THE CONSTRUCTION AND STANDARDIZATION OF SKILLS TESTS TO MEASURE ACHIEVEMENT IN SPECIFIC SOFTBALL PLAYING ABILITIES

by

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Submitted as an Honors Paper
in the
Department of Physical Education

Woman's College of the University of North Carolina
Greensboro
1960

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ACKNOWLEDGMENT

To Dr. Gail Hennis for her time, patience, and understanding,

To Miss Ellen Griffin, Dr. Mathilde Hardaway, and Dr. Whitfield Cobb for their helpful suggestions,

To Mrs. Eleanor Lambert and Miss June Galloway for making available subjects and time,

To Misses Margaret Acton, Louise Black, Betty Brown, Marilyn Colby, Peggy Coleman, Mary Hester Greene, Mary Ann Hancock, and Dolores Leonard for giving of their time to administer the tests,

the author wishes to express her most sincere thanks.

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CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

Measurement and evaluation are today a vital part of the educational process. Together they provide a scientific foundation on which progress in education may be built. Physical education, as a part of the total educational program, relies on measurement and evaluation to provide a scientific basis for establishing and promoting its program.

Luther Gulick, a pioneer physical educator, felt that many other fields could attribute their rise to recognition to the employment of measuring devices and evaluative techniques. It would, therefore, seem likely that the program of physical education would benefit if these general methods were applied to it. (12:950)

Beginning with the anthropometric measurements of Edward Hitchcock at Amherst in 1861, testing has gradually increased in both importance and scope. From its simple beginnings, measurement has found a variety of uses in the physical education program. Students' abilities may be recognized before class instruction begins. The teacher is then able to section the classes so that each student receives maximum individual instruction and is in the optimum learning situation. Subject matter may be adjusted to meet the needs of the students, and

useless repetition may be avoided. Evaluation throughout the educational process enables students and teacher to note the progress which has been made. The teacher may check on his own teaching efficiency, his methods, his weaknesses. A good testing program often is synonomus with motivation, for students may strive to do well when they feel the pressure of competition with one another or simply within themselves. (11:627) Testing is important to those in education who are striving to justify the importance of physical education in the total program. These people may point to statistical results, figures in black and white, and say that these symbols represent the improvement of mankind as a result of participation in physical education activities.

Measurement in physical education delves into many different areas, all related to the physical in some way: anthropometric, motor ability, physical fitness, general motor skills, sport skills, knowledge, and attitudes and appreciations. (2)

The area with which this paper shall deal will be that of testing in the area of sport skills, specifically in the realm of softball. There are two types of sport skills tests. The first is a single device which measures skill in an isolated element, such as a test of underhanded pitching accuracy. An instrument of this type would measure the ability of an individual to pitch and direct accurately an underhanded throw, one of the many elements or skills in softball. A second type of skill test consists of a number of devices grouped in a test battery which measures or predicts performance in the total activity. (22:9) The battery is a

combination of single devices in the same sport area which individually have adequate validity and low intercorrelations. Thus, each measures a part of the total activity, and together they indicate the player's overall ability in the sport. A test battery may be used for diagnostic purposes where an individual test item might be ineffective.

Sport skills tests are subject to the same principles of construction, criteria, and uses as any other educational tests. In constructing such instruments scientific authenticity, administrative feasibility, and educational application must be considered. (14:19) When these elements are held in disregard, little value will be found in the tests. Aside from these basic criteria, certain others are peculiar to the area of skill testing. The test constructor must isolate those qualities and skills of the game which are most important, and in constructing his tests he should place these elements in a simulated game situation. Good form by the subject should produce a higher score than faulty form, and a player's score should not be dependent upon the performance of another subject. The scoring of skills tests poses a problem all its own. A subject's performance cannot be measured in terms of right and wrong; it must be measured in degrees of achievement. Thus systems for accurately determining and recording the level of achievement must be devised. The test must, of course, interest the student. It should be neither above his capacity nor below his level of attainment; it must be challenging and stimulating. (20:10-16)

Applying the above criteria to the area of softball, one must first isolate the qualities to be measured. Everett (8:15)

tests ten specific qualities characteristic of the baseball player: distance throwing, running speed and agility, hand-eye coordination, reaction time, judgement of distance, spatial relationships, ability to make rapid decisions, accurate throwing, relaxation, and good motor capacity. The same qualities are characteristics of the good softball player. General playing ability can be determined by a battery of tests which measures some or all of these abilities. It is not always the desire of the teacher to test over-all playing ability and elements of motor capacity which are peculiar to a sport; he might prefer to test specific skill abilities. Instruments of the latter type must rate very high in the criteria of relationship to game situation.

It is the measurement of specific skill abilities with which the author is concerned. Many individual tests and batteries have been constructed to measure specific softball playing abilities. To date the throw for distance is the best single test yet devised to measure general playing ability. (20:203) Many of the other tests lack standardization, have low reliability and validity, or were standardized on elementary aged children.

It is, then, the purpose of this study to devise and standardize a battery of softball skills tests which measures the specific playing abilities of high school girls.

CHAPTER II

REVIEW OF LITERATURE

There have been a number of skills tests devised for various aspects of softball defensive play, i.e., fielding, throwing and catching, and pitching. However, very few of these tests have been standardized. Many are merely variations of the same basic skill concept, and most lack standardization as to administration, reliability, validity, and/or objectivity.

Such variability may be seen in the tests of pitching accuracy. Rogers and Heath (18:115, 116, 123) have standardized a pitching test using as subjects fifth and sixth grade boys. This test involves pitching at two concentric rectangles, 30" by 48" and 18" by 36", from a distance of 35 feet. A T-scale, a reliability coefficient of .60, and validity coefficient of .58 were established. Subjective ratings were used as the criterion for this test.

Andersen (10:71) compiled norms for a pitching test using three concentric rectangles. The norms were computed for the third through eighth grades based on classification by grade, age, height, and weight. Brace also established a T-scale in his pitching test for college women which involved the use of two concentric rectangles. (10:71) Reliability and validity are not available for either test.

Another pitching test with available norms, compiled by Murphy (21:26, 27), uses as a test area two home plates thirty-five

feet apart. The test unit involves eight people: a batter, catcher, plate umpire and recorder at each home plate. The catchers alternate as pitchers, and the number of strikes pitched in thirty trials is recorded. All of these pitching tests except the Murphy test employ the same basic concept, varying only in the target area. The latter test is of a much more subjective type involving an umpire who must subjectively determine whether or not a pitched ball is in the strike area.

The Throw for Distance also has some variations, chiefly in scoring. Scott and French (20:202) have standardized this test, resulting in a reliability coefficient of .95 when administered to seventh and eighth grade girls. The best throw in each of three trials is recorded, and three throws per trial are allowed. The validity coefficient was .81 when correlated with judges' ratings of playing ability. Norms have also been established for this test. This same scoring system was used by Andersen (10:73) in a Throw for Distance for third to eighth grade students, norms being established on the basis of age, grade, weight, and height.

