum strength applied in a single muscular contraction; muscular endurance is the ability to continue muscular exertions of sub-maximal magnitude; circulatory endurance, which requires the adjustment of the circulatory and respiratory systems, is the moderate contraction of large muscle groups for a relatively long period of time; muscular or "explosive" power is the ability to release maximum muscular force in the shortest period of time; agility is the speed in changing body positions or in changing direction; speed is the rapidity with which successive movements of the same kind can be performed; and body balance is the ease with which the body can maintain its position.

According to Broer,

> "In the overhand (throwing) pattern the many segments of the body are brought into the movement in sequence giving a 'whiplike' action at the distal end of the system of levers."(3, p. 189)

The object being thrown acquires the motion given it by the thrower. On the basis of this statement it would seem logical to assume that a good test of overhand throwing ability would also measure general motor ability, since throwing utilizes the many segments of the body.

Scott(14) found that the throw test was the best single measure of softball playing ability, which assumes a certain amount of general motor

ability. She also stated that throwing does not necessarily measure a particular ability; "throwing is a basic skill and tests of throwing ability are included in almost all batteries of general motor ability". (14, p. 11)

A test of motor ability was developed by Rodgers(25) in 1947. It is based on scores in sports skills' tests and consists of the hurdle race, the standing broad jump, and the "scramble". Rodgers obtained a correlation coefficient of .73 between the tests and judges' ratings and a correlation of .91 with the selected motor ability criterion.

THROWING TESTS

Numerous tests have been designed to measure throwing ability. Cozens(5) describes an overhand target throw. The target, painted on a wall, consists of five concentric circles one, two, three, four and five feet in diameter, the center of which is three feet six inches from the floor with the bottom of the outside circle one foot from the floor. The width of each line is included in the diameter of the circle. A throwing line three feet long is drawn parallel to and thirty-five feet distant from the target, and a number of twelve-inch playing balls are used in the test. The subject's one foot must be in contact with the throwing line at the time the ball is released; the other foot may be ahead of the line, and a free overhand throw must be used. The scores for the zones from inside out are ten, eight, six, four and two. Any throw hitting outside the target is equal to zero, and a throw hitting a line between two zones assumes the score of the inner zone. The subject's trial score is the total number of points accumulated in ten successive

throws at the target, and his final score is the best of his two trial scores.

In his presentation of throwing tests Cozens includes a throw for distance. Ten subjects are tested at a time using five twelve-inch outseam playground balls either new or in good condition. The subjects are divided into two groups, and the five pairs of throwers are allowed one minute to warm up. The examiner gives the following instructions:

> "The field is lined off and marked so that it is possible to throw from both ends. Each contestant must remain behind the restraining line when the throw is made. A fifteen-foot run is allowed. The markers on the right of the receiver indicate the distance the thrower has made to the nearest ten-foot interval. The receiver should catch the ball and then call out the distance to the thrower, estimating the nearest foot to the spot where the ball first hits the ground."(6, p. 19)

After each person has thrown three times to her partner, the subjects report the best of their three throws to the examiner. The score is recorded in feet as the distance to the nearest foot from the restraining line to the point where the ball first lands. The contestant is not permitted to step over the restraining line and only three throws are allowed per subject, her score being the best of the three. Achievement scales have been established.

Scott(14) also describes a softball distance throw. The equipment consists of a number of regulation softballs and a field marked every five feet from zero to one hundred. The subject, using either an overhand or sidearm throw, is permitted one step which takes her to a point behind but not over the restraining line. Three throws constitute one trial, and the best of the three is measured from the starting line to the point where the ball first touches the ground and recorded. Three

trials are permitted, and the final score is the best of the three trial scores. The reliability of the test was .95 on successive trials given to 118 seventh- and eighth-grade girls in Riverside, Illinois' Intermediate School. Broer obtained a reliability of .94 with the same test given to two groups of junior high school girls numbering 239 and 141 respectively. The validity coefficient was found to be .81 compared with ratings for the 118 seventh- and eighth-grade girls and .63 compared with ratings when given to 173 college women in various central states.

Scott and French(14) also cite a Wall Pass Test which was developed originally by Smith. A soccer ball is thrown from behind a line seven feet from and parallel to a wall space six feet wide. The ball is caught on the rebound and may be caught but not thrown from over the restraining line. Any type of throw may be used and four trials of fifteen seconds are given. Each throw made from behind the line equals one point and the score is equal to the total number of seccessful throws made during the four trials. The reliability for this test was .75 using the odd-even method and .86 when the Spearman-Brown Prophecy Formula was applied. The subjects were sixty-three freshman women physical education majors enrolled in a speedball course at Illinois State Normal University, the majority of whom had had no previous speedball experience. The validity of the test was .51 as rated by three judges according to the subjects' general speedball playing ability.

Scott and French(14) also cite a Basketball Throw for Distance requiring a space eighty feet long and twenty feet wide. A throwing line is drawn eight feet from one end of the space and parallel lines are

marked every five feet thereafter, beginning fifteen feet from the throwing line. The subject is allowed three throws of any type from anywhere behind the line, and only the longest counts. The test is explained but not demonstrated, and any questions other than those regarding the type of throw to use may be answered after the examiner has explained the test. The reliability for this test was found to be .89 on successive trials for 200 women at the University of Iowa. The validity for the test, given to 155 women, was found to be .79 with the McCloy total points score on running, throwing, and jumping and .78 with the total points plus additional sports items and subjective ratings.

In assessing the motor abilities of college women, Scott(28) found four criteria: the subjective criterion, the sports criterion, the achievement score criterion, and a fourth criterion which was a composite of the first three. The basketball throw for 200 subjects was found to have a correlation of .78 with the fourth criterion and a reliability of .89 computed by correlating the first and second halves. The ball toss, administered to 159 students, was found to have a correlation of .62 with the fourth criterion, and a reliability coefficient of .60 computed on the basis of the first and second tests. The third throwing test, a sandbag distance throw, when given to forty-eight subjects, was found to have a correlation of .62 with the fourth criterion, and a reliability coefficient of .90 computed by correlation of the first and second tests.

Yates(32) found that the Softball Throw for Distance was the best single test to measure general throwing ability.

MOTOR ABILITY TESTS

In 1937 Humiston(21) developed a test of motor ability in an attempt to find a method of reliably measuring the present motor ability status of college women for the purpose of classification, improvement of teaching methods, and greater fairness in class and intramural competition. She first established the basic qualifications of a good test as objectivity, reliability, economy, useable scores, validity, and the yield of norms to be used in further testing. The five criteria used to validate the data were comparison of competetive scores with actual scores of each student on each item, comparison of athlete and non-athlete scores, comparison of teacher judgment and scores, comparison of scores of freshman women with junior and senior physical education majors, and comparison of team and non-team success.

On the basis of her review of literature, she chose twenty-two items to be included in the preliminary trials. The preliminary tests consisted for the most part of large muscle activity and change of direction. The seven items chosen to be used as a single consecutive unit in the construction of the test correlated .92 $\pm$ .008 with the other fifteen preliminaries.

As a single unit the test correlated .81 $\pm$ .03 with the preliminaries when it was given to 437 women. Teams with superior scores won over those with inferior scores in sports such as baseball, volleyball, tennis, hockey, and soccer. When two different examiners tested one group of girls on different days, there was a correlation coefficient of

.91 ± .01 between the two sets of data. Further, there was a reliability coefficient of .85 ± .04 on the test given by the same examiner to the same group on successive days.

Thirty-five students may be tested in forty minutes using one examiner and two class assistants. The equipment needed is that which is commonly found in gymnasia and can be arranged in five to ten minutes after the chalk or adhesive markings have been set. Humiston concluded at the end of her study that the test measured the fundamentals of motor activity which include running, jumping, getting up from the floor (equilibrium), getting over obstacles, dodging, and hand-eye coordination. Age, weight, and height had no significance.

In 1939 Scott(28) undertook a study of motor ability of college women with the development of a test battery as her primary goal. The tests were to represent strength, motor educability, ability, and skill. She began with student-teacher ratings and scores in a variety of sports' skills, intercorrelating the items with each of three criteria (running, jumping, and throwing) and with every other item. The ratings and scores were chosen as the two major criteria in the evaluation of ability and prediction of success in the sports' program. Secondly, they were chosen to evaluate the present level of achievement and to measure the skill educability of persons in the service program. The best single items were found to be the basketball throw, the broad jump, the Sargent jump, the sandbag distance throw, the ball toss, the dash, and the obstacle race.

Four different criteria were used for validating purposes. One

was a subjective criterion consisting of the establishment of an individual's motor capacity and ability to learn motor skills as shown by class activity. In establishing the criterion three students were given three weeks to observe and rate; the median of the student ratings correlated .67 with the author's own rating. This combination was used as a final rating. The sports criterion consisted of an average T-score for nine items as computed from a T-scale for each event. The nine items were drawn from a wide selection chosen to represent a variety of sports' skills. An achievement score was obtained from the total points accumulated from participation in the three fundamental activities (running, jumping, and throwing). The fourth criterion was established as a composite of the other three.

The sports' tests were chosen on the basis of previously calculated reliability and validity coefficients. These tests were ranked according to their correlations with each of the three criteria. "The strength items had very low correlations with all three of the criteria." (28, p. 67) In the final analysis the composite criterion seemed to be the best of the four used. The best single items measured by the composite criterion were the basketball throw, the ball toss, the dash, and the obstacle race.

