A STUDY OF UNSELECTED BEGINNING TENNIS PLAYERS WITH RESPECT TO INTELLIGENCE, MOTOR EDUCABILITY, FUNDAMENTAL SKILLS, AND KNOWLEDGE OF THE GAME, WITH IMPLICATIONS OF THESE FACTORS FOR MORE OBJECTIVE GRADING

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN HEALTH AND PHYSICAL EDUCATION IN THE GRADUATE DIVISION OF THE TEXAS STATE COLLEGE FOR WOMEN

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CHAPTER I

ORIENTATION TO THE STUDY

Introduction

The game of tennis was first introduced into the United States by Mary Outerbridge in 1875.[1] At the time of its introduction, the popularity of tennis in America was somewhat limited in appeal due to the traditions that associated tennis in England primarily with the leisure class. Also, the expense of court and equipment in those days, with limitation to small numbers who could participate at one time, made the game prohibitive for the general populace. With emphasis upon leisure time activities, tennis has steadily increased in popularity for both sexes and particularly for women and girls. Tennis as a recreation has been stimulated by universal appeal and fascination for the game and by its adaptability to all ages. Tennis as a sport has flourished under the stimulus of friendly competition. This popularity of tennis both as wholesome recreation and as a competitive sport has motivated considerable research concerning the scientific measurement of skill and information in tennis. The growth of scientific measurement in skill and information has been a rather slow process. It is only within the last few years that individuals in the field of physical education have felt a need for objective measurement in tennis. This need has been brought about by the emphasis on tennis in the educational curriculum of schools, colleges, and universities. With tennis included as a subject in the curriculum, instructors have been re-

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[1]Helen Driver, Tennis for Teachers (Philadelphia: W. B. Saunders Co., 1936), p. 23.

quired to give their students a grade or mark to be applied toward promotion and graduation. In order to award marks conscientiously in tennis, instructors have felt the need of an objective basis for awarding marks with reference to skill developed and information acquired. With the realization that there has been no scientific objective measurement of tennis information for beginners in tennis, the investigator chose this field of tennis for a study of various factors which might lead to such objective measurement.

Purpose of the Study

This study has been undertaken in an effort to compare intelligence, motor educability, skill, and knowledge in the game of tennis for beginners only, and to evaluate these specific factors for purposes of awarding marks to students in beginning tennis classes. It seeks specifically:

1. To determine whether there is a correlation between the tennis skill test and the tennis information test used in this study.

2. To determine whether there is a correlation between the tennis skill test and the intelligence test.

3. To determine whether there is a correlation between the tennis skill test and the motor educability test.

4. To determine whether there is a correlation between the intelligence test and the motor educability test.

5. To determine whether there is a correlation between the intelligence test and the information test.

6. To determine whether there is a correlation between the information test and the motor educability test.

On the basis of these findings, suggestions will be made for a more objective grading of beginning tennis players.

Survey of Previous Studies

Several investigators have reported studies comparable to the present one in that they employed information and skill tests in an attempt to measure performance in various specific sports.

In 1917, Reilly used a test of tennis serving which was included in his Standards of Achievements for Girls.[1] Reilly did not use the actual court situation. Two strips of cloth, one 8 feet by 18 inches and the other 8 feet by 12 inches, were attached one above the other on the wall. Individuals stood from 27 to 39 feet from the base of the wall, serving five balls against the wall. The individuals received five points for each ball that hit upon the lower strip and three points for each ball hitting the upper strip.

Hetherington was responsible for setting up the California Decathlon Achievement Test in 1918.[2] These achievement scales included a tennis serving test. Ten balls were served into the correct service court and the score was noted in terms of the number of good balls thus served. The test was included in the Elementary[3] and High School[4] Decathlon Chart. The score made on

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[1]John F. Bovard and Frederick W. Cozens, Tests and Measurements in Physical Education (Philadelphia: W. B. Saunders Co., 1938), pp. 119-120, 394.

[2]John F. Bovard and Frederick W. Cozens, Tests and Measurements in Physical Education (Philadelphia: W. B. Saunders Co., 1931), pp. 94-98.

[3]Ibid., Appendix, Table XLVII.

[4]Ibid., Appendix, Table XLVIII.

the tennis test was incorporated with scores made on the other nine events of the achievement test to yield a final composite score. The California Achievement Test has had wide recognition and use.[1]

Beall was one of the first persons to devise tests for measuring tennis ability.[2] She set up the following objectives: (1) to determine the essential physical and mental qualities necessary to become a good tennis player, (2) to devise means of measuring these essential qualities, (3) to determine before instruction and after instruction the degree to which individuals possess these essential qualities, and (4) to determine the relative value of the tests given. The tests were given to 174 students enrolled in beginning tennis classes at the University of California. Nine tests were given; they were first administered during the two weeks immediately following the beginning of Physical Education classes, and administered a second time after various periods of instruction. Those parts of Beall's study of particular interest with reference to this study are the tests measuring ability to execute the serve, the forehand drive, the backhand drive, and motor ability in terms of speed of arm and foot. In the serving test, the subject served ten balls to each of the right and left hand service courts respectively. A score of one point was awarded for each serve correctly placed. The forehand

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[1]Bovard and Cozens, op. cit., p. 94.

[2]Elizabeth Beall, "Essential Qualities in Certain Aspects of Physical Education with Ways and Means of Measuring and Developing the Same," American Physical Education Review, June to December, 1928.

and backhand test consisted of bouncing and driving ten successive balls into the backcourt area. One point was allowed for each ball accurately placed, making the total possible score ten for the forehand drive and ten for the backhand drive. In measuring speed of arm, Beall used a target with three holes bored 15 inches apart to form a triangle. The subject, using a fencing foil, tried to make ten thrusts through the holes as rapidly as possible. Time was taken from the starting signal to the last thrust. Speed of foot was measured by having the subject run for a distance of 25 yards around the lines of the tennis court. Time was recorded from the starting whistle to the time the runner crossed the finish line. From her experiment, Beall concludes that the tests for agility were not successfully measured by the tests employed, but that the tests devised for the forehand drive, backhand drive, and serve are important elements to be evaluated for measuring tennis ability. Beall suggests a repetition of the three tests (forehand, backhand, and serve) as a means of measuring improvement in the test elements. She based this suggestion upon the computation of mean differences between scores received on the first test and scores received on the re-test. Beall made no attempt to establish the reliability or the validity of her test.

The Playground and Recreation Association, now known as the National Recreation Association, was probably the first organization to incorporate a tennis test in a battery of tests

for measuring athletic prowess.[1] The association realized the inadequate facilities for promoting sports, and felt the need of standardized tests which might be used in any situation. Three sets of tests, for measuring various activities, were devided to be used for both boys and girls. A tennis test was included in each of the three tests for girls. In the first test, the subject was allowed six trials to serve three good balls into the correct court. The second test allowed the subject five trials, and in the third test, the subject was required to make three good serves with only four trials. These tennis tests were not standardized and no attempt was made to establish their validity or reliability.

Heath and Rodgers designed and developed tests for play-ground baseball[2] and soccer.[3] They have given their tests over a period of five years in two entirely different sections of the country. Definite knowledge and skill tests were developed to be used in actual teaching situations. These tests can be used easily from the standpoint of facilities, equipment, time, and administrative economy.

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[1]Department of Interior, Athletic Badge Tests for Boys and Girls, Prepared for the Office of Education by the National Recreation Association (Washington: United States Government Printing Office, 1931), pp. 1-19.

[2]Marjorie Heath and Elizabeth Rodgers, "An Experiment in Playground Baseball," Research Quarterly American Association for Health and Physical Education, December 1, 1931, pp. 113-131.

[3]Marjorie Heath and Elizabeth Rodgers, "A Study in the Use of Knowledge and Skill Tests in Soccer," Research Quarterly American Association for Health and Physical Education, December, 1932, pp. 33-54.

The tests developed by Heath and Rodgers have a practical value in that they may be used as a basis for more objective marks in physical education. In order that scores on the separate tests might be in comparable units, the raw scores on each item of the skill test were transposed into T-scores. Heath and Rodgers provide tables whereby any individual using their tests may easily convert raw scores into T-scale scores. A graph was made of the T-scale scores for each class. By this means a pupil can judge his grade in relations to the grades of his classmates.

In the field of basketball, a study of ability and progress was made by Edgren.[1] This experiment was an attempt to develop and use some tests and measurements in the field of motor ability and in the specific activity of basketball. The three types of tests used were: (a) eight tests of specific ability in basketball skill, (b) four tests of general athletic ability, and (c) The Brace Motor Ability Test of Neuro-Muscular Co-ordination. Two groups of students were used: an experimental group consisting of 30 beginners in basketball, and a control group including 30 members of varied basketball ability. The basketball, general ability, and Brace tests were given to both groups at the beginning of the school year and again two months later, in order to determine whether or not progress had been made in motor skill. The raw scores of each test were reduced to T-scale scores to make all scores comparable and to rate each student's ability

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[1]H. D. Edgren, "An Experiment in Testing of Ability and Progress in Basketball," Research Quarterly American Association of Health and Physical Education, March, 1932, pp. 159-172.

more accurately in relation to that of other students. This is an excellent report which shows definitely that progress in basketball fundamentals can be measured. The experiment indicates a fairly high correlation of .77 between basketball and general athletic ability which implies a fairly close relationship in terms of the measures employed by this investigator. When Edgren correlated improvement scores in basketball with improvement scores on the general athletic ability test; he found a low correlation. Edgren concludes from this low correlation that learned skills in one activity do not carry over in the same amount to another skill. This conclusion, as stated by Edgren, may not be entirely sound. With concrete drill, a normal individual might be expected to improve his score on basketball fundamentals. On the other hand, perhaps, he might not improve his score on a general athletic ability test without specific drill directed toward that end.

Edgren has made a more recent study of ability and progress of tennis players.[1] In this report Edgren makes definite suggestions to beginners, to the average player, and to the superior player. He also suggests that the objective testing of individuals in any activity is a means of ascertaining their present ability and might be used to measure their progress over a given period. To substantiate this theory Edgren constructed tests for the purpose of measuring the efficiency with which a player could place a ball in a designated spot on a tennis court. The following tests were suggested as a means of testing the

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[1]H. D. Edgren, "Tennis Technique," Journal of Health and Physical Education, May, 1934, pp. 30-31, 56.

ability and progress of any tennis player: serve, stroking with forehand and backhand, rallying, and volleying. Edgren draws no definite conclusions concerning the tests as to their reliability or validity, nor does he subject the tests results to any statistical treatment.

Murphy constructed a golf information test with criteria for judging the test and the use of the test in grading.[1] The test items were selected on a basis of frequency of "use," analyzed from six textbooks and twelve articles on the subject. The test was given to 89 young women and repeated for the same group 6-1/3 weeks later. The reliability coefficients of .86 and .76 were found by self-correlation of the whole test and half-test. Murphy then gave the golf knowledge test to 408 young women. Of the 408 women, 300 scores of Thurston's "Psychological Examination for College Freshmen and High School Seniors" were available. The correlation coefficient between the golf information test and the Psychological Examination was found to be .45. Murphy developed regression equations from which she attempted to predict probable golf scores of an individual from scores on the Psychological Examination. The low correlation found between these two measures does not seem to warrant prediction of individual scores in this manner.

Mynard reports an interesting study in which a preliminary analysis of the game of tennis was made, and the reliability of certain skill test and practice board areas for the serve

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[1]Agnes Murphy, "Criteria for Judging a Golf Knowledge Test," Research Quarterly American Association for Health and Physical Education, December, 1933, pp. 81-89.

and drive was determined.[1] Mynard used 25 subjects to establish the reliability of the serving test, drop-bounce forehand, and drop-bounce backhand. These three tests were given at the beginning and end of the semester. The three tests were considered to be fairly reliable as the coefficient for each test was .756, .842, and .713 respectively. These tests might be used for group classification, but would not be satisfactory for individual diagnosis due to the small number of students tested.