Palmer and Mosbek (10:73) scored the test on the maximum distance from home plate that the ball could be thrown. Points, or fractions thereof, were awarded for each sixty feet the ball was thrown. No attempt was made to determine the validity or reliability of this test.

In the area of accuracy there have been several tests constructed to measure overhand throwing accuracy. Again most of these lack standardization. Brophy (10:68) has, however, established reliability

of such a test for ten to fifty trials with a range of .72 to .97. The target used in this test was composed of four concentric circles, 66", 42", 22", and 6" in diameter, and a scoring system of 4, 3, 2, 1 respectively. On the basis of scores made on throws when using two concentric rectangles as a target, Brace (10:68) compiled a T-scale for college women.

Rogers and Heath (18:116, 117, 123) included fielding and throwing tests in their battery. These are wall volley-type tests of flies and grounders in which the subject is to throw and field as many times as possible in thirty seconds. The ball must hit within a wall target area, and, in the case of grounders, be fielded within a restricted floor area. The reliability of Catching Fly Balls using test-retest method was .63 for fifth and sixth grade boys, and the test had a validity of .61 when correlated with subjective ratings and success in making the school team. Catching Grounders yielded a reliability coefficient of .61 and a validity coefficient of .42. Andersen (10:81) constructed a similar test for which he established norms for third through eighth grade children. No mention was made of test reliability or validity.

Wardlaw and Brace (10:81) each developed very similar tests in which the ball is thrown against the wall a specific number of times; the score is the length of time required to complete the throws.

The Research Committee of the Central District Association of Directors of Physical Education for College Women (21:23) devised an achievement test known as Repeated Throws. This test measures the speed of throwing and ability of the subject to catch balls.

The ball is thrown above a line 7'6" high on the wall from a distance of 15 feet as many times as possible in 30 seconds. The reliability calculated on the basis of odd-even trials and corrected by the Spearman-Brown formula was .94. The validity was .64 using subjective ratings as the criterion. (20:199) This test does not, however, differentiate between subjects in the middle ability group.

Another test, constructed by this same organization, is the Field and Throw (21:23), which tests the subject's ability to field a ball and throw accurately. The test itself is much like a double play game situation. The subject stands on a base, throws the ball against the wall, fields it, touches the base, pivots and throws at a concentric-circles target area on an adjacent perpendicular wall surface. Ten trials are allowed, and the final score is the cumulative time and the sum of the scores made on each of ten hits. In a slight variation of this test, Scott and French (20:204) suggest a deduction of points from the hit score for slow speed throws. Scott and French have standardized this test for freshman and sophomore college women and have established a reliability coefficient of .56 by the odd-even method and a validity coefficient of .49 against subjective ratings. This test must be administered to a large group of subjects in order to be of value, as local norms and scales must be established for the various skill levels of the students.

A very different type of test involving throwing, catching, and running was included by Cozens and Neilson. The subject throws the ball over a football crossbar, runs under the bar and catches the ball at the greatest distance possible. The score is the best distance

of three trials. Achievement scales have been established; neither reliability nor validity, however, have been determined. (6:18)

Considering all these various tests, there are very few which are standardized and can be recommended as a battery or as individual tests. Scott and French (20:211) recommend the Throw for Distance as the best single test of general softball playing ability. This is true in most sport activities as throwing is a motor skill basic to many activities. An intercorrelation between Repeated Throws and Throw for Distance was .81, indicating that the administration of both is unnecessary (20:211). Carpenter (21:21) recommends a combination of the Throw for Distance and the time record and hits score of the Field and Throw test. These two tests correlate .80 and the battery T-score is attained by the following weighting: T-score equals .2357 Distance Throw minus .2701 time record of Field and Throw minus .2687 hits for Field and Throw plus 44.56. The Rogers and Heath battery, while standardized, is not acceptable for testing high school girls when an accurate measure is needed, due to the age group on which it was standardized. The accuracy of the criteria against which the validity was established may also be questioned. (10:66, 67)

The other two areas in which softball skill tests have been established are base running and batting. Underkofler (20:25) and Hillas and Knighton (10:78) have devised similar tests in which the batter swings the bat and runs the bases. The score is the time required to circle the bases. The Underkofler test permits two trials, the best of which is scored. This test varies from that

of Hillas and Knighton in that the player is timed on the run only from home to second although he completes the circle of the bases. A reliability of .71 and a validity of .54 were reported for this test. Hellas and Knighton allow three trials in their test. The value of base running as a skill has not been definitely established. Higher validities have, however, generally been obtained when the run is timed to second rather than to first or around all the bases.

Many batting tests have been constructed; however, a great number rely on the human element of a pitcher. Rogers and Heath (10:83), Brace, and Wardlaw (10:78) have constructed tests all of which depend on the accuracy of a pitcher. Rogers and Heath have standardized their test on fifth and sixth grade boys, obtaining a reliability coefficient of .61 and a validity coefficient of .51 based on the subjective ratings of the teacher and pupils.

Underkofler (21:25) has also developed a batting test using a pitcher, and has established a reliability of .79 (after Spearman-Brown correction), and a validity of .72 when correlated with student and teacher subjective ratings. The subject hits ten balls which are pitched into the strike area and scores according to the area into which she hits (outfield- 5 points, infield- 3 points, foul- 1 point). The final score is the total points made in the ten trials.

More recent batting tests have utilized a batting tee. Use of the tee has removed the element of pitching, which varied at each administration of a batting test. The batting tee is an adjustable stand on which the softball is placed. The player assumes his normal batting stance and attempts to hit the ball as far as possible from

the tee. It is necessary that the students be familiar with the use of a batting tee in order to obtain the best results. Two tests using the tee are available.

Davis (20:207) has established a test with a reliability coefficient of .90 and a validity coefficient of .33. The score is the total yardage for twenty trials.

Fox and Young (20:210) devised a Bat for Distance Test. This test is scored in the same manner as Davis' test with the exception that only five trials are permitted. A reliability coefficient of .87 was obtained when the Spearman-Brown Prophesy Formula was used to correct the split halves coefficient. College students were the subjects. Validity, when correlated against the sum of three judges' ratings, was .64.

The only other possible means of providing standard pitching, a catapult, is still too expensive for general high school use.

Everett (8:15-19) constructed a T-scale to predict baseball playing ability which had the formula: T-score equals .92 Sargent Jump - .08 "S" test - .23 McCloy's blocks test + 16.19.

All of the previously mentioned tests have been grouped into definite categories indicating that most test constructors have selected many of the same skills as being important to the game of softball. Such skills include: throwing for accuracy - overhand and underhand, throwing for distance, and fielding and throwing. Testing in the area of base running and batting has not been extensively developed; for running is a skill not peculiar to softball, and batting tests are largely dependent upon the human

element or upon practice from a batting tee.