The batteries appearing to be the best measures of motor ability for college women as defined by Scott are the dash, the basketball throw, and the broad jump which correlated .90 with the fourth criterion; and the obstacle race, the basketball throw, and the broad jump which correlated .89 with the fourth criterion.

In 1943 Scott(26) shortened the obstacle race of the previous battery and constructed T-scales for the test batteries. The reliability coefficient of the instrument remained the same.

The Scott Motor Ability Test consists of two batteries, either one of which may be used to obtain a motor ability score. The first consists of the Four-second Dash, the Basketball Distance Throw, the Standing Broad Jump, and the Basketball Wall Pass test. The second consists of the Obstacle Race, the Standing Broad Jump, and the Basketball Distance Throw.

In 1949 Phillips(24) computed a factor analysis of various physical education tests. Her main purpose was to isolate the common factors in the tests. Three-hundred-twenty-five intercorrelations were calculated and arranged in a correlation matrix, and the Thurstone method was used to isolate the common factors. Factor one was identified as general strength because of its high correlation, .87, with the Strength Index. This factor also showed significant correlation, .46, with the Standing Broad Jump and Basketball Distance Throw in which strength is a major factor. Factor three was identified as velocity or speed because of its relatively high correlation with all speed events and its zero correlation with the dynamometer strength tests. The Scott battery correlated. 76 with factor three. The Standing Broad Jump correlated .68 with the same factor. The Humiston test correlated .15 with factor one and .56 with factor three.

In correlating the Humiston and Scott tests Phillips found that the Humiston test correlated .56 with the Scott Obstacle Race, .49 with

the Basketball Distance Throw, .44 with the Standing Broad Jump, and .59 with the Scott Motor Ability Battery II.

The Table of Intercorrelations(24, p. 62-63) illustrates the significant, but relatively low, correlation between the Scott and Humiston tests, .59, which was apparently due to the low correlations between the Humiston test and the Strength Index and between the Humiston and the tests which correlated highly with the Strength Index.

CHAPTER IV

PROCEDURE

The purposes of this study were to determine what relationship, if any, there was between general motor ability and throwing ability; and to attempt to develop a throwing test or battery of tests which would be predictive of motor ability, yet require less time, equipment, facilities, and administrative personnel than previously validated motor ability tests.

SELECTION OF TESTS

Motor Ability Tests.

Two different motor ability batteries were used in this study. Evidence of the differences in the factors measured by the Scott and Humiston tests is given by Phillips(24). In her study she discovered a correlation of .59 between the two motor ability tests. The tests in the Scott battery represent strength, motor educability and ability, and skill. The items in the Humiston test represent what are considered by some to be fundamental elements of motor activity: running, jumping, equilibrium, getting over obstacles, dodging, and hand-eye coordination.

Phillips began her study in an effort to isolate common factors in tests of motor ability and to thereby determine the nature of the tests. There were two factors which were of particular importance to the research, Factor 1, which was a general strength factor and correlated highly with the Strength Index(.8702), as well as with individual

dynamometer tests; and Factor 3, which was velocity or speed, and had a high correlation with all speed events and a zero correlation with dynamometer strength events. The Scott test correlated .4650 with Factor 1, and the Humiston test correlated .1521 with the same factor. The Scott test correlated .7628 with Factor 3, and the Humiston test correlated .5628 with the same factor.

McCloy(24) contends there are two types of tests which are valid tests of general motor ability: three or four track and field events in combination with a strength test. Two basic factors in track and field events are speed and strength and, on this basis the Scott battery is a very good measure of motor ability in college women. Phillips found that the Scott test correlated .7072 with speed and fairly high with strength. She also discovered the Humiston test has a lower correlation with speed and no significant correlation with strength. If one accepts McCloy's contention, it would appear from the Phillips study that the Humiston is not as good a measure of motor ability as is the Scott.

There are two frequently used power tests: the jump and reach and the standing broad jump. Power (strength) equals force times velocity (speed). In the Scott battery the standing broad jump correlated .6840 with the speed factor. It would seem, therefore, that the Scott test is the better measure of power when compared with the Humiston. Many investigators accept the factors of power and speed as important elements in motor ability; if this is so, then the Scott battery is the better measure of motor ability.

The Scott Motor Ability Battery II. The Scott Motor Ability

Battery II, consisting of an obstacle race, a basketball throw for distance, and a standing broad jump, was chosen as one of the items to be used in this study because of its proven reliability and validity. Scores for this particular battery were available for the freshmen enrolled in physical education classes at the Woman's College. See Appendix for test description.

The Humiston Motor Ability Test. The Humiston Motor Ability Test consists of an adaptation of the Alden Dodge Test, a roll-over on a mat, running to and climbing over a gymnasium box, turning around in a circle, climbing up and down a ladder, throwing a ball up and over a rope, and catching it on the run to carry it to the finish line. The Humiston test was chosen for use in this research because it purports to measure motor ability, as does the Scott test, yet according to Phillips, it measures different factors. The Humiston test has a reliability of .91 $\pm$ .01 to .85 $\pm$ .04 and a validity coefficient of .81 $\pm$ .03 when a combined score on fifteen items considered by Humiston to be essential to the concept of motor ability was used as the criterion score. See Appendix for test description.

Throwing Tests.

The throwing tests were chosen to be included in this study after a review of the literature revealed a variety of tests, each using a different object, a different method of scoring, and a different space plan. The tests were chosen on the basis of their differences as well as their established reliability and validity. When throwing ability was compared with motor ability, it was felt that a variety of throwing tests,

each using a different object as well as a different type of throw, would give a more comprehensive picture of the relationship.

The Wall Pass. The Wall Pass is unique in its use of the soccer ball as well as in the way it is to be administered. It does not specify the type of throw to be used and upon observation appears to measure a more reflex-oriented pattern than does any other throw test. The scores are recorded as the number of times the subject catches and throws the ball in a fifteen-second period. When Smith(14) gave the test to a group of sixty-three freshman women physical education majors at the Illinois State Normal University, she obtained a reliability coefficient of .75 using the odd-even method and .86 when applying the Spearman-Brown Prophecy Formula. A validity coefficient of .51 was obtained when test results were correlated with the ratings of three judges who rated the subjects according to their general playing ability in speedball. See Appendix for test description.

The Basketball Distance Throw. The Basketball Distance Throw was selected for use in this research because the throw is measured in distance, thus bringing in the strength factor, and a large-sized object is to be thrown. The type of throw to be used is not specified. A reliability of .89 on successive trials was found when 200 women were given the test at the State University of Iowa. Validity coefficients of .79 with the McCloy total points score on running, throwing, and jumping, and .78 with total points plus additional sports items and subjective ratings were found for 155 women.(14) See Appendix for test

description.

The Softball Throw for Distance. The Softball Throw for Distance was included in this study because it has a known reliability and validity and because it utilizes another type of object to be thrown. The test specifies the use of the sidearm or overhand throw and consists of three trials of three throws each, making a total of nine throws. As is true with the Basketball Distance Throw, the Softball Throw for Distance appears to measures a strength factor and the scores are recorded as the distance from the restraining line to the point where the ball first touches the ground. Scott(14) obtained a reliability coefficient of .95 on successive trials when the test was administered to 118 seventh- and eighth-grade girls in the Intermediate School in Riverside, Illinois; a validity coefficient of .81 was found when the results were compared with ratings. Broer(14) found a reliability of .94 when she tested two groups of junior high school girls; one group contained 239 subjects, the other 141. A validity coefficient of .63 was obtained when results for 173 college women in various central states were compared with ratings. The Softball Throw for Distance is said to be the best single predictor of softball playing ability(32); and, according to Scott(28), is also a good indicator of ability in general. See Appendix for test description.

DEVELOPMENT OF THE MESENBRINK TEST

It occurred to the author while developing the design of this research that, if there were a substantial correlation between throwing ability and motor ability and if it were, therefore, possible to predict

motor ability from throwing ability, a test combining the elements of the two abilities might be developed which would be easier to administer and which would give an adequate estimate of an individual's motor ability. Keeping in mind the essential factors of motor ability (agility, speed, balance, strength, power, and hand-eye coordination), the essential parts of a test of throwing ability (distance, a type of throw and type of object thrown), and that throwing might measure ability in general, the author set about combining the ingredients into one test.

The softball was selected as the object to be thrown since the most reliable throwing tests and the ones most frequently used to estimate throwing ability are those in which a softball is used. Secondly, the softball is most generally available in the equipment supply of most schools. Third, it is an object easily grasped and, unlike the basketball, is thrown more easily.

The overhand throw was chosen as the throw to be required in the test. According to Broer(3), the object thrown using an overhand throw acquires the momentum of the entire system of body levers put into use in stepping into and throwing the object. The movement of the thrower's entire body is concentrated in the object thrown and in the path taken by the thrown object.

A number of balls were used in the initial stages of the test development. The individual participating was expected to move from one ball to the next as rapidly as possible, thus utlilizing the speed factor which is present in the majority of tests of motor ability. Equilibrium, hand-eye coordination, and running, as well as foot-eye coordination

which is included in the definition of motor ability by Clarke(4), were utilized as the subject moved from one ball to the next and, with as much speed as possible, stooped down and picked up the ball, then stepped into the throw.