In an attempt to construct a more objective skill test Mynard devised a ball-throwing machine. This machine was used to test the forehand drive, the backhand drive, and the smash. Mynard advises against the use of the machine because the reliability coefficients were very low when the results were correlated with those of other skill tests.[2] When this machine is perfected so that it will throw accurately and yield reliable results, it will approximate more nearly the game situation than tests using the drop-bounce type of skill test.

Another phase of Mynard's work consisted in the determination of areas for the tennis serve and drive for use on a practice board. Sixty individuals were chosen as subjects. The subjects stood behind the base line serving and hitting balls across the net. Examiners observed the height of each ball as it came over the net in an effort to approximate the mean height of all balls hit by each subject. This very subjective judgment was used in estimating the height of the area to be placed on

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[1]Virginia Mynard, "A Preliminary Analysis of the Game of Tennis, the Reliability of Certain Tennis Skill Tests, and the Determination of Practice Board Areas for Serve and Drive," Unpublished Master's Thesis, Graduate School, Department of Hygiene and Physical Education, Wellesley College, 1933.

[2]Ibid., p. 28.

the practice board. To determine the width of the rectangular area to be placed on the practice board ten more balls were hit by each individual. Examiners estimated the mean width for all balls. After the mean heights and widths were thus determined by examiners, the areas for the tennis serve and drive were accomplished by means of scale drawings. In correlating the serve and drive on the practice board with the skill test, the reliability coefficients were found to be .769 and .837 respectively. Complete dependence cannot be placed on these results as only sixteen subjects were used. Mynard's study as a whole was very interesting and worthwhile. It would be interesting to correlate scores on Mynard's practice board with scores made on Dyer's Backboard Test in order to determine the relationship between the two tests and to determine if they are measuring the same factors.

Cutts' study was a continuation of the work begun by Mynard in 1933.[1] She attempted to provide further material upon which achievement tests in tennis might be based. Cutts attempted to establish a standardized classification and achievement test for college women. The tests used in her battery were the serve, the forehand rally, the backhand rally, and the forehand-backhand rally. All four of these tests were arranged for the backboard. All tests except the serve were a modification of the Dyer Test. The serve was measured in terms of accuracy of aim at a service board target. This target was designed to represent the vertical area above the net through which most

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[1]Jeannette Cutts, "A Practice Board Test of the Fundamental Strokes of Tennis," Unpublished Master's Thesis, Graduate School, Department of Hygiene and Physical Education, Wellesley College, 1935.

balls must pass if they land inside the service court. The scores in the other three tests depended both on accuracy of placement on the practice board and on speed with which the ball was handled. All tests were given twice with one week elapsing between the re-tests. These tests were objective as to scoring, time, equipment, and administration. To establish reliability of the practice board tests, each test was correlated with the re-test. The reliability coefficients of the battery as a whole ranged from .687 to .796. Cutts felt the need of correlating the scores made on the battery with actual tennis ability in a game. The criterion of tennis ability used by Cutts was the number of points won out of 36 points played against a steady "standard" player. The serve was alternated between the standard player and the subject every three points. This method of using a "standard" is not conducive to reliability. The presence of another individual as an opponent, however "steady", means the introduction of a human variable into the test situation. The tennis ability scores were correlated with scores on the serve, forehand, backhand, and forehand-backhand rally. The coefficients of correlation ranged from .471 to .616. Cutts concluded that the forehand-backhand rally made the largest contribution to tennis playing ability.

Under the direction of Snell, Physical Education Knowledge Tests were prepared by the University of Minnesota to be used as pre-tests for classifying students on entering the University, and as post-tests for the same students at the end of the term.[1] The tests included ten different sport activities

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[1]Catherine Snell, "Physical Education Knowledge Tests Developed by the Department of Physical Education for Women, University of Minnesota, "Research Quarterly of American Association for Health and Physical Education, October, 1935, pp. 78-94.

with 45 questions covering each activity plus 85 questions tapping information in hygiene. These tests were of a general nature ranging in degree of difficulty to tap information possessed by advanced as well as by beginning students. A test for tennis was included in this group of ten information tests. The test scores were computed and manipulated for determination of reliability and validity by the Department of Physical Education for Women at the University of Minnesota. Expert opinion was the criterion used as the basis for establishing validity. The correlation of change halves was computed to determine the reliability coefficient for half the examination. The "Spearman Brown Prophecy Formula" was used to find reliability coefficients for the whole examination. The reliability coefficient for the whole tennis test was .6551 ± .0991.

Hewitt spent five years gathering material for a comprehensive tennis knowledge test.[1] He hoped to have his test serve a four-fold purpose: (1) to diagnose students' knowledge in tennis, (2) to ascertain the degree of student improvement in such knowledge, (3) to classify students, as a result of knowledge scores, into three instructional units--beginner, intermediate, and advanced, and (4) to serve as an objective grading device. Four hundred and five students were tested. Hewitt's original test of 200 items was given at the beginning of the term and again eleven weeks later. By comparing the scores made by students at the start of the term and after the eleven-week

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[1]Jack E. Hewitt, "Comprehensive Tennis Knowledge Test," Research Quarterly of American Association for Health and Physical Education, October, 1937, pp. 74-85.

period of instruction, Hewitt found an appreciable improvement of mean scores. Reliability of the knowledge test was found by correlating the odd and even items of the test. The correlation resulted in .900 raised to .947 by application of the Spearman-Brown prophecy formula. The Hewitt test, when correlated with the Minnesota Tennis Knowledge Test, yielded a coefficient of .808 ± .084. This correlation coefficient is high enough to suggest that the two tests are measuring equivalent factors.

Knowledge scores on the Hewitt Test were correlated with the number of year's experience each student had had in playing tennis. A correlation of .656 ± .053 was found for the group of 54 students so tested. As a means of securing more accurate data than approximate number of years playing experience, the same 54 students were given the Dyer Backboard Tennis Test. Pearson's Product Moment r yielded a correlation coefficient of .939 ± .080. From the foregoing data Hewitt concludes that his knowledge test scores may be used to classify individuals roughly at the beginning of the term into three instructional groups -- beginners, intermediates, and advanced.

The preceding studies are valuable as points of reference for this study only as their results may be compared with results found in this study of beginning tennis players. No one of these studies supplies answers to the problems with which this investigation is concerned. The present study has been undertaken in an effort to compare intelligence, motor educability, skill, and knowledge in the game of tennis for beginners only, and to evaluate these factors for purposes of awarding marks for students enrolled in beginning tennis classes. Tests covering the above factors were administered to 175 women enrolled in beginning tennis classes in three colleges in various sections of the state of Texas.

CHAPTER II

DESCRIPTION OF TESTS, THEIR ADMINISTRATION, AND TREATMENT OF DATA

The Intelligence Test

A. Criteria for the Selection of the Test

In selecting an intelligence test for this study, it was necessary to select a group test for purposes of economical administration. In considering intelligence tests of this type, these fundamental criteria were kept in mind:[1]

1. The test should be valid. Validity is the degree to which a test measures exactly what it purports or claims to measure. In determining the validity of a test, we must have some measure with which to compare the test, such as correlation with a previously validated test or by the use of rating scales.
2. The test should be accurate. A test is accurate when the units of measure are equal at all points of the scale.
3. The test should be reliable. A test is said to be reliable when two applications of the test or equivalent forms of the test to the same student result in identical scores. Perfect reliability in all cases is practically impossible, so charts have been developed that provide limits within which are found significant results.
4. The test should be objective. A test is objective

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[1] William A. McCall, How to Experiment in Education (New York: MacMillan Co., 1930), pp. 82-83.

when two or more examiners using equivalent tests on the same individual, secure identical scores. Objectivity of a test is a contributing factor to the reliability of a test.

5. The test should provide norms. A test has satisfactory norms when an adequate group has been sampled plus a sufficient number of cases to reduce the standard error of estimate to a negligible quantity.
6. The test administered should be economical of funds, time of the examiner, and time of the pupil.

The Otis Self-administering Test, Higher Examination, Form D, was chosen above all other intelligence tests as an instrument with which to measure the intelligence of beginning tennis players. It was chosen because it satisfactorily fulfilled the criteria in the following manner:

1. The Otis Intelligence Test is considered to be a valid test. The Otis Test has been widely used and thoroughly standardized. The Higher Examination, Form D, used in this study was validated with the Advanced Examination, yielding a correlation coefficient of .889.[1] The average of four coefficients of correlation between the Higher and Intermediate Examinations was .842.[2]
2. Standardization of the test has insured accuracy.

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[1]Arthur S. Otis, Otis Self-administering Test of Mental Ability, Manual of Directions and Key (Rev. ed.; New York: World Book Co., 1928), p. 12.

[2]Ibid.

It is the newest form of the Higher Examination and therefore the units of measure are more likely to be equally novel to all subjects. The items included in the test have been arranged in the order of difficulty. In this way the students are stimulated through confidence of first success to answer subsequent items more accurately.

3. Not only is the Otis Intelligence Test valid and accurate but it is also a highly reliable measure of intelligence. The reliability or consistency was determined by means of correlating different forms of the same test. The coefficients of correlation were found between Forms A and B of both examinations. In the Higher Examination, the average correlation was .921.[1]

4. Objectivity was established by making the test self-administering. In the examination, provision has been made for each student to read the directions for himself. The examiner plays no part in shaping the answer to any question. The examiner's duties are to distribute the papers, give the signal to start, and the signal to stop. Objectivity in scoring has been insured by providing very clear, precise scoring keys for each page.

5. Norms for college women have been provided, thereby offering a basis of comparison with other groups.

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[1] Ibid.

6. The Otis Intelligence Test fulfills the last criterion in economy of expense, administration, and time for pupils and investigator. The administration of the test is simple, and the time for taking and administering the test does not consume more than 20 minutes. The 20 minute time limit is suggested for college students to preclude their finishing the test.[1] Any number of students may be tested at the same period.

The Otis Self-administering Test, Higher Examination, Form D, therefore satisfies criteria set up by McCall as guides to the selection of tests.

B. Administration of the Otis Test

Before the Otis Intelligence Test was administered, a letter of explanation was sent to each examiner.

1. In each package was enclosed a set of instructions for the administration of the Otis Intelligence Test.
2. The items of particular importance were underlined in red pencil.
3. Each examiner was requested to follow the directions explicitly.
4. The time limit for college students was set at 20 minutes. Each student was instructed to circle the "20" in the left hand corner of the test paper.
5. All students were started exactly at the same time.

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[1] Ibid., p. 1.

6. The clock was noticed to be sure the time was recorded.
7. The clock was watched to be sure students were stopped exactly at the end of 20 minutes.
8. The test was administered during the regular class period with no interruptions once the test had started.
9. The tests were administered Wednesday and Thursday, December 8-9, 1937.
10. Students were advised to be present on these days so make-up tests would not be necessary.
11. If students were absent, the test was scheduled for the next regular class period, following the same directions in its administration.
12. When tests had been completed, they were sent to the investigator as all tests were scored by the investigator.

The test was administered according to the directions outlined by Otis.[1] The twenty minute time limit recommended for college women by Otis was used for administering the test.[2]

C. Scoring the Otis Test

The scoring for each test was done by the investigator. The scoring was checked by an assistant according to directions stipulated in the Manual by Otis.[3]

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[1] Ibid., p. 2-3.

[2] Ibid., p. 1.

[3] Ibid., p. 2-3.

The scores on the Otis Intelligence Test ranged from 62 to 18 making the range of scores from lowest to highest 44 points.

Motor Educability Test

A. Criteria for the Selection of the Test

Motor educability is a term popularized by McCall. It refers to "the ease with which an individual learns new skills."[1] Included in this category are three motor educability tests which might be used in a measurement program: (1) The Brace Scale of Motor Ability Tests,[2] (2) The Johnson Physical Skill Test,[3] and (3) The Iowa Revision of the Brace Test.[4] The Brace Test consists of twenty items of the stunt type scored by means of the T-scale and designed for the purpose of classifying students and evaluating achievement. The Johnson Test consists of ten exercises which attempt to measure native neuromuscular skill capacity. The test is performed over a design painted on a special canvas strip involving locomotion for a distance of fifteen feet. As a result of the score made on the Johnson Test, students are grouped homogeneously. The Iowa Revision of the Brace Test consists of

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[1] C. H. McCloy, "The Measurement of General Motor Capacity and General Motor Ability," Research Quarterly of American Association for Health and Physical Education, Supplement, March, 1934, pp. 46-61.