After surveying the area of pitching tests, it is evident that most of the previously mentioned tests emphasize control or accuracy rather than speed. Craine (7:187), Fischer (9:9) and Meyer and Schwartz (15:225) all emphasize control over speed. Fischer points out that control is the ability to pitch to specific areas, not down the center of the plate. Control, speed, and deception are listed by Meyer and Schwartz in descending order of importance.

In Scientific Principles of Coaching, John Bunn (4:142-144) places great importance on speed of throwing. Noren (17:7) also places greater value on speed of pitching rather than control, stating that control can be attained after speed is mastered.

Most coaches and teachers agree that a catcher must have a good throwing arm. Meyer and Schwartz (15:329), Fischer (9:27), and Noren (17:15-16) value the strength and accuracy of a catcher's throwing arm, while Bunn (4:147-154) conceives stability as being fundamental to good catching and general playing ability.

These same experts stress accuracy and arm strength for the outfielder. Speed, distance throwing, and judgement are considered as attributes of a good outfielder.

Considering the opinions of these authorities, it is understandable why a large number of overhand throw for accuracy tests have been deemed important by many test constructors. As has previously been stated, most of these tests involve the use of stationary wall targets.

The infield positions seem to be the only positions in which

speed is placed at a premium. Noren (17:21), Fischer (9:36), and Meyer and Schwartz (15:326) state that speed of fielding and throwing are necessary to every good infielder. Tests of Fielding and Throwing (21:23), Repeated Throws (21:23), and Catching Flies and Grounders (18:116, 117, 123) were constructed to measure such speed. These tests also measure accuracy, which is rated second only to speed by the experts, in varing degrees.

It may be concluded that most of the existing softball skill tests are soundly grounded upon those skills which have been recognized as being important to various positions. The problem of lack of standardization still remains.

CHAPTER III

PROCEDURE

In constructing a battery of skills tests it is first necessary to isolate those skills or abilities peculiar to the sport and which may be measured objectively. The following may be considered those abilities which are important to the softball player: running speed, agility, throwing accuracy, throwing speed, reaction time, arm strength, judgement, fielding ability, timing, and balance.

Measuring Instruments

Desiring to measure these skills as they are related to specific position play, the author subjectively assigned these skills into position groupings, with certain ones being more important to one position than another.

Infield	Pitcher
fielding grounders	underhanded accuracy
agility	pitching speed
running speed	timing
throwing speed	balance
throwing accuracy	

Catcher	Outfield
arm strength	fielding flies
overhanded accuracy	arm strength
agility	judgement
judgement	throwing accuracy
balance	running speed

Eight individual tests were then devised which took these various groupings into consideration. Each device was designed to measure skill of play at a certain position: infield, outfield, catcher, pitcher.

During February, 1960, these tests were administered to a trial group of students enrolled in the girls' physical education program at Greensboro Senior High School in order to ascertain the feasibility and practicality of each test. After considering the results of these trial devices, six tests were selected to be given in the final testing period.

Double Play:

Speed, fielding and throwing accuracy are the prime elements of this device. The situation is similar to that of a double play in which the infielder fields the ball, moves to tag the base, and throws to a team mate. Throwing speed and direction are emphasized rather than distance. For that reason the base is only thirty feet from the wall target.

Underhanded Accuracy:

The underhanded accuracy target places greater value on the outside areas. A pitcher has greater control if she can pitch to the inside or outside areas of the strike zone rather than the home-run portion down the center of the plate. The starting line is regulation distance from home plate.

Squat-Stand Throw:

Agility, speed, accuracy, and distance throwing are the important abilities to be measured by this test. The situation may be compared to a catcher receiving the ball, standing, and throwing a baserunner out. A peg throw is desirable; for that reason the lower wall and the floor targets carry the highest value.

Field and Throw:

The Field and Throw instrument places a premium on the fielder who is able to field and throw the ball on the run. The target area provides a general degree of accuracy in throwing. The player who can field the ball and throw immediately receives a better score than the one who runs excessively before throwing.

Shuttle Rebound:

The outfielder must be able to field the fly ball. In order to do this, judgement and timing are essential. The restraining line in this test makes moderate arm strength in throwing imperative. Once the ball is

caught, the player must move rapidly into position for the next throw, thus providing some measure of speed and agility.

Wall Rebound

As in the Shuttle Rebound, emphasis is placed on judgement and speed. The player must be able to determine the angle of incidence necessary so that she may catch the rebound, yet cover the greatest distance possible. She must, therefore, know her own running speed and have, as well, some overhand throwing control.

Complete descriptions of these tests and directions for administering them may be found in the Appendix.

The subjects to whom the tests were administered were eighty-two tenth, eleventh, and twelfth grade girls at Greensboro Senior High School taking the required physical education course and eighteen tenth graders at Curry School enrolled in the same course. The tests were given in the early spring before any practice in softball skills had begun.

Administration of Tests

On Monday, March 21 and Tuesday, March 22, the first administration of the tests was held at Greensboro Senior High School. The Throw for Distance, which was used as the criterion, and make-ups for the first administration were given on Friday, March 25. Curry High School students also took the skills tests on that day. Each class was divided into four equal groups. A counter-clockwise system of rotation was established with the tests being arranged in the following order: Double Play, Squat-Stand Throw, Field and Throw, Shuttle Rebound, Wall Rebound, Underhand Accuracy. Monday, March 29, Tuesday, March 30, and Friday, April 1 were the dates for the second administration of the tests.

Five assistants were used to administer the tests. These administrators were kept constant for each day the tests were given; this was an attempt to insure consistent scoring.

Each student carried a set of score cards stapled together which provided space for the scores of both administrations. Each student's name was stapled to the cards to facilitate redistribution. At the conclusion of the testing, the names were removed, the cards numbered, and filed according to the specific tests. Scores were then tabulated on the master score sheet. Sample copies of the score cards may be found in the Appendix.

Treatment of Data

The data thus collected were organized, and the reliability and validity of each device determined. Validity was computed using the Throw for Distance as the criterion, and reliability coefficients were calculated by the Pearson Product Moment method of correlation, using test-retest scores. In tests in which both speed and accuracy were recorded as scores, separate reliabilities were computed. The Doolittle method of multiple correlation was employed to obtain the validity of test batteries combining the various devices.

Using the correlation technique, some comparisons were possible between the validity coefficients on the first and second administrations of the tests. Thus, one is able to determine the influence of practice on test validity. Test intercorrelations, as well as being necessary for the multiple correlation technique, indicated the relationship between the different tests. It was possible to determine

if specific abilities or general softball playing abilities were measured.

CHAPTER IV

ANALYSIS OF DATA

The Pearson Product Moment method of correlation was used exclusively to determine the reliability coefficient of each of the six tests administered. These data appear in Table I. In those devices for which more than one method of scoring was possible, a reliability coefficient for each method was determined. The combined score of the Squat-Stand Throw was achieved by adding to the time score .1 second for each point below two in the hit score, and subtracting from the time score .1 second for each point above 2 in the hit score.