The test which was first laid out and experimented with by the author allowed an interval of approximately four feet between balls. This distance permitted a step, side-step, step pattern of movement between throws. It was reasoned that an individual, in running up to a ball and preparing to throw it, reached down with the left hand (if she were righthanded), left foot forward, side-stepped one step as the ball was transferred to the throwing hand, and stepped into the throw with the left foot. During the first stages of experimentation it was discovered that the proposed interval was not suitable for all subjects. Consequently, the balls were placed far enough apart to require a number of running steps, thus allowing for individual differences and adjustments between balls.

In the fall of 1962 the test underwent further experimentation. Seven Balls were placed at five-foot intervals, the first one being five feet from the starting line, the last one thirty feet from the wall. Four trials were given. When the first test was administered to a group of fifteen women enrolled in a college physical education class, a reliability coefficient of .82 was obtained using the odd-even method of calculation stepped up by the Spearman-Brown Prophecy Formula. A second group of forty-three college women including physical education majors was tested. Their scores yielded a reliability coefficient of .94 when

the Spearman-Brown Prophecy Formula was applied. The same group, after the scores of the majors were deleted, totalled thirty-two subjects and their scores yielded a reliability of .78, using the odd-even method of analysis. The predicted reliability for this group was .87 for a total of four trials.

In an attempt to improve the test, the author asked a group of graduate students to participate in an experimental session. It was discovered that seven-foot intervals permitted better individual adjustment to the pattern of the test. The increase in interval size required a subsequent decrease in the number of balls used. Using seven-foot intervals and three balls, the revised test was administered to a group of sixteen college women. The starting line remained sixty-five feet from the wall; the last ball remained thirty feet from the wall. The revised test yielded a reliability coefficient of .92.

In observing the administration of the test as it had been revised, the rebounding balls, coming directly toward the subject taking the test, appeared to have had some effect on the speed with which the subject worked. A group of graduate students convened for the purpose of experimenting with the test, and this experimentation resulted in the placing of the balls on a diagonal line. When the balls were placed on the diagonal, the last ball was too great a distance from the wall, and it was felt by all concerned that an even greater interval between the balls was desirable. Consequently, the balls were placed on the diagonal fourteen feet apart.

In its final form the space required for the administration of the

test was sixty-two feet long and forty feet wide with an unobstructed wall surface at the end toward which the balls were thrown. The last ball was forty-two feet from the wall. Spots were taped on the floor to mark the positions of the balls and starting line. Spots were also marked on the opposite diagonal to facilitate the testing of left-handed subjects. See Appendix for test description. This revision of the test yielded a .97 reliability, using the odd-even method stepped up by the Spearman-Brown Prophecy Formula, when given to the previously tested group of fifteen college women.

SELECTION OF SUBJECTS

The subjects for this study were freshman college women enrolled in physical education classes at the Woman's College of the University of North Carolina at Greensboro and were selected at random from the Class of 1966. During the month of November, 1962 all of the freshman women at the Woman's College were given the Scott Motor Ability Battery II. Their score cards were filed alphabetically and, using a table of random numbers(9), one hundred subjects were chosen. In entering the table of random numbers a number was selected by chance from the telephone directory; the last four digits were used to select the table, the row and the column in the table of random numbers.

The scores of the subjects on the Scott test (the broad jump, the basketball throw, the obstacle race, the total GMA, and the T-score) were recorded as their names were pulled in the random selection.

Letters describing the study and requesting the subject's

participation were sent to the selected students through the local mail on February 4, 1963. Self-addressed cards, on which the subject could indicate whether she would or would not participate and the time at which she wished to be tested if she consented to be a subject, were enclosed in the letters. Space was also provided on the card for the subject's signature and address. See Appendix for copy of letter and return card.

The letters yielded a total of nineteen subjects, making a second sample necessary. The table of random numbers was re-entered at the place where the last selection was made, and the alphabet was re-entered at the point of the last previous selection. Each student selected in the second sample was contacted personally during her physical education class and was asked to participate for one hour out of the six scheduled for Friday, February 22 at 1:00, 2:00 or 3:00 P. M. and Saturday, February 23 at 1:00, 2:00 or 3:00 P. M. Of the hundred girls contacted, seventy-six indicated a willingness to participate and sixty-one actually reported for the testing sessions. Added to the subjects who were tested as a result of the letter contact, a total of eighty subjects were tested.

TEST ADMINISTRATION

In preparation for the testing sessions, the author instructed a group of graduate students in the proper administration of the tests. Insofar as possible the same persons administered the same tests during the various sessions. The author acted as administrant for the Mesenbrink Test and the Softball Throw for Distance and substituted for any administrator who was unable to attend a session.

The Humiston Motor Ability Test was set up in Rosenthal Gymnasium and the Wall Pass and Mesenbrink Test were set up in Coleman Gymnasium. The Wall Pass was administered at two stations at the west end of the gymnasium, and the Mesenbrink Test was arranged at the east end. The subjects began in Rosenthal Gymnasium, and after having taken the Humiston, proceeded to Coleman Gymnasium where they took first the Wall Pass and then the Mesenbrink Test. Since inclement weather did not permit the administration of the Softball Throw for Distance during the scheduled testing times, the subjects were given the three afore-mentioned tests during the first session and told that they would be contacted for the softball test at a future date when they would normally be on the physical education premises.

The Softball Throw for Distance was conducted all day Thursday, March 14, 1963, and Monday, March 18, 1963. Two additional sessions were scheduled the following Thursday, March 21, 1963, and Friday, March 22, 1963 to obtain scores from those people who had for some reason been unable to participate during their scheduled physical education classes.

Motor Ability Tests.

The Scott Motor Ability Battery II. The Scott Motor Ability Battery II was administered to all of the freshman women at the Woman's College during one of their physical education classes in November of 1962. Two administrators were required at the Obstacle Race for the purposes of timing and recording. The test was given in the southeast corner of Coleman Gymnasium. The Basketball Distance Throw was given at two stations in the northeast corner of the gymnasium, and each required

two administrators acting as recorders and retrievers. When it was possible, an additional person was stationed at the two stations to instruct the subjects as they came. The Broad Jump was administered in the southwest corner by two people, one of whom measured the jump while the other recorded the score and instructed the subjects. Again, two stations were used for this test item.

The Humiston Motor Ability Test. The Humiston Motor Ability Test was arranged in Rosenthal Gymnasium with the starting line at the south wall and the ladder attached to the balcony on the north wall. The test was administered by four people: a person who served as timer and recorder and also gave test directions to the subjects, a person who handed the basketball to the subject, and two spotters. One spotter was stationed at the ladder, the other at the box.

Throwing Tests.

The Wall Pass. The Wall Pass was set up in two stations and required two administrators, each acting as timer and recorder. When there were few subjects both administrators worked at one station, one acting as timer and the other acting as counter and recorder.

The Mesenbrink Test. The Mesenbrink Test was administered by one person acting as timer and recorder. The subjects were encouraged to help each other retrieve the thrown balls and to replace them on the designated spots as quickly as possible; however, the testing proceeded more rapidly when there were one or two assistants available to retrieve

the balls.

The Softball Throw for Distance. The Softball Throw for Distance was administered by one person. The administrator, after having explained the test to the subjects, stationed herself down the throwing field, called out the scores, and, after each trial, threw the balls back to the starting line. The subject recorded her own score on the score card with the pencil provided for that purpose. The test was administered outdoors on the hockey field, which had been previously marked every five feet from zero to 150 with pieces of paper measuring eight and one-half inches by eleven inches and marked with black crayoned numbers approximately seven inches high. The papers were fastened down with fence staples on either side, the numbers facing away from the restraining line and toward the administrator.

TREATMENT OF DATA

Recording the Scores.

The scores for each subject on all tests were recorded on a single card along with the subject's name. See Appendix for copy of score card. The subject's raw scores on the parts of the Scott Motor Ability Battery II, as well as her total GMA score and T-score, were recorded from the random selection sheet onto the card immediately after the first testing session. The subject's scores on the Humiston test, Wall Pass, Softball Throw for Distance, and Mesenbrink Test were recorded as the subject completed the necessary trials, and each subject's final scores were

calculated and recorded in the space provided upon completion of the testing sessions. The score cards were alphabetized and each subject was assigned a number. Finally, the subject numbers and raw scores were tabulated. See Appendix for the list of raw scores.

Mesenbrink Test Reliability.

In determining the reliability coefficient for the Mesenbrink Test, the Pearson Product-Moment method of correlation was used. Correlations were based upon the odd-even method in conjunction with the Spearman-Brown Prophecy Formula.

The reliability coefficient for the original test(I) was computed for the total time in trials one and three versus the total time in trials two and four. The total hits in the odd and even trials were also correlated. The highest reliability was obtained in the comparison of time in the odd trials and time in the even trials. The reliability coefficient for the first revision of the test(II) was computed in the same manner, and the pattern was used again in computing the reliability coefficient for the final revision of the test(III). After each computation of reliability, the Spearman-Brown Prophecy Formula was applied.

When the test was given to the eighty randomly selected subjects, the reliability coefficient, using the odd-even method, was computed only for the time element; and the Spearman-Brown formula was applied.

Intercorrelations of All Tests.

In determining the relationship of each test with every other test,

the Pearson Product-Moment Coefficient of Correlation was used.

Multiple Correlation of Throwing Tests with Motor Ability Tests.

Multiple correlation coefficients were computed by use of the Wherry-Doolittle Method for all possible combinations of throwing tests, using the motor ability tests as criteria. This analysis was undertaken to determine whether it would be practical to administer a battery of throwing tests for the purpose of defining motor ability, which battery would be more predictive than any one of the throwing tests used in the combination.