[2] David K. Brace, Measuring Motor Ability, A Scale of Motor Ability Tests (New York: A. S. Barnes and Co., 1930).

[3] Granville B. Johnson, "Physical Skill Tests for Sectioning Classes into Homogeneous Groups," Research Quarterly of American Association for Health and Physical Education, March, 1932, pp. 128-136.

[4] C. H. McCloy, Test of Motor Educability: Iowa Revision of the Brace Test Mimeographed by the author, second revision, 1933.

ten stunts. T-scores were based on two trials for each stunt.

In selecting the motor educability test to be used in this study, definite criteria were considered before the final choice was made:

1. The motor educability test should be standardized with adequate validity coefficients.
2. The test should be objective.
3. The test should be economical.
4. The test should provide norms.
5. The motor educability test should be easy to score.

The Iowa Revision of the Brace Test was chosen as the motor educability test to be used in this study because it fulfilled the above criteria in the following manner:

1. The Brace Test is standardized with validity coefficients ranging from .70 to .80 in correlations between motor ability test scores and scores on athletic events.[1] When McCloy revised the Brace Test, Bovard and Cozens believe this revision resulted in doubling the validity of the test.[2] The validity coefficients are not available in published form so this statement cannot be collaborated. McCloy felt that the Brace Test lacked something quite essential as a measure of general motor capacity,[3] even though Brace discovered a "relatively high correlation with

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[1]Brace, op. cit., p. 95.

[2]Bovard and Cozens, op. cit., p. 137.

[3]Ibid.

every type of motor ability test.[1]

2. Objectivity of the test is enhanced by the fact that the test is scored either success or failure with definite instructions for each stunt as to what constitutes a success or a failure. Objectivity is also increased by sending standardized procedures to each of the three colleges.

3. The Iowa Revision of the Brace Test was selected because of the economy in time and administration required by the use of only one class period for the entire group. McCloy believes that the test battery in the Iowa Revision of the Brace Test has a slight advantage over the original Brace Test, in that the time of administration is shortened by having to administer only ten tests instead of twenty.[2] Because the Iowa Revision of the Brace Test was more economical of time than the Johnson Test, the latter was definitely eliminated.

4. Norms are available for this motor educability test, thereby offering a basis of comparison with other groups.

5. There is evidence from McCloy's study which indicates

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[1]C. H. McCloy, "The Measurement of General Motor Capacity and General Motor Ability," Supp. Research Quarterly of American Association for Health and Physical Education, March, 1934, p. 52.

[2]C. H. McCloy, "An Analytical Study of the Stunt Type Test as a Measure of Motor Educability," Research Quarterly of American Association for Health and Physical Education, October, 1937, p. 51.

the scoring of two trials in each stunt gives a somewhat better correlation with motor educability than scoring on one trial only.[1] The scoring for the Iowa Revision of the Brace Test is relatively simple and scores lend themselves to objective statistical treatment.

The Iowa Revision of the Brace Motor Ability Test satisfies the criteria set up and was chosen, therefore, as the most feasible instrument for measuring motor educability for beginning tennis players.

B. Administration of the Motor Educability Test

In administering the Iowa Revision of the Brace Test to the three colleges, a preliminary letter was sent to each examiner.

1. In the package was enclosed the general directions for administering the test, the test items, and scoring blanks for each student.
2. The suggestion was made that test items were to be reviewed thoroughly prior to the administration of the test to insure an accurate demonstration of their performance.
3. Each examiner was requested to follow the directions closely when administering the test.
4. The tests were administered Wednesday and Thursday, January 5-6, 1938.
5. When tests had been completed, they were sent immediately to the investigator unscored.

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[1] Ibid.

The directions for the Iowa Revision of the Brace Test were almost exactly like the directions outlined by Brace in his original Motor Ability Test. Brace's directions needed to be clarified, so they were broken up into more definite individual items. The following general directions were typed and sent to each examiner:

1. Arrange the class in parallel rows of even numbers, each student standing 6-7 feet apart. Number each row one, two, one, two, etc.
2. Pass out scoring blanks and pencils to each student. Have students fill in the spaces at the top of the scoring blank.
3. Give the following explanation of the test to your group of students:

   You are going to be given a test consisting of a number of items or stunts. Some are easy and some are difficult. Probably no one will be able to do them all, but all of you will be able to do many of them.

   You are to score each other in this test. Each stunt will be explained and demonstrated.

   Each test is to be scored either "success" or "failure". If the test is done correctly, mark an "X" in the first column by the number of the test. If the test is not done correctly, mark a "O" in the first column by the number of the test. Each test must be marked either "X" or "O", success or failure. If a test is scored a failure, a second trial will be

allowed. A signal shall be given for the second trial of each test as soon as the first trial has been scored. The mark, "X" or "O", success or failure, shall be placed in the second column for the second trial of each test. Be fair to the person you are scoring but watch her carefully so that you can score her correctly.

4. Use formal control. Do not allow laughing and talking. Do not allow a student to watch the scoring which is done on her own performance.
5. Have rows one and two face each other. Students opposite each other will serve as partners for the administration of the test.
6. Have partners exchange scoring blanks.
7. Students in the odd rows will stand for the demonstration and administration of the first half of the test (Stunts 1 through 5) while students in the even rows will sit on the floor to watch the demonstration and to score their partners on the performance of the stunts in the first half of the test.
8. Explain and demonstrate the first test. Do the test correctly and say, "That would be scored a success, (X)." Do it incorrectly and say, "That would be scored a failure (O)." Ask, "Are there any questions?" Discourage questions after you have started the examination. After the demonstration of the first item, give a signal for the first trial of the stunt by students in the odd rows while students in even rows

score their performance. Give a second signal for the second trial. Follow this procedure of demonstrating correctly and incorrectly the performance of each stunt.

9. Students on the odd rows sit on the floor after the first half of the test (Stunts 1 through 5) with the scoring blanks of their partners, while students on the even rows are tested over the second half of the test (Stunts 6 though 10). Each stunt is to be preceded as before by an explanation with a demonstration of its correct and incorrect performance.
10. Students on the even rows sit on the floor after the second half of the test (Stunts 6 though 10) with the scoring blanks of their partners, while the students on the odd rows are tested over the second half of the test (Stunts 6 though 10).
11. Students on the odd rows sit on the floor after the second half of the test (Stunt 6 through 10) with the scoring blanks of their partners, while the students on the even rows are tested over the first half of the test (Stunts 1 through 5).
12. When the tests are completed, have the students check on the information at the top of the blank. Have scoring blanks passed to the head of each row and collected.

C. Scoring the Motor Educability Test

The test for each student was scored by the investigator

and checked by an assistant. The T-scale scores for stunts were based on point values earned on two trials for each stunt. If the student succeeded on the first trial, two points were scored; if she failed on the first trial but succeded on the second trial, one point was scored; and if both trials were failed, a score of "zero" was recorded for that stunt. The highest possible score for the test was twenty. McCall provides three tables of T-scale scores, one for elementary school, one for junior high school, and one for senior high school and college. The scores on the tables vary for each group because of the degree of difficulty of various combinations of the ten stunts for each group. Group III or the table for college was used for converting raw scores into T-scale scores for this study. The scale scores on the Iowa test ranged from 71 to 28, making the range of scores from lowest to highest 43 points.

The Tennis Skill Test

A. Criteria for the Selection of the Test

In selecting a tennis skill test for this study, these criteria were beneficial:

1. The test should include the skill elements for a beginning tennis player as closely related to the game situation as possible.
2. The test should be a valid test; that is, it must measure the elements that it purports to measure.
3. The test should be objective.
4. The test should be economical of time.
5. The test should be reliable.

6. The test should be suitable and usable for college women.

The Dyer Backboard Test of Tennis Ability was chosen to measure the skill of beginners in tennis, because it satisfactorily fulfilled the criteria for the selection of the test items in the following manner:

1. The Dyer Test is designed to measure ability in tennis by rallying a tennis ball against a backboard. It includes two skill elements of a beginner in tennis by using the forehand and backhand drives for rallying. The serve is not included in Dyer's Test, as she believes there is a very close correlation between playing ability and serving.[1]
2. Dyer's Test is a valid test. It measures improvement of tennis players ability, especially beginning tennis players' ability. The validity coefficients have been found to run between .85 and .90.[2] The criterion used to establish validity consisted of the judgment of experts. The test scores were correlated with judgments in five different sets of test data.
3. The test is objective because the opinion of skill is not dependent upon judgment or worth, and the testing media can be kept constant.

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[1] Joanna T. Dyer, Personal Communication.

[2] Joanna T. Dyer, "The Backboard Test of Tennis Ability," Supplement Research Quarterly of American Association for Health and Physical Education, March, 1935, p. 72.

4. The Dyer test is economical of time in that thirty people can be tested in a half hour. This includes three trials of the test for each individual. Mynard[1] and Cutts[2] suggest tests to be used for measuring skill, but they are not economical of time in that only one person can be tested at a time. In a preliminary study by the writer, a group of skill tests was used for experimentation, and players were rated by experts.[3] Reliability coefficients were so small that their use was not warranted.
5. The test is reliable as signified by the range of reliability coefficients, .84 to .90.[4]
6. The Dyer test is suitable for college women. It was designed primarily for college women, although it might be used in high schools or in camps.

B. Administration of the Dyer Test

A preliminary letter was sent to each examiner regarding the administration of the Dyer Backboard Test in the three colleges.

1. In the letter was enclosed a diagram of the backboard and specific directions for the test.
2. Scoring blanks were sent under separate cover to each

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[1]Mynard, op. cit.

[2]Cutts, op. cit.

[3]Katherine Winter, "Physical Education Knowledge and Skill Tests as a Means of Rating and Grading Tennis Players," Unpublished Study, Department of Health and Physical Education, Texas State College for Women, 1937.

[4]Dyer, op. cit., p. 73.

college.

3. The test was administered at a regular class period.
4. Each examiner met with the group to be tested before the testing day, in order to explain the test and the scoring method.
5. At this meeting students were divided into groups of four so as to familiarize each student with her duties and the method of rotation.
6. On receiving the scoring blank, each student inserted her name in the proper space, and was cautioned to record scores in only the "Hit" column or the "restraining line error" column.
7. When students gathered to take the test, a brief review and demonstration was given.
8. The test was administered during the week of January 17-22, 1938.
9. All scoring blanks were returned to the investigator unscored.

The Dyer Backboard Test was administered according to the directions outlined by Dyer in the Research Quarterly,[1] except for certain items that were changed as the result of personal correspondence with Dyer. The following typed directions were sent to each examiner:

Equipment Needed

1. Backboard or smooth wall free from projections, approximately ten feet (10 feet) in height, and allow-

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[1]Dyer, op. cit., pp. 63-74.

ing about fifteen feet (15 feet) in width per person taking the test at one time. To have two players take the test at the same time has been found to be a very satisfactory arrangement. This allows for adequate supervision by the administrator.

2. On the backboard or wall, a plainly visable line three inches (3 inches) in width, to represent the net, should be drawn so that the top of the net line is three feet from the ground.
3. A restraining line, <u>five feet from the base of the wall</u>, should be drawn on the floor.
4. A starting line, <u>twenty feet from the base of the wall</u>, should be drawn on the floor. Allow ample space in back of the starting line to permit freedom of movement in rallying.
5. Several extra balls should be placed in a box conveniently located at the side of the playing area five feet from the wall. This stationary box insures the same testing conditions for all players to obtain extra balls when needed.
6. A stop watch.
7. Two balls and a racquet per player. It is desirable that the balls be in good condition, although it is not essential that they be absolutely new. The racquet should be without flaws.
8. One pencil per group of four players.
9. Score card per player. (Score cards will be provided for each student.)

Organization

I. Divide the group to be tested into units of four players each, and number them from one to four. Provide each player with a score card on which she writes her name. After this is done, please read the following description of the test to the group.