The Double Play and Shuttle Rebound (best single score) produced the highest reliability coefficients - .72 and .74 respectively. By simply doubling the number of trials the reliabilities may be increased to acceptable coefficients of .84 and .85.

The Field and Throw test showed a primary reliability of .60. By increasing the trials to nine, a reliability of .82 can be predicted. Nine trials in this test are not unreasonable, as each trial requires two to four seconds per player.

The only other test which gave some indication of being reliable was the Underhanded Accuracy test. An increase in the number of trials from ten to thirty resulted in a reliability increase from .52 to .78. Thirty trials are given in the Underkofler test (21:25): it has generally been found that tests involving specific accuracy require a large number of trials in order to attain good reliability.

TABLE I

SOFTBALL TEST RELIABILITIES

	Original r	trials	Spearman-Brown r_x	trials
Double Play	.72	3	.84	6
Underhanded Accuracy	.52	10	.78	30
Squat-Stand Throw		3		
1. Time	.45		.71	9
2. Score	.12			
3. Combined	.32		.40	6
Field and Throw	.60	3	.82	9
Shuttle Rebound		3		6
1. Best	.74		.85	
2. Total	.70		.82	
Wall Rebound	.36	5	.54	10

The other tests showed very poor reliability and failed to reach an acceptable level when stepped-up by the Spearman-Brown Prophesy formula. Reliability of all the tests would have been higher had the tests been administered later in the spring after the girls had had some review and practice in softball skills. There was a general improvement in scores on the second administration of the tests indicating that some learning and review had taken place. The reliability was also influenced by the fact that many of the subjects were relatively inexperienced in softball, and many of the skills upon which they were tested were new to them. A more experienced group of subjects would have resulted in increased reliability coefficients for all tests.

The validity coefficients, presented in Table II, were computed for those tests having the highest reliabilities. The score of the best trial rather than the total score of three trials was the figure selected for scoring the Shuttle Rebound as this method gave the higher reliability coefficient.

The coefficients of validity indicated that there was some relationship between general playing ability, as measured by the throw for distance, and each of the individual tests. The coefficients were low enough, however, to point out that elements other than general playing ability are present--perhaps specific playing abilities. There are no established criteria available to determine if this is the case. Subjective ratings of each subject's playing ability at every position--infield, outfield, pitcher, catcher--would be the only possibility, and this would be highly impractical

TABLE II

SOFTBALL TEST VALIDITIES

	First Adm.	Second Adm.	Total
Double Play	.59	.56	.57
Underhanded Accuracy	.40	.51	.46
Field and Throw	.51	.54	.46
Shuttle Rebound- Best	.62	.69	.72

with such a large number of subjects. One may only surmise by the mediocre validity coefficients that specific playing abilities are measured by the tests.

The test intercorrelations also tended to uphold the previous statement. As the individual tests were not particularly good measures of general playing ability, neither did they appear to measure the same specific abilities. The most closely related tests were the Field and Throw and Double Play tests and the Field and Throw and Shuttle Rebound tests. The intercorrelation coefficients of these tests did indicate that some of the same qualities were being measured; yet the coefficients were not high enough to warrent the exclusion of one or more tests from the battery. These data may be found in Table III.

The battery coefficients as determined by the Doolittle method showed the same trend. See Table IV. The coefficient, .78, of the three-test battery indicates that the Field and Throw, Double Play, and Shuttle Rebound tests together give a fair indication of general playing ability. It must be remembered, however, that the individual validity coefficients are introduced in the formula for the battery coefficient. Therefore, mediocre individual test validities would not produce an exceedingly high battery validity coefficient.

The three test and four test battery coefficients were very similar-- .78 for the three test battery and .79 for the four test battery. Since the addition of the Underhanded Accuracy test increases very little the validity coefficient, the three test battery, which

TABLE III

INTERCORRELATION COEFFICIENTS

1 Double Play
2 Field and Throw
3 Shuttle Rebound
4 Underhanded Accuracy

TESTS	R
12	.52
13	.49
14	.43
23	.52
24	.31
34	.34

includes the Double Play, Field and Throw, and Shuttle Rebound tests, would be the better battery to administer.

TABLE IV

MULTIPLE CORRELATION COEFFICIENTS

BATTERY	R
Battery I	.78
Double Play	
Field and Throw	
Shuttle Rebound	
Battery 2	.79
Double Play	
Field and Throw	
Shuttle Rebound	
Underhanded Accuracy	

CHAPTER V

SUMMARY AND CONCLUSIONS

The construction of a battery of softball skills tests to measure specific playing abilities was preceded by a semester's study of softball playing skills and methods of constructing educational measuring instruments. At the conclusion of this study, the important skills and abilities at each position- infield, outfield, pitcher, catcher- were selected and incorporated into tests which simulate a game situation. Eight tests were administered to a small group of high school girls, and from these eight, six were selected to be used during the final testing period. One hundred senior high school girls were given the six selected tests twice in testing periods one week apart. The Throw for Distance was also administered, the scores of which were used as the validity criterion. The data obtained were organized and validity, reliability, and multiple correlation coefficients obtained. On the basis of the analysis of the data, the following suggestions may be offered:

1. Test scores and reliability would be of greater value if the tests were administered to girls of intermediate or advanced skill level in softball.
2. Better results would be obtained if the tests were given after the subjects had had some review and practice in softball skills. This would also eliminate stiffness following the tests.
3. Subjective ratings of skill at specific positions would be helpful in determining validity of the tests

as measures of specific playing ability.

Conclusions

1. The Double Play and Shuttle Rebound are the best single tests having reliabilities of .84 and .85 (after Spearman-Brown correction) and validities of .57 and .72 respectively. Their intercorrelation, .49, indicates that they do not measure the same specific abilities.

2. The best battery as determined by the Doolittle method of multiple correlation consists of the Double Play, Field and Throw, and Shuttle Rebound tests. This battery gives a fair indication of general playing ability with a coefficient of .78.

3. The skill level of the subjects and the time of year at which the tests were administered were not conducive to the best test results.

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APPENDIX

DOUBLE PLAY

Equipment

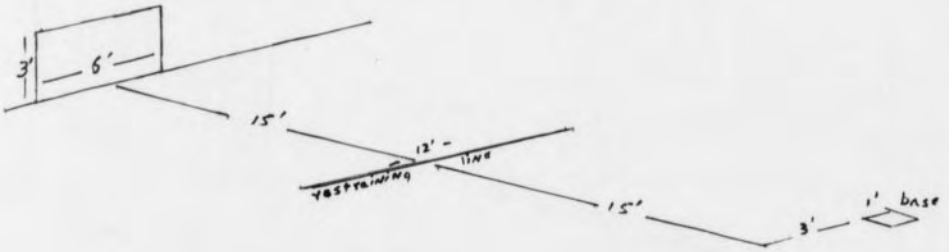
1. One indoor softball; wall space 3 feet by 6 feet; one stop watch.