CHAPTER V

ANALYSIS OF THE DATA

PRESENTATION OF THE DATA

The motor ability tests which were chosen for use in this study were tests which had previously established reliabilities and validities for college women and which apparently, according to Phillips(24), measured different factors included in the concept of motor ability. The throwing tests, selected on the basis of substantial validities and reliabilities for this age group, were diversified in methods of throwing, objects used for throwing, and planning of space used in the test.

The Mesenbrink Test was developed by the author in an attempt to construct a single-unit test which would be more easily administered than most motor ability tests and which might be an adequate predictor of motor ability. This test was designed to combine the elements of throwing with other components of motor ability; it went through several revisions during the process of construction. Table I lists the reliability coefficients obtained, using the odd-even method of correlation, in each phase of the development.

Test I, given to a group of sixteen college women, yielded a reliability coefficient of .82 as computed with the Spearman-Brown formula. When the same test was given to forty-three college women, including a number of physical education majors, a reliability coefficient of .94 was obtained. The reliability was reduced to .87 when it was computed for the same group of thirty-two college women after the scores for the physical education majors were deleted.

TABLE I

RELIABILITY COEFFICIENTS COMPUTED FOR THE MESENBRINK TEST
(ODD-EVEN METHOD)

	N	r	Spearman-Brown r
Test I, Group I	16	.70	.82
Test I, Group II (with majors)	43	.88	.94
Test I, Group II (with majors eliminated)	32	.78	.87
Test II, Group I	16	.94	.97
Test III, Group I	15	.94	.97
Test III, Random Selection	80	.84	.91

The second form of the test was readministered to the same group of sixteen college women and yielded a reliability coefficient of .97. The reliability coefficient did not change for this group when the final form of the test was administered to them.

The final form of the Mesenbrink Test was administered to a group of eighty randomly selected college freshman women. The Pearson Product-Moment method of correlation yielded a reliability coefficient of .84 when the odd-even method was used and .91 with the application of the Spearman-Brown Prophecy Formula. Both reliabilities were sufficiently high for practical use.

Attempting to discover what relationship, if any, existed between throwing ability and motor ability was of primary importance in the development of this research. Table II offers a succinct review of the extent of that relationship.

TABLE II

CORRELATION COEFFICIENTS OF THROWING TESTS WITH MOTOR ABILITY TESTS

	N	Humiston Motor Ability Test	Scott Motor Ability Battery II	Obstacle Race	Broad Jump
Wall Pass	80	.32	.54		
Softball Throw for Distance	79	.44	.74		
Basketball Distance Throw	80	.45	.88		
Mesenbrink Test	80	.54	.59	.51	.44

The correlations obtained between each of the throwing tests and each motor ability test were appreciably lower in the case of the Humiston test. Each of the throwing tests correlated .54 or lower with the Humiston test and .54 or higher with the Scott test.

The order of amount of correlation with the Humiston test, ranging from .32 to .54, consisted of the Wall Pass, the Softball Throw for Distance, the Basketball Distance Throw, and the Mesenbrink Test. The order of amount of correlation between the throw tests and the Scott test, ranging from .54 to .88, was the Wall Pass, the Mesenbrink Test, the Softball Throw for Distance, and the Basketball Distance Throw.

It was interesting to note that the distance throws correlated appreciably higher with the Scott test in comparison with their correlations with the Humiston, and in comparison with the correlations of the Wall Pass and Mesenbrink tests with each motor ability test. The softball Throw for Distance correlated .44 with the Humiston test and .74 with the Scott test. The Basketball Distance Throw correlated .45 with the Humiston test and .88 with the Scott test.

Intercorrelations between the throwing tests were computed to more throughly study the relationships between the types of throwing tests. These correlation coefficients are presented in Table III.

That there was very little difference between the two distance throws in spite of the use of two objects of differing size was evidenced by the high correlation, .76, between the Softball Throw for Distance and the Basketball Distance Throw. The correlations between the other tests were appreciably lower, .53 to .27, perhaps indicating a diversification

of the factors measured by each test.

TABLE III

INTERCORRELATIONS OF THROWING TESTS

	Softball Throw for Distance	Basketball Distance Throw	Mesenbrink Test
Wall Pass	.51	.48	.27
Softball Throw for Distance		.76	.53
Basketball Distance Throw			.48

The intercorrelations between the various throwing tests seemed to warrant the computation of multiple correlation coefficients, using each motor ability test as the criterion with all possible combinations of throwing tests.

The Wherry-Doolittle Method of multiple correlation was used to determine if it were possible, within the confines of this study, to use a battery of throwing tests to predict motor ability scores. Using the Humiston and Scott tests as criteria, multiple correlation coefficients were computed for each possible combination of throwing tests. All the possible combinations and the resulting multiple correlation coefficients, which are arranged in order from the highest to the lowest, are presented in Table IV.

Consistent with the findings for the individual tests, the Humiston Motor Ability Test correlated lower with the combinations of throwing tests

TABLE IV

MULTIPLE CORRELATIONS OF ALL POSSIBLE COMBINATIONS OF THROW TESTS WITH EACH MOTOR ABILITY TEST

Criterion	Mesenbrink Test	Wall Pass	Softball Throw for Distance	Basketball Distance Throw	Multiple R
Scott Motor Ability	X			X	.91
		X	X	X	.91
	X	X	X	X	.90
		X		X	.89
			X	X	.89
	X	X	X		.80
	X		X		.78
		X	X		.76
	X	X			.71
Humiston Motor Ability	X	X	X	X	.59
	X	X	X		.58
	X			X	.58
	X	X			.57
	X		X		.57
	X	X	X		.48
		X		X	.47
			X	X	.47
		X	X		.45

than did the Scott Motor Ability Battery II. When the correlations were arranged from the highest to the lowest, the Scott correlations ranged from .91 to .71 and the Humiston correlations ranged from .59 to .45. None of the correlations for the Humiston test were as large as the lowest correlation with the Scott test.

INTERPRETATION OF THE DATA

When the Mesenbrink Test was administered to fifteen college women the obtained coefficient of correlation was .94 using the odd-even method and .97 when the Spearman-Brown Prophecy Formula was applied. The obtained reliability coefficient was sufficiently high to warrant the use of the test as a possible indicator of motor ability.

When the test was given to a group of eighty randomly selected college freshman women, a reliability coefficient of .84 was obtained using the odd-even method and .91 using the Spearman-Brown Prophecy Formula. Correlation coefficients with the Scott Motor Ability and Humiston Motor Ability tests were .59 and .54 respectively.

The Mesenbrink Test appeared to be reliable measure; however, when it was correlated with each of the two tests of motor ability, it was discovered to have been lacking in some aspects and did not by itself appear to be an entirely adequate estimate of motor ability as measured by either the Scott or Humiston test.

Correlation coefficients were computed between the Mesenbrink Test and the Obstacle Race and the Mesenbrink and Standing Broad Jump tests to further study the aspects being measured by the experimental test.

According to Phillips the Scott test correlated .46 with the strength factor and .76 with the speed factor. The Scott battery correlated .57 with the Obstacle Race, .71 with the Standing Broad Jump, and .88 with the Basketball Distance Throw. The Mesenbrink Test correlated .59 with the Scott test, .51 with the Obstacle Race, .44 with the Broad Jump, and .48 with the Basketball Distance Throw.

Since the Obstacle Race correlated considerably lower than the other two battery items with the strength factor(.07) and significantly with the speed factor(.63); since the Basketball Throw and Broad Jump were significantly related to both strength and speed; and since the Mesenbrink Test correlated higher with the Obstacle Race than with either of the other two tests; it appeared to be logical to assume that the Mesenbrink Test measured primarily speed. The apparent lack of the strength factor in the new test probably accounted for the relatively low correlation, .59, between the Scott and Mesenbrink tests.

It was evident from the computation of correlation coefficients between the throwing tests and motor ability tests that the throwing tests correlated consistently higher with the Scott test. The correlations of each of the four throwing tests with the Scott battery ranged from .54 up, while the correlations of the same four throwing tests with the Humiston test were .54 and lower.

The extremely high correlation, .88, between the Scott test and Basketball Distance Throw was undoubtedly due to the fact that the basketball throw test is one of the items in the Scott battery and is a heavily weighted factor. The Softball Throw for Distance also correlated highly

with the Scott test, .74, and in addition correlated .76 with the Basketball Distance Throw. The high correlation of the softball throw with the Scott test seemed to have been due to the high degree of similarity between the basketball and softball tests which were both measured in terms of the distance the ball was thrown.

The study indicated a definite and significant relationship between motor ability and throwing ability; however, that relationship was true to a greater extent when motor ability was defined by the Scott Motor Ability Battery II than by the Humiston Motor Ability Test.

With the exception of the correlation, .76, between the distance throws, all of the intercorrelations computed between the throwing tests were .53 and lower. These data seemed to indicate the measurement of various aspects of throwing ability.

The correlation between the Mesenbrink Test and the Wall Pass was .27 and, unlike the other correlations, was not significant at the one per cent level. This evidence seemed to indicate a greater difference between the traits being measured by the Mesenbrink Test and those being measured by the Wall Pass than existed between any other two tests.

The Humiston Motor Ability Test correlated consistently lower with the combinations of throwing tests than did the Scott Motor Ability Battery II. This consistency may have been due to the presence and heavy weighting of the Basketball Distance Throw in the Scott test. This same throw test, because it was a part of the Scott test, correlated .88 with the motor ability score and, therefore, could have been a causal factor in the high multiple correlations obtained when the Scott test was

used as the criterion and a combination of throw tests including the basketball throw was used in comparison. The Humiston test, on the other hand, was given as a unit test and the throwing involved did not include distance as a factor, nor was the throwing a heavily weighted part of the subject's final score.