"The Backboard Test consists of rallying a tennis ball against the wall. The object of the test is to cause the ball to strike the wall on or above the net line as many times as you can in thirty seconds. (Pause.) When I say, 'Go!' start the test immediately by dropping the ball and putting it in play against the wall. Continue to play it to the wall until I say, 'Stop!' at the end of thirty seconds. There is no limit to the number of times the ball may bounce before you hit it. You may use any stroke or combination of strokes. Each ball striking the wall on or above the net line, before the word 'Stop', counts as a hit and scores one point. You may use any number of balls. If for any reason you lose control of the ball in play, do not try to recover it, but take another ball and put it in play as at the start. Each time a student crosses the restraining line while rallying the ball it deducts one point from the total score for that trial if the ball hit on or above the net line. You will each be given three trials. The final score on the test is the sum of the total scores for the three trials. All three trials must

be completed in one testing period."

Answer questions and demonstrate:

1. The starting position and method.
2. What is meant by rallying.
3. What is meant by a ball out of control, showing how to save time by taking another ball instead of trying to recover the ball out of control.

II. After the foregoing explanation and demonstration of the test, read the following paragraph, making certain that each player understands fully the test procedure and her duties.

"In each group:

"No. 1 takes the test. At the signal 'Ready?', she steps up to the starting line, with her racquet and two balls, prepared to take the test at the word 'Go'.

"No. 2 counts the number of balls which strike the wall on or above the net line, <u>before</u> the word 'Stop', and enters them on the score card in the column headed 'Hits' opposite the appropriate trial number. A ball striking coincident with the word 'Stop' does not count.

"No. 3 counts the number of times per trial, if any, that the player <u>hit the ball on or above the net line</u> while <u>standing closer to the wall than the restraining line</u>. She reports, at the end of the trial, the number of such in-

fractions to the scorer (No. 2) who enters this number on the score card in the column headed 'Restraining Line Errors' opposite the appropriate trial number. (Note that the infractions do not count against the player over the restraining line unless the ball hit on or above the net line.)

"No. 4 collects the balls for her group and places them in the box.

"Each person takes the test in rotation.

"After No. 1 has had her trial she assumes the duties of No. 2 (counting the number of balls striking on or above the net line.) No. 3 and No. 4 continue their same duties.

"While No. 3 takes the test, No. 4 scores the number of balls striking on or above the net line. No. 1 watches the restraining line and counts infractions; No. 2 collects the balls.

"When No. 4 takes the test, No. 3 scores the number of balls striking on or above the net line; No. 1 watches the restraining line and counts infractions. No. 2 collects the balls.

"After each person in the entire group being tested has had one trial, the test is repeated in the same order until everyone has had three trials in all."

The foregoing organization consumes about ten minutes.

Great care should be exercised in these prelimin-

aries to make certain that the test procedure is clearly understood. The testing will then take place smoothly and accurately.

III. The examiner, with the stop watch, should assume a position to the rear of the players and begin testing the two No. 1's who are taking the test simultaneously. Nos. 2, 3, 4 of these two groups will follow, and so on until all have had one trial, after which the test is repeated twice in the same order. In case the group does not divide exactly into groups of four, add a fifth player to a group.

C. Scoring the Dyer Test

The Dyer Test was scored according to the revised method suggested by Dyer in personal correspondence. The score for each trial consisted of the number of hits minus the number of restraining line errors. These three scores were added to yield a final total score for the test. The investigator had hoped to use the Cozens, Cubberly, and Neilson achievement scales for determining the T-scale score for the Dyer Test.[1] These scales are based on the old method of scoring, however, and could not be used in this study employing a revised method of scoring. The raw scores from the Dyer Test were arranged in order from lowest to the highest and the T-scale scores were computed according to the method outlined by McCall.[2] The T-scale scores on the

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[1]Frederick W. Cozens, Hazel J. Cubberly, and N. P. Neilson, Achievement Scales in Physical Education (New York: A. S. Barnes and Co., 1937), p. 106.

[2]William A. McCall, How to Measure in Education (New York: MacMillan Co., 1922), pp. 278-279.

test ranged from 77.5 to 23 making the range of scores from lowest to highest 54.3 points.

The Information Test

A. Need for the Development of the Test

The original information test used in this study was constructed after a thorough survey of all available tests failed to disclose any tennis information tests for beginning players only. Information Tests were prepared by the University of Minnesota including ten activities.[1] A test of 45 true-false questions on tennis was included. This tennis test was very general in nature, ranging in knowledge from a beginner's level to the advanced level. It was desirable for the present study to use a test covering more in detail information expected of a beginner in tennis. The Minnesota Test, therefore, was not suitable for use in this study. Hewitt's test, like the Minnesota one, was a comprehensive test for measuring information of tennis students of all levels of skill.[2]

B. Criteria for the Selection of the Test Items

The Information Test items were chosen because they fulfilled these criteria:

1. The test items should be chosen within the scope of beginning tennis players.
2. The language of each statement should be formulated

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[1]Snell, op. cit., pp. 78-94.

[2]Hewitt, op. cit., pp. 74-85.

in terms of a beginner in tennis.

3. Items should be selected which can be graded objectively.
4. The test should be self-administering for any group of students.
5. The test should be economical of time, that is, not consuming more than one-hour class period.
6. Scores made on the test should lend themselves to statistical treatment.

C. Construction of the Information Test

The Information Test was constructed after a survey of previous tests and studies, suggestions from the staff of Health and Physical Education at Texas State College for Women, and a careful analysis of books concerning tennis.[1] As stated previously, the test was constructed with the premise that statements should be within the field of experience of a beginning tennis player. Questions were selected from ten different groups of skills and knowledges: these included knowledge of the forehand drive, backhand drive, and serve; outstanding players in

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[1]George Agutter, Lessons in Tennis (New York: American Sports Publishing Co., 1929). Lou Eastwood Anderson, Tennis for Women (New York: A. S. Barnes Co., 1926). Mercer Beasley, How to Play Tennis (New York: Doubleday Page, 1916). M. K. Browne Top Flite Tennis (New York: American Sports Publishing Co., 1928). Helen Driver, Tennis for Teachers (Philadelphia: W. B. Saunders, 1936). Helen H. Jacobs, Modern Tennis (Indianapolis: Bobbs-Merrill, 1933). Lawn Tennis Association, Lawn Tennis Guide (New York: American Sports Publishing Co., 1936-37). J. Parmly Paret, The Lawn Tennis Library for Beginners (New York: American Lawn Tennis, Inc., 1926). Dorothy Randle and Marjorie Hillas, Tennis Organized (New York: A. S. Barnes and Co., 1932). William T. Tilden, II, Art of Lawn Tennis (New York: George H. Doran Co., 1921).

tennis; the rules of the game; court and equipment; tournament play; tennis terminology; history of tennis; and scoring. True-false, completion, and multiple choice questions were used for the test. These three types of objective questions were used because some phases of subject matter definitely land themselves better to one type of question than to another type,[1] and also a battery with three parts is probably more fair, since it is more inclusive.[2]

Questions were compiled and given to the nine faculty members in the Department of Health and Physical Education at Texas State College for Women. Each instructor was asked to criticize the test as to form, sentence structure, "catch" questions, improved phrasing, vocabulary, ambiguities, overlapping statements, and to indicate any phase of beginning tennis that had been omitted. The results of these criticisms were weighed and analyzed to form a test of 100 true-false, 28 completion, and 25 multiple choice statements. This test was given to 185 students enrolled in beginning tennis classes at Texas State College for Women during the fall of 1936-37. The reliability of the information test was determined by split half correlation according to the Pearson Product-Moment Method.[3] The reliability coefficient was found to be .610 $\pm$ .062. This coefficient was

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[1]Irene Palmer, Tests and Measurements (New York: A. S. Barnes and Co., 1932), p. 101.

[2]Ibid.

[3]Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Co., 1926), pp. 163-168.

raised to .76 by application of the Spearman-Brown Formula.[1]

For the final revision of the tennis information test, a frequency distribution was compiled of statements missed most often. This was done for the purpose of eliminating perfect scores, zero scores, and doubtful or questionable statements. The final revision of 100 true-false, 28 completion and 25 multiple choice statements constituted the original Tennis Information Test, which was administered to the three colleges, X, Y, and Z, in the fall of 1937-38.

D. Administration of the Information Test

In administering the Tennis Information Test to the three colleges, a preliminary letter was sent to each examiner.

1. Each examiner was instructed to give at least five lectures to her group including knowledge of the forehand drive, backhand drive, and serve; outstanding players in tennis; rules of the game; court and equipment; tournament play; tennis terminology; history of tennis; and scoring.
2. Copies of mimeographed tests were sent under separate cover just prior to the testing period.
3. The test was administered at a regular class period or examination period under the same regulations as other college examinations.
4. The test was scheduled at least a week in advance. All students were urged to be present at this time.

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[1] Ibid., pp. 269-271.

5. On receiving the test paper, each student was asked to fill in the blanks at the top of the paper, inserting name, class, school, instructor, date, and classification. All other spaces were left blank.
6. A definite date was not set for administering the test as each college had an examination schedule to follow.
7. Separate directions were provided for each of the three parts of the examination. Students were encouraged to read and to follow the directions exactly as they were stated.
8. All tests were returned to the investigator unscored.

E. Scoring of the Information Test

Each part or section of the Tennis Information Test was scored separately. Part I, the true-false section, was scored by substracting the number of questions answered incorrectly from those answered correctly. Part II, the completion section, was scored by allowing one point for each space correctly filled. The multiple choice section, Part III, was scored by allowing one point for each space correctly filled. The total score on the test was determined by adding the scores made on each of the three parts or sections. The scores ranged from 130 to 27, making the range of scores from lowest to highest 103 points.

F. Reliability of the Test

The Reliability of the original Tennis Information Test was determined by the Pearson product-moment correlation of odd and even items. The odd and even correlation resulted

in a coefficient of .70 ± .026. This coefficient of correlation was raised to .824 by application of the Spearman-Brown formula. Reliability coefficients ranging from .80 to .89 are significant and high enough to justify the belief that the original Tennis Information Test is a reliable measure of the information of beginning tennis players.[1]

General Administration of the Tests

The institutions selected for the administration of the four tests were three colleges located in different parts of the State of Texas. The four tests included in the study were:

1. The Otis Intelligence Test, Higher Examination, Form D.
2. The Motor Educability Test -- The Iowa Revision of the Brace Ability Test.
3. The Dyer Backboard Test of Tennis Ability.
4. An original Tennis Information Test.

Before administering any of the above tests, a random sampling of beginning tennis students was secured in each of the three colleges participating in the study. The subjects were selected in the following manner by each examiner.

1. All students enrolled in beginning tennis classes were met during the regular class period.
2. Students enrolled in these classes were asked the following questions:
   a. Have you ever played in a tennis tournament prior to enrolling in this class?
   b. Have you ever had tennis instruction prior to

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[1]Bovard and Cozens, op. cit., p. 333.

enrolling in this class?

c. Have you ever played a game of tennis prior to enrolling in this class?

3. Students who answered "no" to all three questions were considered absolute beginners.

4. This group of beginners then became the subjects for the study.

Before each test was administered, a letter was sent to the examiner in each of the three colleges with necessary directions and diagrams. In each college, the instructor in charge of beginning tennis was to be the examiner. A definite date was scheduled for each test to insure uniformity of testing conditions.

Tests were administered in the three colleges during the fall semester of 1937-38. Complete sets of data were returned from one hundred and seventy-five students. The sets of data were divided in the following manner: college X, 25 students; college Y, 17 students; and college Z, 133 students.

General Treatment of Data

Certain general procedures have been followed in the treatment of the data for each of the four tests. Standardized directions were supplied for each test. Papers were scored and tabulated by the investigator and checked by an assistant. The means and standard deviations were ascertained according to techniques outlined by Garrett[1] and Palmer.[2] Coefficients of correlation were calculated by the product-moment method to determine the reliability of the original information test and to deter-

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[1]Garrett, op. cit., pp. 28-32.