2. Markings

(a) A target shall be outlined on the wall which is 3 feet wide and 6 feet long beginning at the floor and continuing upward.

(b) A box one foot square shall be outlined on the floor 30 feet from the wall so that the left side of the box is opposite the right side line of the wall target.

(c) A restraining line shall be placed on the floor 15 feet from the wall and parallel to the wall. This restraining line shall be 12 feet long, with the midpoint of this line opposite the midpoint of the wall target.



Test:

The subject stands with one foot on the base (box). On the signal, "Ready, Go," she throws the ball into the wall target area. She moves off the base, fields the ball behind the restraining line, returns to the base touching it with either foot and repeats the throw. Three trials, not in succession, are administered. For better reliability six trials should be administered.

Scoring:

The score is recorded as the number of seconds to the nearest tenth of the second required for the player to complete five successful throws. The watch is started on "Go" and is stopped when the player touches the base after fielding the fifth successful throw. In order for the throw to be successful it must strike the target area and be fielded behind the restraining line.

Three trials shall be given with time for rest between each trial.

UNDERHANDED ACCURACY

Equipment

1. One indoor softball; wall space 3 feet by 4 feet.

2. Markings

(a) A target shall be outlined on the wall 40 inches wide and 30 inches long, the lower boundary of which shall be 18 inches from the floor. A line parallel to the side line shall be drawn 8 inches from each line within the original rectangle.

(b) A line one foot in length shall be drawn on the floor 36 feet from the wall target so that the midpoint of the length of the wall target is opposite the midpoint of the floor line.

Test:

The subject stands with both feet on the starting line, the softball held in both hands in front of the body. She delivers an underhanded pitch to the target. She may take one step forward as she delivers the ball. She may use any legal windup. Thirty pitches are recommended for best results.

Scoring:

A total of ten pitches (30 for greater reliability) are given each player. If the ball strikes the outer rectangles, a score of

2 is recorded; hits in the center rectangle have a value of one point. A ball landing on the line is awarded the higher score. A score of 0 is recorded if the target is missed or if the subject takes an excessive number of steps.

SQUAT-STAND THROW

Equipment:

1. One indoor softball; wall space 4 feet by 6 feet; stopwatch.

2. Markings
   (a) A target shall be outlined on the wall which is 4 feet wide and 6 feet long beginning at the floor and continuing upward. A line 2 feet from the floor and parallel to the floor shall be drawn through the target area. A floor target 2 feet wide and 6 feet long is outlined adjacent to the wall target.

   (b) A line shall be drawn on the floor 55 feet from the center of the wall target.

Test:

The subject assumes a squatting position with at least one foot touching the floor line. The softball is in her non-throwing hand. On the signal, "Ready, Go," she comes to a stand, changes the ball to her throwing hand and throws to the wall-floor target. She may step forward to throw, and her feet do not have to remain in contact with the floor line. Three trials shall be administered; one practice is allowed. Nine trials will yield an improved reliability.

Scoring:

Throws striking the lower wall target and the floor target shall score 2 points; those landing in the upper wall target shall score 1 point. Time is recorded from the signal "Go" until the ball strikes the wall. Throws landing on the lines shall be awarded the higher score.

FIELD AND THROW

Equipment

1. One indoor softball; wall space 4 feet by 6 feet; one stop watch.

2. Markings

(a) A target shall be outlined on the wall which is 4 feet wide and 6 feet long beginning at the floor and continuing upward. A floor target 2 feet wide and 6 feet long is outlined adjacent to the wall target.

(b) An X shall be drawn on the floor 40 feet from the center of the wall target.

(c) A starting line 1 foot in length shall be drawn on the floor parallel to the wall and 55 feet from the midpoint of the outlined wall target.

Test:

The ball is placed on the X. At the signal, "Ready, Go" the subject runs from behind the starting line and picks up the ball with her non-throwing hand. She changes the ball to her throwing hand and throws overhanded at the target area. Three trials shall be administered; one practice trial shall be allowed. Nine trials are recommended for best results.

Scoring:

Three trials are given each player. They shall not be in succession. The score for each trial shall be the number of seconds to the nearest tenth of the second from the signal "Go" until the ball strikes the target. If the ball does not strike the target, the trial does not count.

SHUTTLE REBOUND

Equipment:

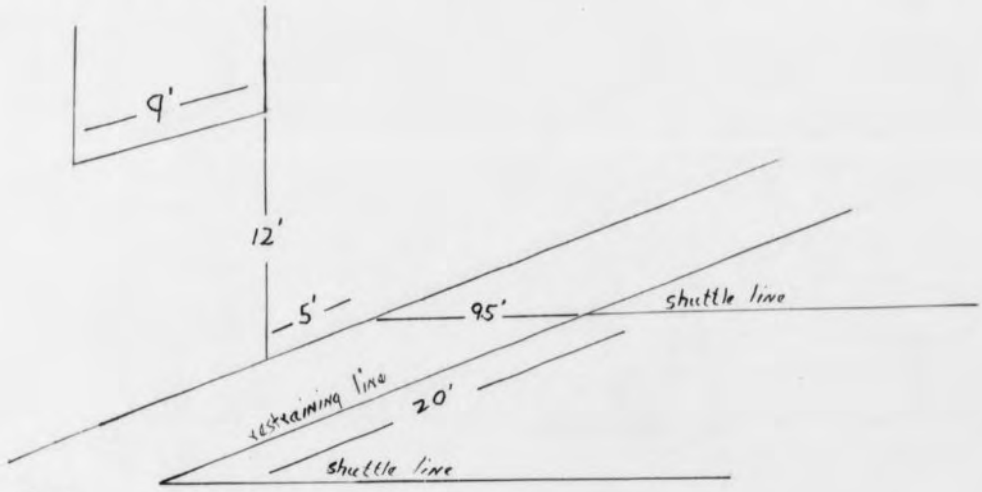
1. One indoor softball; 20 feet by 12 feet of wall space; stopwatch.

2. Markings

(a) A line parallel to the floor and 12 feet from the floor shall be drawn on the wall. Two lines 9 feet apart shall be outlined perpendicular to the 12 foot line and shall extend upward.

(b) A restraining line shall be outlined on the floor 9½ feet from the wall and parallel to the wall.

(c) Two shuttle lines 20 feet apart shall be drawn perpendicular to the restraining lines and shall extend away from the wall. The right shuttle line shall be five feet to the right of the right wall target line.



Test:

The subject starts behind the right shuttle line. On the signal, "Ready, Go," the subject throws the ball overhanded into the wall target and runs into the fielding area. The ball is caught on the fly. The subject then moves behind the left shuttle line and repeats her throw. She is timed for 20 seconds. Three trials are administered. Six trials, however, should be administered for better results.

Scoring

The score is counted as the number of completed catches made in 20 seconds. The ball must be thrown from behind the shuttle line and must be caught on the fly in order to count as good. The subject may not cross the restraining line to catch the ball.