The combinations of throwing tests with coefficients below the arbitrary limit of .80 were discarded. As a result, the study resulted in six possible combinations of throwing tests which correlated .80 or higher with the Scott Motor Ability Battery II.

The combinations and their correlations were as follows:

Mesenbrink Test-Basketball Distance Throw	.91
Wall Pass-Softball Throw for Distance-Basketball Distance Throw	.91
Mesenbrink Test-Wall Pass-Softball Throw for Distance-Basketball Distance Throw	.90
Wall Pass-Basketball Distance Throw	.89
Softball Throw for Distance-Basketball Distance Throw	.89
Mesenbrink Test-Wall Pass-Softball Throw for Distance	.80

In reviewing the possible combinations three points were considered: the space and time involved in administration, and the amount of correlation between the battery and criterion. Of the two batteries having a multiple correlation of .91, the Mesenbrink Test-Basketball Distance Throw is the more practical. The second combination would be more time- and space-consuming and would not result in any correlation increase. The Mesenbrink Test-Basketball Distance Throw, on the other hand, could conceivably be administered indoors or outdoors with minimum amounts of time and equipment.

The third combination, which yielded a multiple correlation of .90, was considered too impractical because it involved the use of all

four throwing tests.

Of the two combinations which yielded .89 correlations, either might be used. The Wall Pass-Basketball Distance Throw could be of practical use indoors; the Softball Throw for Distance-Basketball Distance Throw could be used if only outdoor facilities were available and would afford the advantage of having to set up only one testing area. This same combination also would very probably take less time to administer than would the preceding battery. It would, however, require an outdoor area since the Softball Throw for Distance requires a greater space than is available in most gymnasia. Since there is a substantial correlation (.76) between the two distance throws, it would seem to be impractical to use this combination.

The final combination which yielded a multiple correlation of .80, when it was viewed in respect to the other possible batteries, appeared to be least desirable. This combination would involve a greater area for administration and would be more time-consuming than the two-test batteries.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The tests which were used in this study were selected on the basis of their established reliabilities and validities, as revealed by a review of literature. The Humiston Motor Ability Test and Scott Motor Ability Battery II were chosen to measure motor ability; throwing ability was measured by use of the Wall Pass, Softball Throw for Distance, Basketball Distance Throw, and Mesenbrink Test.

The Mesenbrink Test was developed in an attempt to construct a test utilizing throwing ability and measuring motor ability which might be more efficient in the use of available facilities and equipment than are many motor ability tests. The test was included in the study after continued revision resulted in an appreciably high reliability coefficient.

Subjects were selected at random from the Class of 1966 at The Woman's College of the University of North Carolina at Greensboro. The selection was made from an alphabetical file of freshman women's scores on the Scott Motor Ability Battery II, which had been administered in November, 1962. Two selections of one-hundred were drawn; the first group was contacted by form letter and the second by personal interview during the subjects' physical education classes. The two selections yielded a total of eighty subjects.

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The Scott Motor Ability Battery II had been given to the subjects in November, 1962. The Humiston Motor Ability Test was given them during

the month of February, 1963 and was set up in Rosenthal Gymnasium. After having taken the Humiston test, the subjects proceeded to Coleman Gymnasium, where they participated in the Wall Pass and Mesenbrink tests. Due to inclement weather, it was not possible to administer the Softball Throw for Distance at the same time; the subjects were tested at a later date during their physical education classes.

The data were analyzed by use of the Pearson Product-Moment Coefficient of Correlation, the Spearman-Brown Prophecy Formula, and the Wherry-Doolittle Method of multiple correlation. The reliability of the Mesenbrink Test was computed using the odd-even method of correlation followed by application of the Spearman-Brown formula. Each throwing test was correlated with each motor ability test, and the motor ability and throwing tests were intercorrelated within their respective areas. Multiple correlation coefficients were computed for all possible combinations of throwing tests, using the motor ability tests as criteria.

The data were interpreted on the basis of the size of each correlation relative to the other measures computed in the same table.

After all of the correlations and intercorrelations had been computed, it was discovered that the Humiston test correlated consistently lower than did the Scott with each of the throwing tests. In computing the multiple correlations, the highest correlation using the Humiston test as the criterion was .59. This correlation coefficient was considerably lower than the lowest coefficient(.71) using the Scott Test as the criterion. The best combination used in the comparison with the Humiston test consisted of all four throwing tests, whereas the lowest

correlation using the Scott criterion consisted of a two-test combination. The high correlations obtained with the Scott criterion could, of course, have been due to the fact that throwing ability is a heavily weighted factor in the Scott Battery II.

An arbitrary lower limit of correlation was set at .80 when the best possible combinations of throwing tests were decided upon. This action resulted in six combinations of throwing tests which correlated .80 or more with the Scott Motor Ability Battery. Further elimination of tests on the basis of practicality in administration and space planning, as well as the relative increase or lack of increase in the multiple correlation coefficient, resulted in three possible two-test combinations which could be used in predicting motor ability as measured by the Scott test. The resultant batteries were the Mesenbrink Test-Basketball Distance Throw which resulted in a .91 correlation with the Scott criterion; the Wall Pass-Basketball Distance Throw which resulted in a .89 multiple correlation coefficient; and the Softball Throw for Distance-Basketball Distance Throw which also resulted in a .89 multiple correlation. The latter two batteries could also be eliminated on the basis of the fact that, since the Basketball Distance Throw alone was found to correlate .88 with the Scott criterion, the administration of the second test in combination with the Basketball test does not produce an appreciably large enough increase of the correlation coefficient.

The best single battery of throwing tests which were used in this study was the Basketball Distance Throw-Mesenbrink Test which resulted in a .91 multiple correlation coefficient with the Scott criterion. The

use of this combination in a practical situation might result in some difficulty of space planning; however, there would be advantages in the actual time involved in arranging the tests, in the equipment involved, and in the number of staff required for administration. Either of the two tests could be adapted for use in the out-of-doors if no indoor facilities were available.

CONCLUSIONS

On the basis of this study, the following conclusions were drawn:

1. There was a definite and significant positive relationship between motor ability and throwing ability as defined statistically by use of the Pearson Product-Moment Coefficient of Correlation.
2. There was a definite trend toward positively identifying motor ability by use of a battery or batteries of throwing tests as evidenced by the results of the application of the Wherry-Doolittle Method of Multiple Correlation.
3. The evidence compiled in the study supported Phillips' assertion that the Humiston and Scott tests, though they both purport to measure motor ability and correlate positively to some extent, measure different aspects of motor ability.
4. There appears to be some possibility that the newly developed Mesenbrink Test, in combination with another test of throwing ability such as the Basketball Distance Throw, can give an adequate estimate of the individual's motor ability as defined by the Scott Motor Ability Battery II.
5. Since the Scott and Mesenbrink tests correlated .59; and since the

Mesenbrink Test and Basketball Distance Throw in combination were found to correlate .91 with the Scott Battery II; the author would recommend the use of the combination in an experimental situation for the purpose of predicting motor ability as measured by the Scott test.

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APPENDIX

COPY OF LETTER TO SUBJECTS OF
FIRST RANDOM SELECTION

Department of Physical Education
The Woman's College
February 4, 1963

Dear Student:

As you may know, the Department of Physical Education conducts a graduate program which requires the candidates for Master's degrees to complete a thesis based upon extensive research. The research at times requires persons to whom tests can be administered, and you are one of the persons chosen, by a random sampling of the Class of 1966, to be tested.

You will remember that in November you were given a series of physical skills' tests for the purpose of classifying you into suitable physical education activities. The study which I intend to conduct as a thesis study is also one of classification to determine whether a less time-consuming method can be devised. You will be required to participate in one motor ability test and three throw tests which will require at most a total of two hours of your time including dressing time, testing time, and "traveling" time. The testing sections will be conducted in Rosenthal Gymnasium as follows:

Friday, February 8: 1:00 PM
Saturday, February 9: 1:00 PM
Friday, February 15: 1:00 PM
Saturday, February 16: 1:00 PM
Friday, February 22: 1:00 PM
Saturday, February 23: 1:00 PM

Two sessions will be required to test one person.

Please fill out the enclosed, self-addressed card, indicating whether or not you are willing to participate and your preference of testing time. I would appreciate receiving the card no later than Thursday, February 7. If you desire further information, please do not hesitate to call me at 272-0604. Your cooperation will be very much appreciated.

Sincerely,

_____

Robberta Mesenbrink

COPY OF RETURN CARD ENCLOSED IN LETTER

I _____ will _____ will not be able to participate in the testing.
_____ I cannot come at any of the scheduled times.
I wish to participate on: (indicate two)

_____ Friday, February 8
_____ Saturday, February 9
_____ Friday, February 15
_____ Saturday, February 16
_____ Friday, February 22
_____ Saturday, February 23

Signed: _____
Campus res: _____

SCOTT MOTOR ABILITY TEST (15, p. 125-130)

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PURPOSE

To measure general motor ability in order that individual needs of students may be determined, and for the sectioning of classes.

SEX AND AGE LEVEL

College women; may be used for high school girls.

TEST ITEMS AND EQUIPMENT

Basketball Throw	One regulation basketball, three or four preferred.
Broad Jump	One beat board (can substitute a solid 2-foot board), one gymnasium mat.
Obstacle Run	One jump standard, one boom (jump standards and pole may be substituted), one stop watch.