[2]Palmer, op. cit., pp. 13-26.

mine the correlation between other measures used in the study.[1] When correlations were found between slit-halves of the original information test, the Spearman-Brown prophecy formula was applied.[2] Probable errors reported with these correlation coefficients were computed by means of the formula outlined by Garrett.[3] To present tabular material, histograms were constructed for each test.

In order to suggest an objective grading device for beginning tennis players, it was necessary to secure additional data for the Dyer Backboard Test and the Original Tennis Information Test. A given per cent of the total scores made on each test was calculated by the investigator, and a range of scores determined for each class of A, B, C, D, and F. This same range of scores for each class can be determined by basing any distribution of grades upon the median and upper and lower quartiles, and the mean and standard deviation.

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[1]Garrett, op. cit., pp. 163-168.

[2]Ibid., pp. 269-271.

[3]Ibid., pp. 170-171.

CHAPTER III

FINDINGS

The Intelligence Test

When the Otis Intelligence Test scores from the three colleges X, Y, and Z were combined to form one distribution, the mean score was found to be 39.2 with a standard deviation of ± 6.306. Figure 1 illustrates the distribution of Otis Intelli-

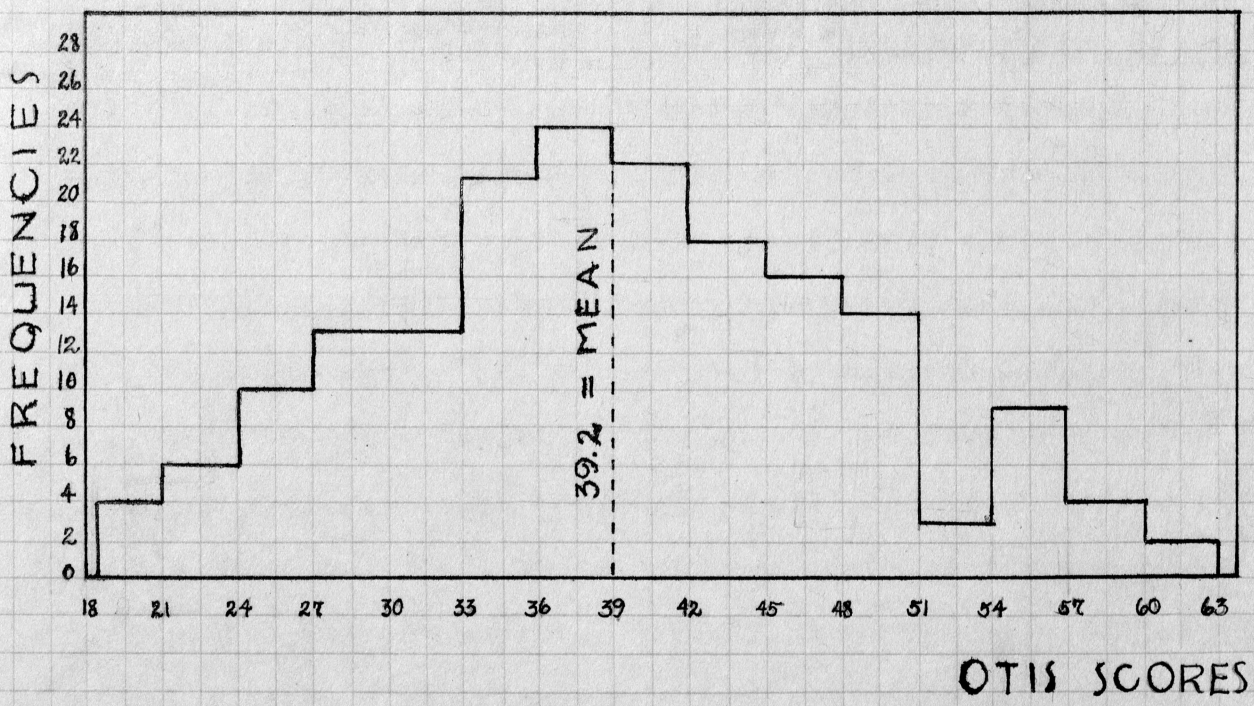

FIG. 1. DISTRIBUTION OF OTIS INTELLIGENCE TEST SCORES WITH REFERENCE TO THE AVERAGE MEAN FOR THE THREE COLLEGES X, Y, AND Z.

gence Test scores with reference to the average mean for the combined group. This histogram yields a fairly normal curve with only a slight peak near the upper range of scores. In comparing the mean score, 39.2, with the Otis norms for college students, the beginning students in this study are below the average mean of 53 points.[1] They are also below the mean of 45.4

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[1]Otis, op. cit., p. 6.

for undergraduate students majoring in various fields in Duggan's study.[1] This low average of 39.2 for mean scores might be due in part to the students' unfamiliarity with this type of test. Excitement and failure to judge time properly, with a consequent expenditure of too much time on each individual question, might be factors in their low scores. On the other hand, in each of the three schools sampled, the selection of the student body is not based on any evaluation of the intelligence of the students entering college. Students in these three institutions, therefore, may have lower intelligence scores than those contributing to Otis' established norms. This is very likely to be true as the students participating in this study are the most part freshmen and sophomores, hence unselected by a normal process of elimination before graduation at the end of the four year college course. When the mean scores on the Otis Intelligence Test are compared in the three colleges, it is apparent that the difference in the mean scores is very slight. Table I shows the mean scores of school X to be 42.08 with a standard deviation of ± 6.386, school Y 35.03 with a standard deviation of ± 4.000, and school Z 37.93 with a standard deviation of ± 6.220. The mean of 37.93 for college Z, could probably be interpreted as the average mean for the Intelligence Test, as it more nearly approximates the true average mean of 39.2; the mean for college Z is based on the largest number of cases in each of the three institutions.

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[1]Anne Schley Duggan, A Comparative Study of Undergraduate Women Majors and Non-majors in Physical Education with Respect to Certain Personal Traits (New York: Bureau of Publications, Teachers College, Columbia University, 1936), p. 86.

TABLE I

COMPARISON OF MEAN SCORES ON THE OTIS INTELLIGENCE TEST OF MENTAL ABILITY ADMINISTERED TO BEGINNING TENNIS PLAYERS IN EACH OF THREE COLLEGES

Colleges	Mean	Standard Deviation	Number
X	42.08	6.386	25
Y	35.03	4.000	17
Z	37.93	6.220	133

Summary.--The Otis Self-administering Test of Mental Ability, Higher Examination, Form D, administered to 175 students, discloses an average mean of 39.2 which is below average in comparison with results from other studies and with norms established by Otis.

The Motor Educability Test

The Iowa Revision of the Brace Motor Ability Test was administered to the 175 beginning tennis players participating in the study. The results of this test disclose a mean score of 45.32 on the Iowa Test. This mean score of 45.32 proves to be slightly above the mean of 45 suggested by McCloy as the average mean for college students.[1] The mean score of 45.32 distinquishes these 175 beginning tennis players as being a normal group with reference to the mean scores. The frequency distribution in Figure 2 shows a tendency for the scores to pile in tri-modal peaks around the mean. These peaks might be smoothed

[1]C. H. McCloy, "Description and Instructions of the Iowa Revision of Brace's Motor Ability Test (Unpublished Material, 1933).

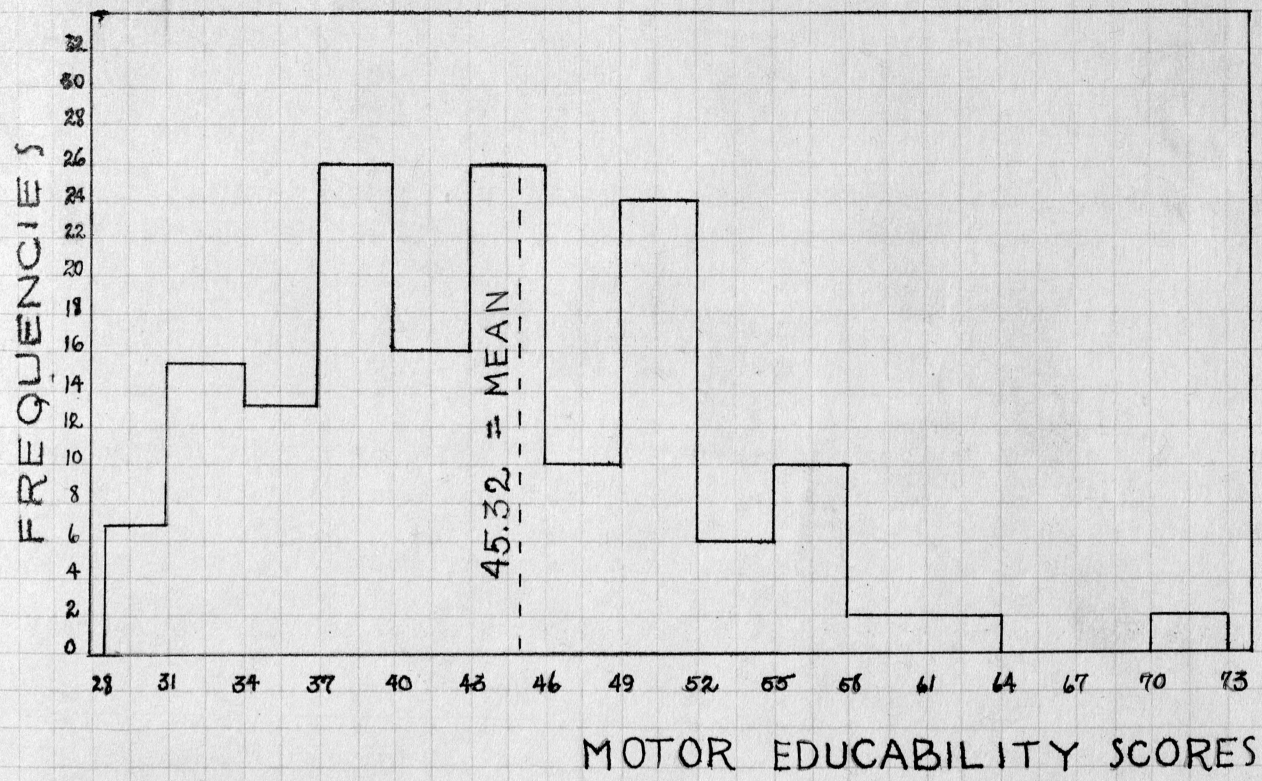

FIG. 2. DISTRIBUTION OF MOTOR EDUCABILITY SCORES WITH REFERENCE TO THE AVERAGE MEAN FOR THE THREE COLLEGES X, Y, AND Z.

into a uni-modal histogram if the size of the step intervals were increased. The tri-modal peaks in the histogram reveal that the students participating in this study are not a homogenous group as far as motor educability is concerned.

In general, students enrolling in colleges today are familiar with the type of stunts included in the Iowa Revision of the Brace Test. As these stunts are the basis of the motor educability test, we might logically expect the scores for college students to be above average. Table II shows the results of the measures of motor educability when the data from each college is treated separately. College Y stands out for having a mean score of 35.32 with a standard deviation of ± 1.614. This mean is

TABLE II

COMPARISON OF MEAN SCORES OF BEGINNING TENNIS PLAYERS ON THE IOWA REVISION OF THE BRACE MOTOR ABILITY TEST IN EACH OF THREE COLLEGES

Colleges	Mean	Standard Deviation	Number
X	49.68	5.532	25
Y	35.32	1.614	17
Z	44.06	5.018	133

much lower than the means of the other two college groups. College X has the highest mean score of 49.68. As on the Otis Test, College Z again has a mean score that more nearly approximates the average mean of scores on the Iowa Revision of the Brace Test. This mean score of 44.06 with a standard deviation ± 5.018 is based on the largest number of cases which accounts for its being more near the average mean of 45.32.

Summary.--From the foregoing results of the Iowa Revision of the Brace Motor Ability Test, we may conclude that the average mean score of 45.32 for the three colleges is slightly above the average mean for college students established by McCloy. When the mean scores for the three colleges are studied separately, college Z's mean score of 44.06 is nearer the average mean than either of the mean scores for the other two colleges.