WALL REBOUND

Equipment:

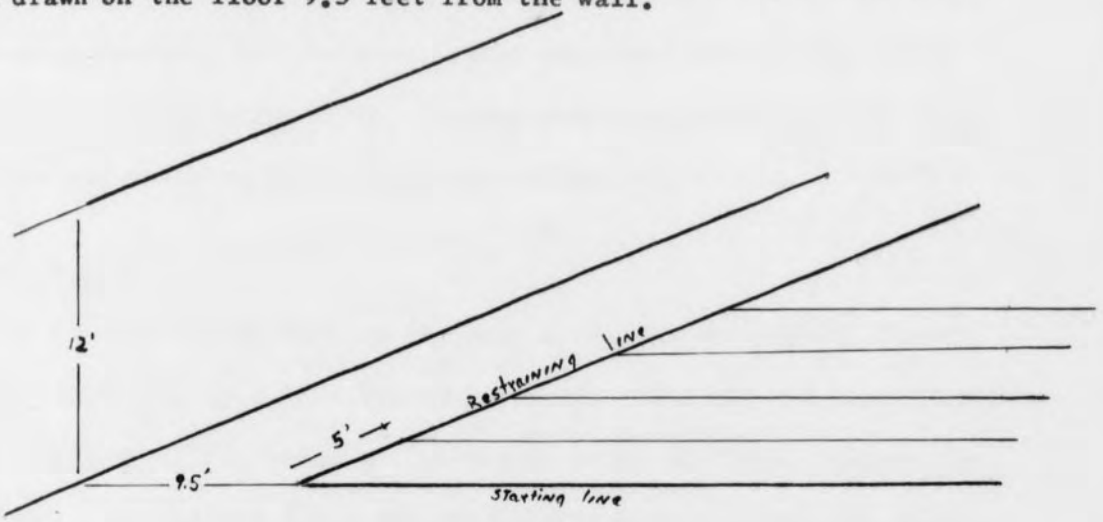
1. An indoor softball; wall space 10 feet by 20 feet.

2. Markings

(a) A line parallel to the floor and 12 feet from the floor shall be drawn on the wall.

(b) A starting line perpendicular to the wall at the left side of the wall target area shall be drawn on the floor beginning 9.5 feet from the wall. Lines parallel to the starting line shall be drawn at 5 foot intervals.

(c) A restraining line parallel to the wall target area shall be drawn on the floor 9.5 feet from the wall.



Test:

The subject stands behind the starting line. She throws the ball above the line on the wall and runs, behind the restraining line as far as possible before catching the ball on the fly. Five trials shall be administered; two practice trials shall be allowed. The administration of ten trials will produce more accurate scores.

Scoring:

The score is recorded, to the nearest foot, in distance covered from the starting line to the point at which the ball was caught on the fly. The player may not cross the restraining line to field the ball; should this happen, the trial shall not count.

TEST INSTRUCTIONS

Field and Throw

Stand behind the starting line. On the signal, "Ready, Go" run forward to the ball and pick it up with your non-throwing hand. Place the ball in your throwing hand and throw to the target on the wall. You may run forward after you have picked up the ball. Your score will be the time required from the signal "Go" until the ball strikes the target area. For that reason excessive running after picking up the ball may result in a poor score. Take enough time, however, to aim, for the trial shall not count if the ball fails to land in the target area. You may have one practice trial after which you shall be given three test trials.

Double Play

Stand with one foot on the base area. On the signal, "Ready, Go," throw the ball into the target area. Move off the base, field the ball as it rebounds, and return to touch the base. Repeat the throw. You may not cross the restraining line to field the ball. Your score will be the time required to complete five successful throws and catches. The watch will be stopped when you touch the base after fielding the fifth successful throw. A throw must land in the target area in order to be considered successful.

Underhanded Accuracy

Stand with both feet touching the starting line. Hold the softball in both hands in front of your body. Deliver an underhanded

pitch at the target on the wall in front of you. You may take one step forward with either foot as you pitch the ball. The two outer rectangles score 2 points; the inner rectangle, one point. But remember--a trial does not count if the target is not hit. A ball on the line receives the higher score. You will have a total of ten pitches.

Squat-Stand Throw

Assume a squatting position with at least one foot touching the line on the floor. Hold the softball in your non-throwing hand. On the signal "Ready, Go," come to a standing position, change the softball to the throwing hand, and throw the ball overhanded at the target. A score of two points will be recorded if the ball strikes the lower wall target or the floor target. A score of one point is recorded if the ball strikes the upper wall target. Your foot does not have to remain in contact with the line as you throw the ball; that is simply the starting point.

Wall Rebound

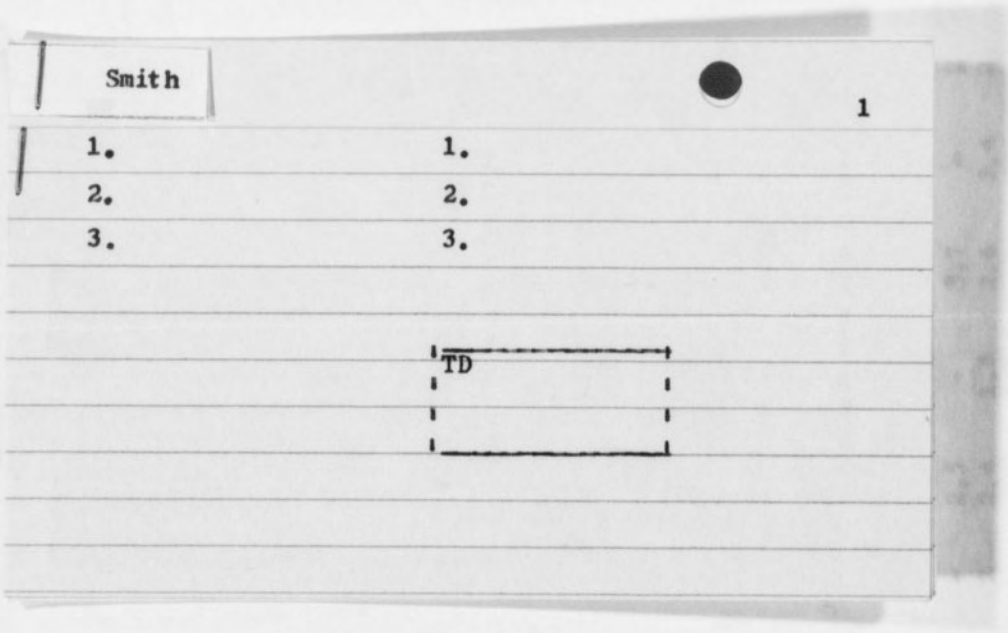
Stand behind the restraining and starting lines. Throw the ball overhanded above the line on the wall, and run forward to catch the rebound before the ball touches the floor. Score will be recorded as the distance, in feet, covered before the ball is caught. You must remain behind the restraining line at all times.