LEADERSHIP

Basketball Throw.--One assistant whose duty it is to mark where the ball lands. She may also, with the help of another assistant, do the measuring. One scorer and one or two ball chasers who collect balls

and keep subjects supplied.

Broad Jump.--One measurer, one scorer. Two assistants may be used to stand on the edge of the mat, to help hold it in place, if a long mat or several mats are not available.

Obstacle Run.--One timer and one scorer.

TIME REQUIREMENTS AND NUMBERS THAT CAN BE TESTED

Thirty to thirty-five subjects may be measured on either battery in a 40-minute period if sufficient space is available to allow all test stations to be operating simultaneously.

SPACE PLANNING AND FLOOR DIAGRAMS

The basketball throw area should be approximately 90 feet long. The measurement of the throws will be greatly faciliated if the floor is marked off at 10-foot intervals. A throwing line is drawn at one end of the area. The rest of the area is marked off with lines parallel to the throwing line and at 10-foot intervals. The distance of each line from the starting line should be denoted by the proper number.

The broad jump will be more easily measured if the gymnasium mat is marked off by lines 2 inches apart. The beat board is placed against the wall to prevent slipping. If one extra long mat is available, the mat can extend under the beat board; otherwise a string of mats placed end to end is preferable. The first line may be drawn 2 feet in front of the beat board and the lines numbered to denote the number of inches of the jump.

A space of approximately 55 by 15 feet is needed to set up the obstacle course. A starting line is marked off at one end and to the

right side of the course. Three rectangular spots, each 12 inches by 18 inches, are marked off at 10-foot intervals from the starting line. Fifteen feet from the third spot a jumping standard is placed. The boom or two jumping standards are set up so they are 13 feet 6 inches from the far end of the course, and the inside edge of the boom, or the inside jumping standard is 4 feet 4 inches from an imaginary extension of the inner edge of the rectangular spots. The boom or pole between standards is 18 inches from the floor. A line is drawn parallel to and 6 feet from the boom or jumping standards, a second line is drawn parallel to and 15 feet from the first line. This is the finish line.

INSTRUCTIONS

There are two batteries available, both of which measure general motor ability. Battery 1 is composed of four tests, basketball throw, dash, passes, and broad jump. Battery 2 is composed of three tests, basketball throw, broad jump, and obstacle run.

The general purpose of the tests should be explained to the subjects before the specific directions are given at each station.

Basketball Throw

This test should not be demonstrated and any technique of throwing may be used, but none should be specified.

To Be Read to the Subjects.--This is a test of your arm and shoulder girdle strength and coordination. Stand anywhere you wish behind the throwing line, but do not step on or across the line while throwing. Attempt to throw the ball as far as you can. You will have three trials.

Broad Jump

To Be Read to the Subjects.--The purpose of this test is to measure your leg power. Stand on the take-off board, your toes may be slightly curled over the end. Jump from both feet simultaneously. It is permissible to swing the arms and bend the knees a few times, preliminary to the jump. Jump as far forward on the mat as possible. Try not to step or fall back, as the measurement is taken from the edge of the take-off board to the nearer heel, or to the nearest part of the body if the balance is lost. You will have three trials.

Obstacle Race

One runner should lie down as the girl ahead starts, in order to save time in administering this test. Do not call the runner back if the toe or heel extends outside of the square. Judge on whether the stride is adjusted to contact the square and whether there is a transfer of weight in the square.

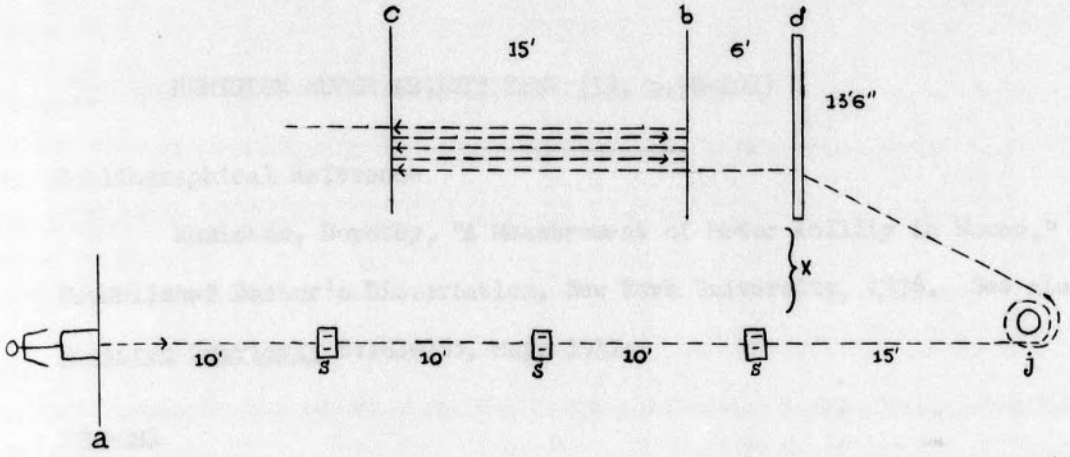
To Be Read to the Subject.--This test is designed to measure a combination of speed, agility, and general body coordination. Start the test by lying on your back with your heels at the starting line. On the signal "Ready, Go," get up as fast as you can and start running at top speed toward the jump standard, as you come to each rectangle on the floor, step on it with both feet. Run twice around the jump standard (that means behind it twice) then run toward the crossbar and go under it. Get up on the other side and run to this line (point out line c in diagram) and continue running between these two lines (lines c and d in the diagram) until you cross this line (line c) for the third time. You will have one trial and your score will be the time to the nearest tenth-second from the signal "Go" until you cross the finish line.

SCORING

Basketball Throw.--The distance from the starting line to the spot where the ball lands is measured for the longest throw only. The measure is taken to the nearest foot.

Broad Jump.--The distance from the take-off board to the nearer heel or nearest part of the body is measured. The measure is recorded to the nearest inch. Only the best of the three jumps is recorded.

Obstacle Run.--The time from the signal "Go" until the subject runs over the finish line is recorded to the nearest tenth second.



a, Starting line.
b, Line for shuttle.
c, Finish Line.
d, Boom (18" high).
j, Jump standard.
s, Spot on floor (12" by 18").
x, Distance from end of boom to line of inner sides of spots (4'4").

Diagram of floor markings for Obstacle Race, Scott Motor Ability Test.

FIGURE 1

HUMISTON MOTOR ABILITY TEST (15, p.98-101)

Bibliographical Reference

Humiston, Dorothy, "A Measurement of Motor Ability in Women." Unpublished Doctor's Dissertation, New York University, 1936. See also Research Quarterly 8:181-185, May, 1937.

PURPOSE

The test is designed to measure the present status of motor ability and to be used as a classifying device.

SEX AND AGE LEVEL

College women.

TEST ITEMS AND EQUIPMENT

An obstacle course run as a unit. Chalk for marking; nine folding chairs; two mats, 5 feet x 7 feet; one regulation gymnasium box, 4 feet 6 inches long by 3 feet 6 inches high by 13 inches top width; folding chairs to equal 4 feet 6 inches length of barrier, backs 3 feet high; one ladder, 1 foot 6 inches (outside measure) rungs 1 foot apart, from top of one rung to top of next, taped rung fourteenth from the bottom; two basketballs (one for emergency); one pair of jumping standards built up so cross rope (taut) can be maintained 7 feet from the floor; one tape measure; floor space at least 90 feet in length.

LEADERSHIP

One timer, one recorder, one assistant to hold the basketball ready.

TIME REQUIREMENTS AND NUMBERS THAT CAN BE TESTED

Approximately 35 to 40 subjects can be measured in one 40-minute period.

SPACE PLANNING.

The starting mark is chalked from the edge of the mat to a point 12 inches to the right. For the dodge test nine crosses are marked on the floor each of which is 9 feet from the other. (See diagram for floor plan.) A chair is centered over each cross with its back toward the ladder. Arrows are chalked on the floor to mark the course of the runner from the time she leaves the starting line until she finishes the course. The distance to the box, 30 feet, is measured from the near end (the finish line end) of the mat to the near edge of the box. The distance from the box to the circle, 26 feet, is measured from the corner of the box (see diagram) to the edge of the circle. The circle, which has a radius of 2 feet, is distinctly marked with an inch-width line. The distance from the circle to the barriers, 3 feet, is measured from the outer edge of the circle to the beginning of the barrier. The barrier is 4 feet 6 inches in length and approximately 3 feet high. This height does not need to be absolute. For the barrier, the backs of the chairs are set facing each other. The distance from the far edge of the barrier to the ladder is 8 feet 6 inches. The ladder is set perpendicularly against the balcony or backboard and should be securely fastened so that it cannot slip. A spot is marked 15 feet from the edge of the ladder, which marks the point over which the ball should be held. The distance from the spot to the jumping standards is 14 feet. The rope between standards is 7 feet high. The distance between standards should be ample so as to not inter-

fere with the runner; 5 feet or 6 feet should be sufficient. The distance from the standards to the finish line is 60 feet. Care should be taken to allow sufficient space for runners beyond the finish line.