The Dyer Backboard Test

A mean score of 50.735 with a standard deviation of ± 7.509 resulted from the administration of the Dyer Backboard Test of Tennis Ability to 175 beginning tennis players. The Dyer Backboard Test, as administered in this study, has not been ad-

ministered in the same manner in other studies reported in the literature due to the recent revision of this test by Dyer. For this reason it is impossible to compare mean scores of the revised form with mean scores available from studies based on the older form of Dyer's Test. The investigator, however, believes that the mean score of 50.735 is above the average of mean scores for college women. The distribution of data from the Dyer Test is shown in Figure 3. It is apparent from the histogram that

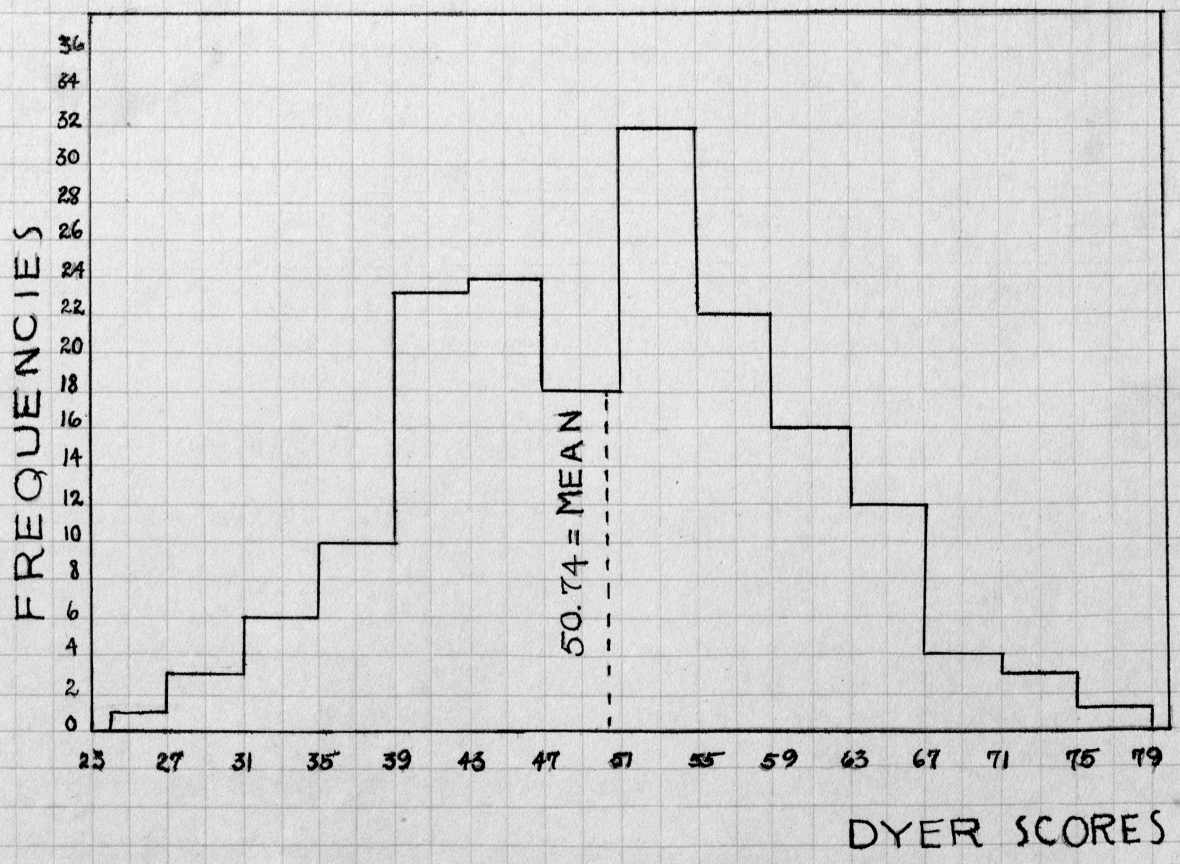

FIG. 3. DISTRIBUTION OF DYER BACKBOARD SCORES WITH REFERENCE TO THE AVERAGE MEAN FOR THE THREE COLLEGES X, Y, AND Z.

there is a peak on either side of the mean. This is indicative of a fairly equal piling up of individual scores on the Dyer Backboard Test of Tennis Ability just below and just above the

mean score for the entire group.

The data from each college are treated separately as shown in Table III. The mean score of 58.56 for college X is

TABLE III

COMPARISON OF MEAN SCORES ON THE DYER BACKBOARD TEST OF TENNIS ABILITY ADMINISTERED TO BEGINNING TENNIS PLAYERS IN EACH OF THREE COLLEGES

Colleges	Mean	Standard Deviation	Number
X	58.56	5.230	25
Y	50.677	9.342	17
Z	47.82	6.678	133

much higher than the mean scores for the other two colleges, but when the mean scores are studied in relation to the average mean of 50.74, there is found to be little fluctuation from the mean.

Summary.--The Dyer Backboard Test of Tennis Ability, as administered in this study reveals a mean score of 50.74 with a standard deviation of $\pm$ 7.509. Inasmuch as there are no available data for comparing this mean score with mean scores in other reported studies, no conclusion can be drawn as to whether this is an average mean for beginning tennis students on the college level. When the mean scores for the three colleges are studied separately, there is less fluctuation on the Dyer Test with reference to the mean than on other tests used in the study.

The Information Test

As in the other three tests, the Original Tennis Information Test was administered to the 175 beginning tennis students participating in the study. When the scores on the Information

Test are treated as a group, the results show an average mean score of 81.466 with a standard deviation of ± 15.804. No comparison can be made with mean scores of the test as this is the first time the test has been administered in its present form. Figure 4 illustrates the distribution of scores made on the

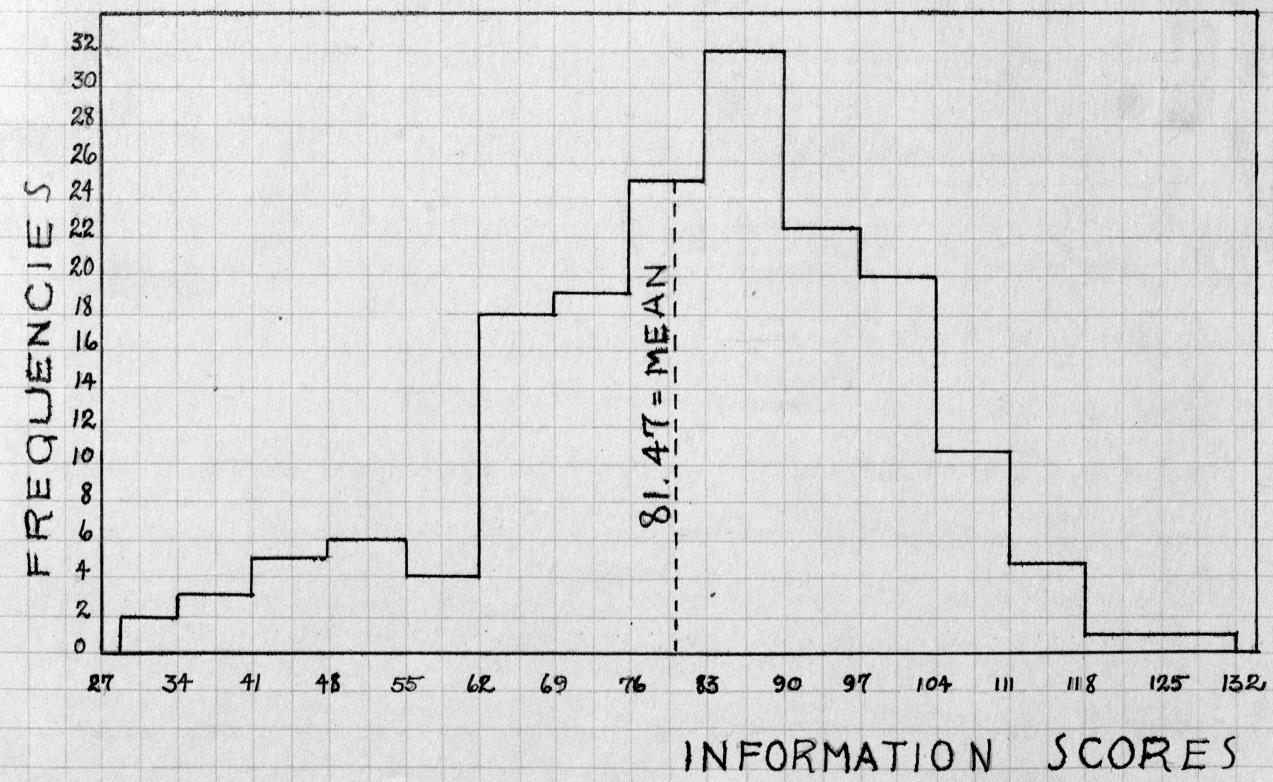

FIG. 4. DISTRIBUTION OF INFORMATION TEST SCORES WITH REFERENCE TO THE AVERAGE MEAN FOR THE THREE COLLEGES X, Y, AND Z.

Tennis Information Test in relation to the mean score. With the peak of the histogram skewed to the right of the mean, it might indicate that the test is somewhat easy for the group. This slight skewness might be explained by the fact that the test covers material within the scope of a beginner in tennis, and that the test is based on a definite number of lectures.

The Tennis Information Test scores are compared in each

college separately. Table IV shows the mean score of 47.64 for

TABLE IV

COMPARISON OF MEAN SCORES ON THE TENNIS INFORMATION TEST ADMINISTERED TO BEGINNING TENNIS PLAYERS IN EACH OF THREE COLLEGES

Colleges	Mean	Standard Deviation	Number
X	80.12	11.756	25
Y	47.64	8.630	17
Z	86.66	12.660	133

college Y is extremely below the average mean of 81.466. The students in this college either did not receive instruction covering the topics outlined by the investigator, or they are very low on their knowledge of tennis. Colleges X and Z are more nearly alike in the mean score on the Information Test, their scores being 80.12 and 86.66 respectively. These scores are nearer the average mean of 81.466, which shows that students in these two colleges are better informed on the knowledge of tennis.

Summary.--The Original Tennis Information Test administered to 175 beginning tennis players participating in the present study discloses that the mean scores for colleges X and Z are markedly higher than the mean score for college Y. College Z shows a slight superiority over college X with respect to tennis information. In general we may conclude that in tennis information, colleges X and Z are better informed on tennis than college Y.

Interrelationships Between Results of Various Tests

The investigator wished to know whether any relationship

existed between various tests used in the study. The Pearson Product-moment Method was employed to determine the coefficient of correlation or relationship between these test results. This coefficient of correlation may vary from a perfect positive relationship (+1.0) to a perfect negative relationship (-1.0).[1] In this manner the degree of relationship between two factors may be expressed in a quantitative fashion.

In correlating scores on the Dyer Backboard Test with scores on the Original Tennis Information Test and the Otis Intelligence Test, the results are .098 ± .050 and -.005 ± .051 respectively. The probable error is large in proportion to the correlation, and the actual correlation is so small that we may conclude no relationship exists between these factors for the group participating in the study.

The coefficient of correlation between the Dyer Test and the Iowa Revision of the Brace Test is found to be .779 ± .020. The results of this correlation are high enough to justify the use of this measure as a means of classifying these students for tennis instruction.

In correlating the Otis Intelligence Test with the Original Tennis Information Test, there is a slight positive correlation indicated by the results of .363 ± .044. This result shows that the factors being correlated have some relationship, but not enough for individual prediction or for group classification. Generally, we expect a higher correlation between in-

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[1]Bovard and Cozens, op. cit., p. 269.

telligence and information, doubtless the group participating in this study did not prepare themselves adequately for the information test.

The correlation of .144 $\pm$ .050 is negligible between the Otis Intelligence Test and the Iowa Revision of the Brace Test. Very few statisticians report any degree of correlation between intelligence and motor ability.

A correlation coefficient of .223 $\pm$ .048 is found between the test of information and the test of motor educability. This slight "going togetherness" of factors reveals that the elements being tested by the two tests are but slightly related to each other.