Shuttle Rebound

Stand behind the right shuttle line. On the signal, "Ready, Go," throw the ball into the wall target, cross the shuttle line

and catch the ball on the fly as it rebounds from the wall. Move to the opposite shuttle line and repeat. You may not cross the shuttle line until the ball is thrown; neither may you cross the restraining line to catch the ball. The ball may be caught only on the fly; otherwise the throw shall not count. Your score shall be the number of catches made in 20 seconds. The ball must strike the wall target area (lines included) in order to be counted.

SCORE CARD



MASTER SCORE SHEET

Subject	Double Play		Und. Acc. score				Squat-stand time		F.T.		Shuttle best		Rebound total		Wall Reb.		Throw for Distance
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1	30.7	25.1	6	4	0	0	1.5	2.0	3.4	3.2	1	1	2	1	15	16	80
2	20.7	-	4	-	0	-	2.0	-	3.2	-	0	-	0	-	0	-	77
3	45.6	23.4	3	7	3	4	1.5	2.2	3.3	3.2	2	6	2	11	18	0	69
4	23.0	-	7	-	0	-	3.5	-	3.0	-	1	-	3	-	10	-	101
5	31.6	28.8	2	4	5	3	2.0	1.5	3.0	3.5	0	0	0	0	14	15	70
								1.8									
6	25.0	24.6	4	6	2	4	2.1	2.0	3.3	3.5	1	6	2	11	12	16	68
							2.4										
7	27.2	21.6	8	6	2	2	2.0	2.1	3.8	4.0	0	0	0	0	0	0	50
							2.5	2.5									
8	36.2	21.5	0	4	4	3	2.0	2.2	3.6	4.3	2	2	5	4	12	16	60
							2.5	2.5									
9	34.2	29.0	4	4	0	0	1.5	1.8	3.8	3.8	1	0	1	0	0	0	57
10	35.5	28.0	4	6	6	1	2.0	2.0	4.4	3.9	1	0	1	0	0	0	69
11	26.0	19.0	2	7	0	0	2.2	1.8	3.8	3.7	3	2	5	4	13	11	60
12	31.9	29.3	2	5	4	0	1.2	1.5	3.2	3.9	0	2	0	2	0	0	71
13	49.1	25.1	2	3	0	0	2.2	2.2	4.3	4.6	0	0	0	0	0	15	42
14	30.4	29.2	3	4	0	0	2.0	1.9	3.7	4.0	0	1	0	1	0	0	40
15	40.6	29.9	2	2	0	0	2.0	1.5	4.0	4.0	1	2	1	4	10	14	59
16	36.2	30.2	8	7	2	2	2.0	2.0	4.0	3.6	0	2	0	3	13	0	65
								2.5									
17	81.9	45.3	5	3	0	0	2.0	2.2	3.0	3.9	1	0	1	0	0	0	45
18	20.3	23.0	10	7	0	4	1.9	2.0	3.1	3.6	5	7	10	15	14	10	83
19	22.1	27.9	6	7	2	0	2.0	1.5	3.0	3.3	1	2	1	4	0	0	60
20	22.6	27.2	7	11	2	0	2.3	2.2	3.6	3.5	4	5	8	10	18	18	98
							2.4										
21	27.3	23.8	14	9	4	3	2.0	2.0	3.3	3.8	3	5	6	11	0	20	94
							2.2										
22	26.4	-	8	-	0	-	2.5	-	3.7	-	2	-	2	-	16	-	75
23	18.2	23.4	2	1	0	2	2.4	1.5	2.6	3.4	2	3	2	9	16	0	93
								2.0									
24	23.1	32.2	1	9	0	2	1.7	2.0	3.8	3.2	2	3	5	5	14	12	45

Subject	Double Play		Und. Acc.		Squat-stand score		Squat-stand time		F.T.		Shuttle Rebound best		Shuttle Rebound total		Wall Reb.		Throw for Distance
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
25	28.2	18.0	13	9	2	1	1.8	2.0	3.2	3.5	1	5	1	8	18	12	78
26	26.5	25.8	0	4	2	3	2.0 2.2	1.8	3.8	4.2	1	2	1	6	0	12	85
27	26.4	21.4	2	2	0	4	2.3	2.2	4.0	3.9	2	3	5	6	0	11	60
28	21.4	24.5	2	6	0	4	2.0	2.0 2.5	3.8	3.7	2	5	4	7	0	20	71
29	27.2	19.8	7	7	4	1	2.0 2.2	1.8 2.0	3.4	3.6	0	3	0	7	0	12	72
30	25.4	20.8	9	8	0	2	2.1	2.0 2.5	3.3	3.3	3	4	5	10	20	16	115
31	28.1	25.2	3	5	6	0	2.0	1.9	3.6	4.0	1	2	1	4	0	0	76
32	32.1	29.8	5	2	0	0	2.0	2.0	3.6	4.1	1	2	1	2	0	0	55
33	26.3	19.6	4	5	0	0	2.1	2.1	3.2	3.1	5	4	12	12	15	17	91
34	72.7	32.2	4	3	0	0	3.0	1.7	4.0	4.3	0	0	0	0	0	0	38
35	25.5	21.2	4	8	0	4	3.0	1.7	3.5	4.0	1	4	1	10	0	10	73
36	23.5	22.9	9	8	0	3	2.0	1.9	2.8	3.6	4	8	11	14	17	17	96
37	h	h	0	2	0	0	1.7	1.2	-	-	0	0	0	0	0	0	31
38	22.1	20.1	3	9	0	1	2.0	1.7 2.5	3.5	3.3	3	6	8	12	16	15	80
39	26.4	28.0	5	7	4	4	2.1	2.1	3.2	3.9	1	3	2	5	14	14	82
40	42.6	23.2	8	6	0	0	2.0	1.5	-	-	1	0	1	0	13	0	49
41	32.3	26.2	2	3	0	0	1.5	2.0	4.3	-	1	1	2	1	0	0	55
42	20.6	20.4	5	7	0	3	2.0	2.0 2.1	3.4	3.0	6	4	15	11	18	18	80
43	35.2	22.2	3	4	0	0	2.0	1.7	3.5	3.5	2	2	2	3	17	17	54
44	31.5	30.9	0	6	0	0	2.5	2.9	4.0	4.0	0	1	0	1	0	0	46
45	22.2	22.5	4	8	2	2	1.5 2.0	2.3 2.5	3.5	3.5	2	3	5	7	0	20	102
46	20.7	21.6	5	6	0	0	1.8	2.6	3.5	3.4	0	1	0	2	0	15	62
47	21.1	21.3	4	9	3	3	1.8	2.2 2.4	3.5	3.4	3	6	7	15	15	14	103
48	31.6	32.0	1	4	0	2	2.0	2.3	4.0	3.5	2	2	3	3	0	13	58
49	33.3	30.9	7	4	2	4	2.2 2.7	2.0	3.0	3.1	3	4	4	7	16	17	84
50	24.3	20.4	9	8	2	2	1.8 2.0	1.8	3.0	2.8	2	2	4	4	17	18	91