INSTRUCTIONS

Leader.--Take your group through each part of the test, walking through or explaining what is to be done at each place or at each piece of equipment. Do not allow trials. Give opportunity to ask questions. Give directions to each group exactly as worded. Read them until you know them. Look at the apparatus from time to time to make sure that it has not been pushed from its proper place. Be sure to urge runners to go by you at top speed at the finish, both to insure relief from strain on their leg muscles and fastest time. Urge this precaution in advance of the test in your preliminary explanation but not after test has begun. Do not shout encouragements at them after they have started: these invalidate the data. The ball holder stands behind the spot on the floor and merely holds the ball out in front of her over the spot. She does not toss it to the coming runner. Kick the box and try to shake the ladder to help eliminate fear from the noise of the hollow box and of any uncertainty about the ladder fastenings. Give the instructions to subjects verbatim to insure best results.

To Be Read to Subjects.--This is a test designed to measure your present status in motor ability. It is based on the fundamentals of running, climbing, dodging, getting up off the floor, and the like. The object is to run this series of events as fast as you can. Your time will be recorded with a stop watch. If you make a mistake, I'll call you back. Try to do your very best. Follow me around while I

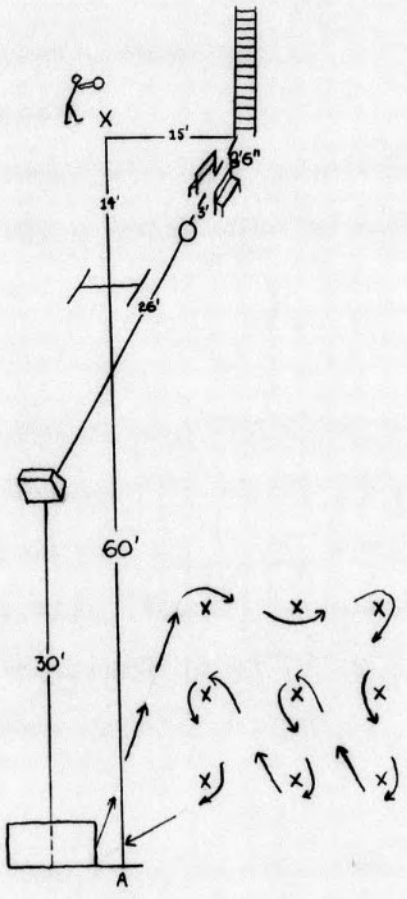
explain the test. Listen carefully. Ask questions if there is any part you do not understand when you are at that part of the test. This mark (indicate line) is both the start and the finish line. You start from a standing position with your toes on this line, and on the signal, "Ready, Go," run in and out among the chairs, following the arrows chalked on the floor. (Walk through this.) The toes of either foot may be on the line. After rounding the last chair, run to the mat. Lie down on it full length, feet toward the finish line, roll over once. This is simply a side roll in the direction toward which you were running. It is not a somersault. You throw yourself on the mat and roll. Run to the box. Get over it any way you can--climb, vault, jump, scramble--anything to get over. Continue to run to the circle drawn on the floor, turn around in it once while running. Continue to run between the barriers to the ladder. This is a climbing test, not a sliding one. Climb up until you can reach with one hand the rung marked with the adhesive tape. Step on every rung--going up and coming down. The ladder is safely fastened. (Shake it to reassure them.) Run to the girl holding the basketball. Take the ball from her. Run to the rope, throw the ball over the rope as you run under the rope, catch the ball and continue as fast as you can over the finish line carrying the ball. This straight-away is a good place to make up speed so be sure to go by me at top speed. Do not slow down so that you can come to a standstill when you get to me. If you drop the ball, pick it up and continue your run to the final line. Are there any questions? You see what you are going to do? On "Go" run through the chairs, then roll over, then get over the box, then run to the circle on the floor and turn around in it, go between the barriers, up the ladder and down, get the ball, toss

it over the rope, catch it and run for the finish.

SCORING

The final score is the total time needed to complete the course. Times are measured in seconds and tenths of seconds, to the nearest tenth second.

Norms are given in terms of percentiles. These percentiles are based on scores made by 2,195 college women.



A, Starting and finishing line.

Diagram of floor plan for Humiston Test.

FIGURE 2

WALL PASS (14, p.213)

EQUIPMENT

1. Stop watches, soccer balls.
2. Markings.

Unobstructed wall space approximately 6 feet in width for each testing station; a restraining line drawn parallel to and 7 feet from the wall.

TEST

Player with ball in hands stands behind the restraining line facing the wall. On signal, the ball is thrown against the wall, caught on the rebound, thrown and caught again as quickly as possible. The throw may be of any type. Four trials of fifteen seconds each are given. Player may cross the restraining line to recover the ball but must be behind the line before the ball is thrown.

SCORING

Each throw from behind the line counts one point. The total for each trial is recorded and the score for the test is the sum of the four trials.

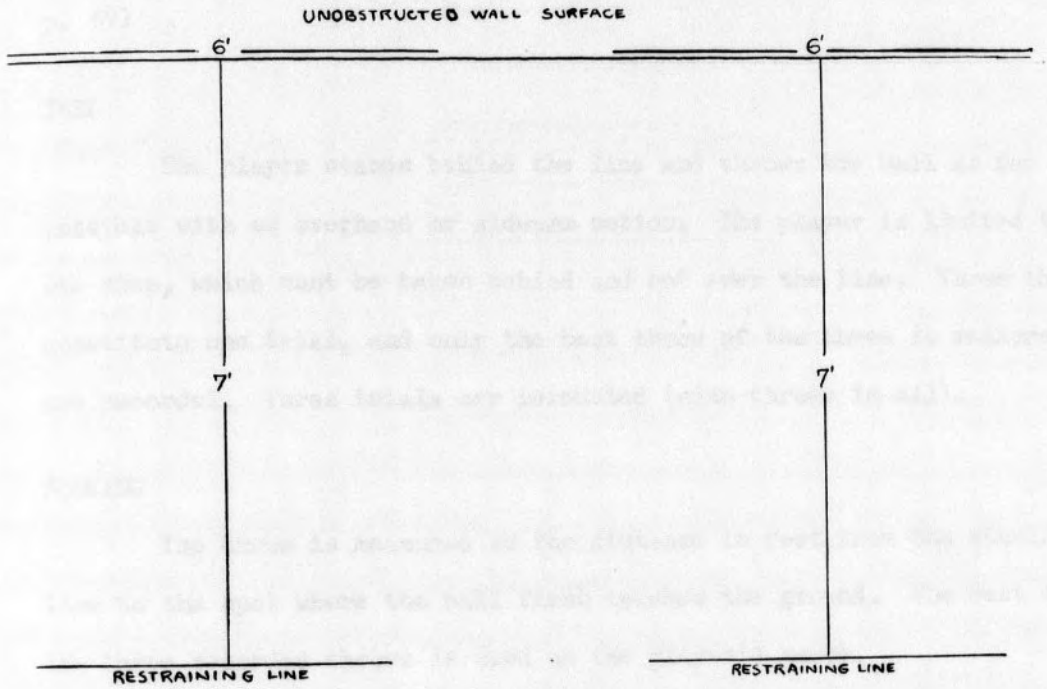


Diagram of floor markings for Wall Pass test.

FIGURE 3

SOFTBALL THROW FOR DISTANCE (14, pp.202-03)

EQUIPMENT

A number of regulation softballs, and a field. (See Figure 4, p. 69)

TEST

The player stands behind the line and throws the ball as far as possible with an overhand or sidearm motion. The player is limited to one step, which must be taken behind and not over the line. Three throws constitute one trial, and only the best throw of the three is measured and recorded. Three trials are permitted (nine throws in all).

SCORING

The throw is measured as the distance in feet from the starting line to the spot where the ball first touches the ground. The best of the three recorded throws is used as the player's score.

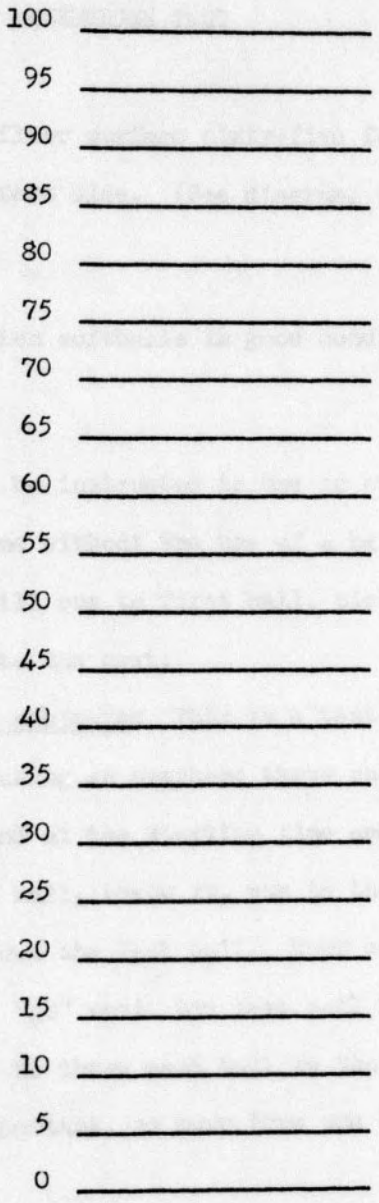


Diagram of field markings for Softball Throw for Distance.

FIGURE 4

MESENBRINK TEST

SPACE

Unobstructed floor surface sixty-five feet long from wall to starting line, forty feet wide. (See diagram, p. 71)

EQUIPMENT

Three regulation softballs in good condition.

INSTRUCTIONS

Subjects will be instructed to use an overhand throw and will be shown how to do same without the use of a ball. On the signal, "Ready, Go" subject will run to first ball, pick it up, throw it and immediately continue to the next.