Implications for Grading Beginning Tennis Players

This investigation has certain educational implications with reference to the selection of tests to be used as a means of grading beginning tennis students more objectively. For many years it was the custom to grade students in Health and Physical Education on the basis of attendance, neatness, promptness, wearing of gymnasium costumes, and other items. This method of grading no longer is approved. With objectives set up in terms of definite achievements, an evaluation of these objectives is a more intelligent basis for grades or marks.

In considering tests suitable for grading beginning tennis students, the investigator cannot recommend the use of the Intelligence Test. These test scores offer no basis for awarding marks on achievement in tennis due to the fact that no correlation exists between skill and intelligence, and between informa-

tion and intelligence. The investigator wishes to make three suggestions for grading beginning tennis students.

1. The Iowa Revision of the Brace Motor Ability Test might be given to students at the beginning of the school year as a general measure of the probable motor educability of each student. This might serve as a tentative classification for those who wish to enroll in beginning tennis classes. Those students scoring high on the Iowa Test can be placed in one section as they will be expected to progress more rapidly in tennis skill than those students who score low on the Iowa Test. A second section of beginning tennis might include those students who score low on the Iowa Test. With students arranged by sections in this manner, the instructor has a more homogeneous group with which to work, and instruction is therefore facilitated.
2. The Dyer Backboard Test of Tennis Ability is suggested by the author as a means of grading students' skill in beginning tennis. It incorporates two of the main techniques necessary for beginning tennis players, namely, the forehand drive and the backhand drive. The serve is not included as a part of the test, but Dyer believes that serving and playing ability are so highly correlated that a test of the former is not necessary.
3. The teacher of physical education is concerned with knowledges in activities as well as skills or techniques, and, therefore, should have ways of determining how much information the student has acquired.

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[1] Joanna T. Dyer, Personal communication.

For beginners in tennis, the Information Test used in this study is suggested as an objective measure of students' knowledges in tennis.

The student must be given a grade for each test and these individual test grades averaged to form a final mark. For college students it is desirable to grade either A, B, C, or 1, 2, 3, or according to five classes as A, B, C, D, and F. This grade should be based on a recognized statistical procedure. Any of the above classes may be set definitely by basing any distribution of grades upon the mean and standard deviation, the median and upper and lower quartiles, or arbitrary percentages of the total scores. The investigator wishes to emphasize that the use of any arbitrary method of awarding marks must be based on an unselected random sampling of students which is large enough to justify the assumption of a normal curve of distribution. The scores on the Dyer Test and the Information Test will serve to illustrate how marks may be awarded by each of the three bases.

Suppose we wish to divide the Dyer scores into three classes, high being the upper 25 per cent -A or 1, average the middle 50 per cent -B or 2, and low the lower 25 per cent -C or 3. Using the median and the upper and lower quartiles (Q_3, Mn, Q_1) we find:

$$Q_3 = 55.65$$

$$Mn = 49.37$$

$$Q_1 = 43.09$$

The arrangement of A's, B's, and C's to be included in

each group will result in:

58 A's or 1's ranging from 55.65 up

74 B's or 2's ranging from 44.0 to 54.0

43 C's or 3's ranging from 43.09 down

Suppose we wish to form five classes. This may be accomplished by two or three methods.

1. By limiting the range of the standard deviation to three sigma on either side of the mean we find:

+3SD = 50.735 + (7.509 x 3) = 73.262

+2SD = 50.735 + (7.509 x 2) = 65.753

+1SD = 50.735 + 7.509 = 58.246

Mean = 50.735 with Standard Deviation of 7.509

-1SD = 50.735 - 7.509 =43.226

-2SD = 50.735 - (7.509 x 2) = 35.717

-3SD = 50.735 - (7.509 x 3) = 28.208

The range for each class will include:

13 A's ranging from a score of 65 and up

23 B's ranging from a score of 58 to 64.5

96 C's ranging from a score of 43 to 57.5

33 D's ranging from a score of 35 to 42.5

10 F's ranging from a score of 34 and below

2. By taking a given per cent of the total score we find these results:

N 175 the total number of scores

7%	A	18%	D
18%	B	7%	F
50%	C		

7% of 175	12.25	or a score of 65
18% of 175	31.50	or a score of 60
50% of 175	87.50	or a score of 50.5
18% of 175	31.50	or a score of 40.5
7% of 175	12.25	or a score of 35.5

The range of scores for each class when using the percentage method will be:

13	A's
19	B's
117	C's
16	D's
10	F's

It is interesting to notice the large number of C's as a result of the percentage system.

3. The last method is not as reliable as the other grading devices, but is satisfactory for a cruder estimate of marks. The median and upper and lower quartiles are used as approximate guides for the distribution of marks. The scores are arranged from the lowest to the highest score with frequencies tabulated to the side of each score. Using Q_3 and Q_1 as guides, the actual distribution of A's, B's, C's, D's, and F's is decided according to breaks or gaps in the distribution of scores. By following this procedure for the Dyer Test, the investigator found:

   1 A ranging from 73.5 and up

   41 B's ranging from 57.5 to 73

90 C's ranging from 43 to 57

39 D's ranging from 30 to 42

4 F's ranging from 29 and below

Using this distribution of scores, the investigator then tabulated scores made on the Dyer Test for each of the three colleges. The results show a fairly normal curve for each college.

Marks	X	Y	Z
A	0	1	0
B	15	5	22
C	9	7	73
D	1	3	35
F	0	1	3

Table V summarizes the results of classes A to F for marks on the Dyer tests in each of the four methods suggested for grading students.

TABLE V

COMPARISON AND SUMMARY OF THE RESULTS OF CLASSES A TO F FOR MARKS AWARDED ON THE DYER TESTS BY FOUR METHODS

Grades	Percentage 7% A or F 18% B or D 50% C	Median Q_3 and Q_1	Standard Deviation +3SD to -3SD	Natural Breaks in Distribution	Grades
A	13		13	1	A
B	19	52	23	41	B
C	117	50	96	90	C
D	16		33	39	D
F	10	43	10	4	F

Scores on the Information Test may be treated in the

same manner. Table VI will summarize the results of classes A to F for marks on the Information Test in each of the four methods suggested for grading students.

TABLE VI

COMPARISON AND SUMMARY OF THE RESULTS OF CLASSES A TO F FOR MARKS AWARDED ON THE INFORMATION TEST BY FOUR METHODS

Grades	Percentage 7% A or F 18% B and D 50% C	Median Q_3 and Q_1	Standard Deviation +3SD to -3SD	Natural Breaks in Distribution	Grades
A	12	56	5	1	A
B	19		33	43	B
C	113	81	106	88	C
D	18		21	38	D
F	13	38	10	5	F

In the results of the four methods for grading students on the Information Test, it is interesting to compare the number of A's, B's, C's, etc., under each method. The results of the percentage and standard deviation are more nearly the same, and the result of the median and natural breaks are approximately the same. By using the method of natural breaks, the Information Test scores range as follows:

1 A ranging from 130 up

43 B's ranging from 95 to 129

88 C's ranging from 72 to 94

38 D's ranging from 41 to 71

5 F's ranging from 40 below

Using this distribution of scores, the investigator then tabulated scores made on the Information Test for each of the three

colleges X, Y, and Z.

Marks	X	Y	Z
A	0	0	1
B	1	0	42
C	18	0	70
D	6	12	20
F	0	5	0

The results show a fairly normal curve for colleges X and Z. College Y, however, has a very low distribution of scores which might be due in part to lack of instruction on the topics listed by the investigator.

After a student has been graded on the Dyer Test and on the Information Test, these grades must be averaged to form a final mark in the course of beginning tennis. There is a great deal of controversy concerning this question. Some individuals believe skill should count three-fourths and information one-fourth, others believe skill should count one-fourth and information three-fourths, and still other individuals believe in a fifty-fifty basis for awarding marks. Until this question has been settled more satisfactorily, the investigator wishes to suggest an equal weighting of information and of skill in awarding final marks for beginning tennis players.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study was undertaken to evaluate several factors in an effort to suggest an objective basis for grading beginning tennis players. The subjects for the investigation comprised 175 students enrolled in beginning tennis classes in three institutions in the State of Texas. Data are presented in terms of mean scores for the total group of beginning students and in terms of the mean scores for each test in each of the three colleges. Relationship between various factors are pointed out for intelligence, motor educability, tennis skill, and tennis information. Suggestions are made with reference to the selection of tests to be used as a means of grading beginning tennis students more objectively.

The Otis Self-Administering Test of Mental Ability, Higher Examination, Form D, administered to 175 students discloses an average mean of 39.2. When the scores are compared in each of the three colleges, there is a very slight deviation of the means from the average mean.

The average mean of 45.32 on the Motor Educability Test-Iowa Revision of the Brace Test is slightly above the average mean for college students established by McCloy. When the mean scores for the three colleges are studied separately, College Z's mean score is nearer the average mean than either of the mean scores in the other two colleges.

The Dyer Backboard Test of Tennis Ability reveals a mean

score of 50.735 ± 7.509. When the mean scores of the three colleges are studied, it is found that each is closely related to the average mean.

The Original Tennis Information Test has a mean score of 81.466. When the colleges are studied separately, the mean score of Colleges X and Y are markedly higher than the mean score for College Y in tennis information.

Table VII summarizes the mean scores and standard deviations on each test.

TABLE VII

RELATION BETWEEN THE MEAN SCORES OF THE FOUR TESTS ADMINISTERED TO 175 BEGINNING TENNIS PLAYERS IN THREE COLLEGES

Tests	Mean	Standard Deviation
Otis Intelligence Test	39.2	6.306
Motor Educability Test	45.32	5.360
Dyer Backboard Test	50.74	7.509
Tennis Information Test	81.466	15.804

Interrelationships between results of various tests are best shown by Table VIII. In correlating scores

TABLE VIII

INTERRELATIONSHIPS OF COEFFICIENT CORRELATIONS BETWEEN RESULTS OF VARIOUS TESTS

Tests	r	PEr
Dyer Test - Information Test	.098	.050

TABLE VIII--CONTINUED

Tests	r	PEr
Dyer Test - Intelligence Test	-.005	.051
Dyer Test - Motor Educability Test	.779	.020
Intelligence Test - Motor Educability Test	.144	.050
Intelligence Test - Information Test	.363	.044
Information Test - Motor Educability Test	.223	.048

on the Dyer Test with scores on the Tennis Information Test and the Otis Intelligence Test, no significant relationship was found to exist between these factors for the group participating in the study.

The coefficient of correlation between the Dyer Test and the Motor Educability Test is .779 $\pm$ .020. The correlation is high enough to justify the use of this measure for the classification of students for tennis instruction.

In correlating the Otis Intelligence Test with the Tennis Information Test and with the Motor Educability Test, there is a slight positive correlation which shows these factors have some relationship but not enough for group classification or individual prediction.

When the tests of information and motor educability were correlated, the results showed a slight "going togetherness" which revealed that the elements beging tested by the two tests

were but slightly related to each other.

In considering tests suitable for grading beginning tennis students, the investigator wishes to suggest the Iowa Revision of the Brace Motor Ability Test as a means of measuring the probable motor educability of each student the Dyer Backboard Test, and the Original Tennis Information Test as objective measures of students' skill and knowledge in beginning tennis.

In order that students may be given a grade for each test based on a recognized statistical procedure, the investigator suggests basing distribution of grades either upon the mean and standard deviations, the median and upper and lower quartiles, arbitrary percentages of total scores, or by using the median and upper and lower quartiles as guides and determining marks according to breaks or gaps in the distribution of scores.

To determine the final mark or grade for a student in beginning tennis, an equal weighting of information and of skill is suggested.

Conclusions

The findings of this study seem to indicate:

1. A tennis skill test is available for grading beginning tennis players objectively.

2. The Iowa Revision of the Brace Test is usuable for measuring motor educability and for classifying students tentatively according to scores made on the test.

3. A beginner's knowledge of tennis can be ascertained objectively by administering the Tennis Information Test.

4. The Otis Intelligence Test is not usable for classifying students tentatively according to scores made on the test.

5. Marks on tests may be given to students by an objective statistical procedure.

6. The final awarding of marks to students by an equal weighting of skill and knowledge is adaptable to any activity in physical education.