Subject	Double Play		Und. Acc.		Squat-stand score		Squat-stand time		F.T.		Shuttle Rebound best		Shuttle Rebound total		Wall Reb.		Throw for Distance
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
51	47.3	44.0	6	5	0	0	2.5	2.6	3.5	3.6	1	1	2	1	0	14	53
52	34.4	36.0	2	4	0	2	2.2	2.0 2.2	3.6	3.3	5	6	9	11	15	15	77
53	24.2	23.9	3	4	4	2	2.0	1.8	3.8	3.5	2	3	3	5	14	15	59
54	20.0	19.2	9	7	0	0	2.2	2.5	3.1	3.1	1	1	1	0	0	16	63
55	23.6	23.6	9	11	0	4	2.5	2.0	3.3	3.1	4	5	7	14	12	15	90
56	25.2	20.7	2	6	0	0	2.0	2.3	3.7	3.3	1	4	2	10	0	16	107
57	38.2	32.2	7	5	0	4	2.8	2.5	3.8	-	0	2	0	2	13	14	48
58	32.4	35.5	4	2	0	0	2.5	2.6	3.7	3.8	3	2	6	2	17	0	55
59	35.0	24.2	2	5	0	0	3.0	2.5	3.6	3.5	2	2	3	3	0	14	60
60	28.4	25.0	4	6	2	2	1.7	1.4	3.4	3.0	1	3	1	6	0	17	101
61	26.2	24.3	7	9	0	0	2.1	2.0	3.9	4.1	0	1	0	1	0	0	50
62	26.4	22.1	3	1	4	0	2.2	2.1	3.5	3.1	2	2	4	5	15	16	55
63	35.8	36.2	4	4	0	0	3.0	3.0	3.9	3.7	2	2	2	2	10	10	48
64	31.2	32.8	2	5	0	0	2.7	2.9	4.2	3.9	0	1	0	1	0	0	62
65	21.6	16.5	4	5	2	2	2.1	1.9	3.0	3.0	2	4	6	10	19	15	85
66	18.1	17.8	8	9	3	3	2.1	1.8	2.8	2.5	4	5	10	10	17	16	129
67	28.6	21.5	4	7	0	3	2.2	1.8	3.8	3.2	2	4	5	8	0	17	73
68	28.8	20.3	7	8	4	0	2.1	2.0	3.6	3.3	3	3	5	9	18	17	72
69	16.9	15.7	3	5	2	1	1.9 2.2	2.0	3.2	3.1	2	6	3	15	17	18	103
70	21.1	20.9	4	4	3	0	2.1	2.0	3.4	3.4	4	6	6	10	16	16	87
71	32.5	30.0	0	2	-	-	-	-	3.3	3.2	0	0	0	0	0	0	45
72	29.5	17.5	4	6	5	0	2.0	2.3	3.0	3.1	5	7	9	16	12	17	78
73	14.2	15.6	7	9	2	4	1.9 2.2	1.7	3.0	3.0	6	8	13	20	19	18	120
74	15.2	20.0	11	10	2	4	2.2 2.4	2.2	3.1	3.0	8	6	15	15	16	18	100
75	17.5	22.3	7	8	1	3	2.0	1.9	3.1	3.1	4	5	9	9	15	16	105
76	28.0	27.2	0	2	2	0	2.2	2.0	3.5	4.2	1	3	1	5	0	16	54
77	24.2	19.4	6	9	4	4	1.9	1.8	3.2	3.0	6	8	17	17	15	16	140
78	24.5	22.0	5	7	1	3	2.5	2.0	3.7	3.5	0	1	0	1	0	0	63
79	20.8	17.5	9	9	4	3	2.3	2.1	3.4	3.3	5	3	9	5	14	15	112
80	21.6	20.8	3	2	4	1	2.3	2.3 2.5	3.4	3.5	3	4	5	6	0	12	75

Subject	Double Play		Und. Acc.		Squat-stand score		Squat-stand time		F.T.		Shuttle Rebound best		Shuttle Rebound total		Wall Reb.		Throw for Distance
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
81	29.9	31.7	0	1	0	2	1.9	1.8	3.1	2.6	4	5	7	10	0	16	82
82	27.3	31.8	5	10	4	0	2.8	2.8	3.0	4.0	4	6	6	11	0	16	70
83	33.2	32.6	8	9	0	2	2.0	2.1	3.8	3.3	3	4	5	12	18	15	59
84	31.5	27.8	8	11	2	4	1.7	2.4	3.5	3.7	6	6	13	11	12	17	110
85	26.9	28.2	3	6	0	0	2.0	2.3	3.8	3.9	0	0	0	0	0	0	66
86	26.4	23.3	6	4	0	4	2.0	1.9	3.5	3.4	3	4	7	11	12	17	76
87	21.7	23.4	6	7	3	2	2.0 2.2	2.6	3.9	4.1	3	1	6	1	0	15	55
88	35.7	28.3	2	6	6	2	2.2	2.3 2.8	3.8	3.7	1	2	1	3	0	16	58
89	43.3	33.9	3	2	0	0	2.0	2.0	h	4.2	2	2	4	3	0	15	61
90	48.5	32.0	5	4	0	0	2.0	2.0	3.6	h	0	1	0	1	0	0	47
91	39.6	28.8	6	3	5	4	2.5	2.5	3.3	3.4	2	2	2	3	0	16	76
92	43.1	42.0	2	5	0	0	1.6	1.9	-	4.2	0	2	0	3	0	0	45
93	21.9	26.4	7	8	2	2	1.9	2.0 2.1	3.0	3.1	3	2	8	4	10	20	84
94	17.9	19.8	6	6	2	4	1.8	2.0 2.1	3.3	3.7	7	5	17	11	11	16	84
95	23.9	-	8	-	2	-	-	2.0	3.6	-	6	-	15	-	14	-	87
96	22.8	19.2	4	3	2	4	2.0	2.0	3.6	3.1	3	7	9	15	0	16	79
97	22.9	23.8	11	4	2	1	2.2 2.5	2.5 2.9	3.5	3.6	1	3	1	9	13	9	75
98	21.7	-	5	-	1	-	2.2 2.7	-	3.7	-	3	-	7	-	13	-	90
99	35.0	28.6	7	9	2	2	2.2	2.4 2.5	3.2	3.5	2	1	4	1	12	10	60
100	30.2	-	6	-	0	-	2.0	-	3.5	-	0	-	0	-	0	-	-

Und. Acc. - Underhanded Accuracy
F.T. - Field and Throw
Wall Reb. - Wall Rebound
h - to be included as highest class score

When two times are listed, the first is the fastest throw, the second is the time of the throw which hit the target. (Squat-stand test)