To be read to subjects: This is a test to see how well you can throw a softball using an overhand throw such as the one you have seen. You are to stand at the starting line and on the signal "Ready, Go" run to the first ball, throw it, run to the second, throw and so on until you have thrown the last ball. Your score will be the time it takes from the signal "go" until the last ball has hit the wall. You are to make an effort to throw each ball so that it hits the wall on the fly. Speed is important, so move from one ball to the next as quickly as possible.

SCORING

The time it takes from the word "go" until the last ball has hit the wall, regardless of whether it has first touched the floor. Time is measured in seconds to the nearest tenth-second.

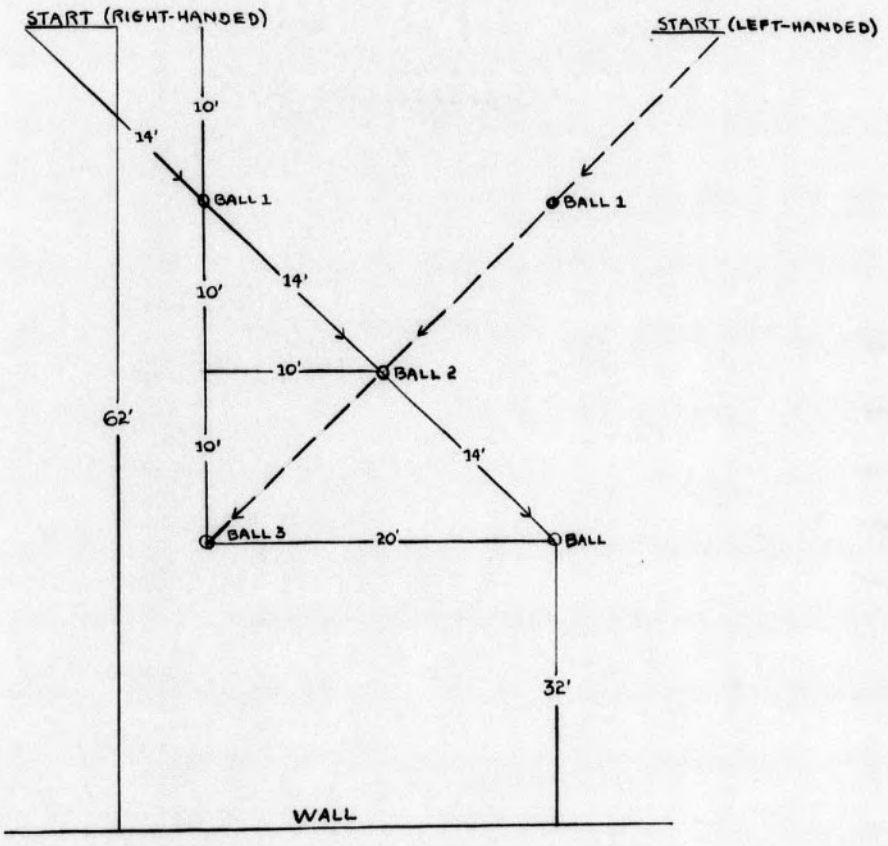


Diagram of Space plan for the Mesenbrink Test.

FIGURE 5

COPY OF SCORE CARD

NAME: _____

SCORE

HUMISTON: _____ ____

WALL PASS: _____ _____ _____ _____ ____

SOFTBALL: _____ _____ _____ ____

MESENBRINK: _____ _____ _____ _____ ____

SCOTT:

BASKETBALL THROW: _____

OBSTACLE RACE: _____

BROAD JUMP: _____

TOTAL GMA: _____ T-SCORE: _____

SUBJECT NUMBERS AND RAW SCORES

		Scott Motor Ability						
Subject Number	Humiston	Wall Pass	Softball	Wesenbrink	Basketball Throw	Obstacle Race	Broad Jump	Total GMA
1	57.5	46	70	31.5	82	21.6	92.4	158.8
2	53.7	53	85	29.4	100	20.7	114.8	194.1
3	56.0	39	51	29.9	68	22.0	98.0	144.0
4	67.0	39	42	39.9	54	25.7	61.6	89.9
5	52.5	44	44	33.6	78	22.5	77.0	132.5
6	58.7	45	45	35.4	48	21.4	110.6	137.2
7	51.8	43	78	30.8	90	23.2	98.0	164.8
8	50.9	39	73	28.7	82	20.5	106.4	167.9
9	56.0	42	67	28.4	92	25.0	67.2	134.2
10	49.0	42	98	26.9	96	21.2	105.0	179.8
11	60.4	46	73	30.3	92	21.9	106.4	176.5
12	48.8	32	42	33.3	42	20.0	102.2	124.2
13	54.2	44	60	31.6	72	20.5	92.4	143.9
14	59.9	45	72	36.9	58	23.3	89.6	124.3
15	57.6	40	47	33.0	60	26.6	88.2	131.6
16	45.9	51	69	30.1	68	20.1	96.6	144.5
17	57.2	47	67	31.1	90	23.0	112.0	179.0
18	46.3	43	87	26.1	102	21.7	100.8	181.1
19	63.4	38	56	31.7	60	23.3	86.8	123.5
20	49.2	48	79	29.6	108	20.2	99.4	187.2
21	71.3	43	68	37.5	76	24.3	99.4	151.5
22	56.4	42	75	33.2	88	21.1	107.8	174.6
23	53.6	52	73	31.5	76	21.7	100.8	155.1
24	56.5	36	50	31.3	56	21.8	93.8	128.0
25	70.1	38	56	36.8	42	24.5	81.2	98.7
26	89.6	40	41	42.8	58	28.8	60.2	89.4
27	65.0	24	50	39.9	66	26.0	74.2	114.2
28	54.1	58	77	31.5	80	20.0	84.0	144.0
29	59.8	55	59	30.9	70	22.7	105.0	152.3
30	67.4	57	77	37.0	68	23.5	85.4	129.9
31	49.4	39	64	31.1	78	22.1	84.0	139.9
32	63.0	49	45	41.4	50	22.7	74.2	101.5
33	45.5	51	86	36.2	88	19.5	110.6	179.1
34	42.8	53	137	28.6	108	22.2	110.6	196.4
35	65.0	44	62	36.4	70	23.3	88.2	134.9
36	46.3	43	98	27.7	80	20.4	112.0	171.6
37	48.4	57	--	31.2	94	21.6	112.0	184.4

SUBJECT NUMBERS AND RAW SCORES (continued)

38	47.9	60	138	28.6	136	21.0	109.2	224.2
39	52.4	28	50	37.3	60	22.1	85.4	123.3
40	49.8	53	87	26.6	120	20.4	96.6	196.2
41	62.2	44	52	30.3	102	23.6	85.4	163.8
42	56.0	32	67	33.6	74	20.2	77.0	130.8
43	53.8	43	91	32.9	64	21.0	89.6	132.6
44	50.6	44	110	29.4	98	22.0	110.6	186.6
45	62.2	35	101	29.8	106	23.2	84.0	166.8
46	56.5	57	105	27.0	104	20.0	100.8	184.8
47	49.4	44	138	28.1	120	21.6	103.6	202.0
48	57.0	41	79	32.5	74	21.5	99.4	151.9
49	48.8	50	122	26.0	130	19.0	102.2	213.2
50	59.8	44	58	28.8	60	20.8	82.6	121.8
51	59.2	31	75	32.6	60	23.9	88.2	124.3
52	83.9	46	98	31.1	70	25.7	68.6	112.9
53	56.0	32	50	37.6	58	23.8	79.8	114.0
54	56.3	26	59	29.9	60	22.5	95.2	132.7
55	51.9	50	92	32.6	102	21.1	106.4	187.3
56	59.0	51	87	31.0	100	23.0	68.6	145.6
57	70.3	27	59	29.6	72	25.6	72.8	119.2
58	52.5	44	65	33.8	68	21.5	77.0	123.5
59	60.0	28	40	35.9	62	24.5	92.4	129.9
60	70.8	39	83	32.7	66	26.0	67.2	107.2
61	61.6	44	68	32.5	74	21.8	89.6	141.8
62	61.4	19	41	39.4	86	25.7	82.6	141.9
63	64.6	43	82	35.1	62	24.5	92.4	129.9
64	62.8	44	67	31.2	74	22.0	112.0	164.0
65	54.8	52	112	33.4	114	20.2	107.8	201.6
66	66.4	31	68	34.8	60	22.6	85.4	122.8
67	61.5	38	58	29.3	62	22.8	89.6	128.8
68	58.8	44	77	38.8	104	20.2	103.6	187.4
69	64.4	44	42	42.1	82	24.7	88.2	145.5
70	64.6	50	57	30.2	72	24.8	105.0	152.2
71	50.0	55	116	27.2	116	19.7	102.2	198.5
72	51.0	50	98	28.0	80	21.0	110.8	159.8
73	51.1	88	89	28.1	88	20.3	107.8	175.5
74	60.7	39	65	37.0	72	25.2	70.0	116.8
75	48.4	60	110	24.5	118	18.8	102.2	201.4
76	65.8	39	48	28.5	68	22.6	82.6	128.0
77	47.1	51	85	28.1	88	19.2	116.2	185.0
78	57.2	38	54	33.7	80	25.2	78.4	133.2
79	56.1	43	50	29.6	46	25.8	75.6	95.8
80	53.4	46	63	33.2	68	21.7	92.4	138.7