7. The statistical procedures used for tests of tennis in this study are applicable to any sport in physical education.

Recommendations for Future Studies

As a result of the survey of previous studies in the field and as a result of this study, the investigator wishes to recommend the following suggestions for future studies:

1. That objective skill and information tests be developed for measurement of ability of intermediate and advanced tennis students.

2. That the tests used in this study be administered to a representative sampling of colleges throughout the United States.

3. That scores on the Dyer Backboard Test be correlated with scores on a tennis serving test in order to confirm Dyer's belief that there is a high correlation between these two factors.

4. That achievement scales be made available for the Dyer Backboard Test according to the revised scoring method.

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APPENDIX

Tennis Information Test

Name_____ Date_____ True-False Score_____

School_____ Classification_____ Completion Score____

Class_____ Total Odd Score_____ Multiple Choice Score___

Instructor_____ Total Even Score_____ Total Score_____

The aim of this information test is to show what you have learned from your study of tennis. The test has been so constructed that all players are considered to be right handed. The test is divided into three parts. Do not hurry but work steadily, as a reasonable length of time has been allowed for the completion of the test.

Part I. True-False Test

Directions: The letters "T" and "F" have been placed before each statement given below. Encircle the letter "T" if the statement is TRUE. Encircle the letter "F" if the statement, or any part of the statement, if FALSE. If you do not know the correct answer, leave the space blank. DO NOT GUESS. Your score is based on the number of questions right minus the number wrong.

Example: (T) F The return of service in doubles should be low and well placed.

T F 1. The word "tennis" is derived from the French "tenez".

T F 2. Power may be added to a stroke by slightly rotating the body on its own base with a turn of the hips, trunk, and shoulders.

T F 3. The swings of the backhand drive and the forehand drive have a common element.

T F 4. The serve should be slow and easy to allow your opponent to get into position to receive.

T F 5. A bent elbow will cramp a forehand tennis drive.

T F 6. The follow through tends to improve the accuracy of placement.

T F 7. In doubles, the server is allowed to stand behind the baseline back of the alley.

T F 8. One player serves an entire set.

T F 9. In doubles, the order of service may not be changed throughout a match.

T F 10. A player wins the set if she wins six games before her opponent has won five.

T F 11. The maximum number of sets in a woman's match shall be five.

T F 12. Racquet covers protect the strings from dampness.

T F 13. White is the accepted color for a tennis costume in national tournament play.

T F 14. In National tennis tournaments, shorts constitute an approved costume for women as well as for men.

T F 15. The Wightman cup matches are between the U. S. A. and England.

T F 16. In France during the middle ages, tennis could only be played on Sundays and holidays.

T F 17. Racquet covers fit every standard type of tennis racquet.

T F 18. A served ball which touches the net and falls into the proper court is not played, but the service is repeated.

T F 19. Tennis can be traced as far back as the middle ages.

T F 20. Getting too close to the ball causes a cramped elbow.

T F 21. In singles, the server may stand behind the baseline back of the alley.

T F 22. In the backhand drive the elbow starts straightening at the beginning of the forward swing.

T F 23. Any ball that must be replayed is called a let ball.

T F 24. In doubles, one player serves every third game.

T F 25. Tennis is a court game to be played for enjoyment.

T F 26. The handle of the racquet should be large.

T F 27. The winner of the toss has a chance to choose either service or court.

T F 28. "Games All" is a term used to indicate that six games have been won by one person.

T F 29. The forehand drive is complete without body rotation.

T F 30. At the beginning of the forward swing in the forehand drive the weight of the body is on the foot nearest the net.

T F 31. If the ball in play touches the person or clothing of a player attempting to return it, the player loses the point.

T F 32. The ball is in play from the time that it leaves the server's racquet until the point has been decided.

T F 33. The Davis Cup Tournament in tennis is for men only.

T F 34. The Wightman Cup Matches consist of competition for women.

T F 35. The first tennis balls were made of solid rubber.

T F 36. Tennis progressed rapidly in Germany from 1910 to 1926.

T F 37. Lime is the only material used for lining tennis courts.

T F 38. After deuce, a game is won by a player winning two successive points.

T F 39. The object of drives in tennis is to send a swift low drive over the net that will land deep in the back court.

T F 40. The receiver, standing behind the baseline, is struck by the ball served before it has touched the ground. The point goes to the player struck.

T F 41. The tennis racquet may be held with both hands to return a ball.

T F 42. The posts for holding the net should be placed on each side line.

T F 43. Tennis is a universal game popular in all parts of the world.

T F 44. It is necessary for the perfection of techniques to keep the net a standard height for practicing.

T F 45. Grass courts cost relatively little to build and to maintain.

T F 46. In doubles, partners shall receive alternately throughout each game.

T F 47. In doubles, the partner of the server may stand in the center of the service court and thereby obstruct the view of the receiver.

T F 48. Helen Jacobs is the present American tennis champion

among women.

T F 49. It is considered good tennis to try to serve before your opponent is ready.

T F 50. A ball falling on a line is out of bounds.

T F 51. A player must be standing inside of the court to make a legal return.

T F 52. The receiving formation of a doubles team may be changed during a set.

T F 53. A player should move directly toward the ball to get into position for the drive.

T F 54. While there are rules governing the size and weight of tennis balls, there has been no rule established to determine the bound of tennis balls for tournament play.

T F 55. The center mark is drawn outside the baseline.

T F 56. A steel racquet is more suitable than any other type of racquet for beginners.

T F 57. In doubles, the order of service may be changed at the end of each set.

T F 58. A foot fault is made by the receiver if he stands on the baseline.

T F 59. When the tennis ball is given a top spin, the ball rotates in the direction of its flight.

T F 60. The wrist should be rigid in a forehand drive.

T F 61. In the forehand drive, a high back swing with a low follow through will result in a netted ball.

T F 62. A game of tennis is won by winning three successive points.

T F 63. The height of the follow through in the forehand drive may be between the shoulder and hip.

T F 64. The server may step into the court with the right foot before the ball has been hit.

T F 65. For the backhand drive the ball must be pushed with the racquet.

T F 66. While a stroke is being made, the grip on the racquet must remain firm.

T F 67. Tennis started as a simple game, gaining in complexity.

T F 68. The serve should be accurate, reliable, and varied.

T F 69. The cannon ball service puts a reverse spin on the ball.

T F 70. Four different forms of service are the slice service, the American twist, the reverse delivery, and the cannon ball serve.

T F 71. In the forehand drive, there should be a slight pause at the end of the back swing before starting the forward swing.

T F 72. The back swing for the forehand drive should start as soon as the ball has left the racquet of your opponent.

T F 73. The western grip is the accepted grip for the forehand drive in this section of the country.

T F 74. In drives, power is obtained from the grip of the player's hand on the racquet.

T F 75. In tournament play, speed and endurance are the outstanding requisites of the singles game.

T F 76. There is no change in the grip from the forehand drive to the eastern backhand drive.

T F 77. In doubles, one of the keynotes to the game is team work.

T F 78. A test used for determining size of the racquet handle best suited for the individual is made by gripping the racquet so the thumb overlaps the first finger.

T F 79. The body weight is evenly distributed on the soles of both feet during the readiness position.

T F 80. Long running steps are used to move into position for the drive.

T F 81. A steel racquet is recommended for the flexibility of the steel strings.

T F 82. The center mark is an imaginary continuation of the center service line.

T F 83. It is essential for the net to touch the ground along its entire length.

T F 84. Tennis racquets were first used about 1800 A. D.

T F 85. In the Eastern forehand and backhand drive, the player uses two sides of the racquet.

T F 86. Footwork is primarily a matter of weight control.

T F 87. In drives, when a ball is hit with the racquet face closed, the ball is driven high in the air.

T F 88. If it is necessary for a spectator to leave a tournament, she should remain until the game has been completed.

T F 89. In drives, when the ball is hit with the racquet face open, the ball goes low and into the net.

T F 90. One reason tennis should be taught in schools is to

enable people to play better tennis in leisure time.

T F 91. Momentum of the racquet is the chief power that puts speed on the ball.

T F 92. The receiver should return the first serve if it is a fault.

T F 93. Wool socks are worn to prevent blisters and to absorb perspiration.

T F 94. In the final analysis, cement courts are less expensive than other courts.

T F 95. In serving, the ball should be tossed on a line with the left shoulder.

T F 96. In serving, the server should be tense and rigid.

T F 97. In serving, the toss of the ball and the backswing of the racquet should be simultaneous.

T F 98. In the serve, the ball should come in contact with the racquet near the top of the head of the racquet.

T F 99. In the serve advocated for general use, the racquet follows through to the right side of the body.

T F 100. When the racquet comes in contact with the ball on the serve, it is up and over the ball.

Part II. Completion Test

Directions: In the following statements, certain key words or phrases have been omitted. Write in each blank the correct word which makes the statement correct and complete. The test is so constructed that all players are considered to be right-handed players. Your score is based on the number of blanks correctly filled.

Example: An outstanding tennis organization, the United States Lawn Tennis Association, was formed in New York and Boston in 1881.

1. Tennis has its roots in the game of _____.
2. The United States men's No. 1 ranking player for the present year is _____.
3. In the back hand drive, the foot nearest the net is the _____ foot.
4. If a service is delivered when the receiver is not ready, it is called a _____ ball.
5. The _____ of the racquet is the opposite side from the striking surface.
6. The lines bounding the ends of the court are called the _____ lines.
7. The racquet for women should not weigh more than _____ ounces.
8. Overstepping the end line before the service is completed is a _____ fault.
9. The service lines are _____ feet from the net.
10. In a game of tennis, to _____ is to put the ball into play.
11. The score in games is server 8 - receiver 9. The server must win _____ games in succession to win the set.
12. The United States No. 1 ranking woman player for the present year is _____.
13. The stroke used to return balls that come to the left side of the body is called the _____ drive.
14. The unit of scoring next higher than the game is the _____ _____.

15. The server has three points and the receiver has two. The score is _____.

16. The server has four points and the receiver has two. The score is _____.

17. For doubles the court shall be _____ feet wide and _____ feet long.

18. A racquet press is used to prevent the racquet from _____.

19. The most economic court from the standpoint of the upkeep is the _____.

20. The surface most commonly used for courts in this section of the country is made of _____.

21. In doubles, the partner of the player who served in the first game shall serve in the _____ game.

22. Opponents should change sides at the end of every _____ game.

23. The wooden shaft of the racquet which is gripped by the hand, is called the _____ of the racquet.

24. The wooden part of the frame just below the head of the racquet is called the _____ of the racquet.

25. The base line or three-stroke game of tennis includes the _____, _____, and _____.

Part III. Multiple Choice

Directions: Each of the following statements is followed by four possible answers. Underscore the correct word or phrase that makes the truest answer and place its NUMBER on the line at the

right hand side of the page. Your score is based on the number of correct words or phrases underscored and entered on the line at the right.

Example: Any ball which necessitates being replayed is called a: 1. let ball 2. net ball 3. dead ball 4. fault. 1

1. To cover the court most efficiently in singles: 1. remain where the last stroke was played, 2. return to the spot behind the center of the baseline, 3. go to the net after every stroke, 4. return to the service line after every stroke. _____

2. The server may have: 1. only three let balls in succession, 2. only one let ball, 3. any number of let balls in succession, 4. only two let balls in succession. _____

3. The first deuce in a game is called if both players have: 1. two points, 2. one point, 3. three points, 4. four points. _____

4. The stroke used to start a tennis game is the: 1. forehand drive, 2. backhand drive, 3. serve, 4. lob. _____

5. The height of the net at the post is: 1. four feet, 2. three feet, 3. three feet two inches, 4. three feet six inches. _____

6. When serving, a ball that touches the net and falls into the proper court is called: 1. net ball, 2. let ball, 3. a good ball, 4. a fault. _____

7. The smallest score necessary to win a set after the games are tied is: 1. 8-6, 2. 5-5, 3. 7-5, 4. 6-0. _____

8. The score is 40-40. The receiver wins the first point and the server the second point. The score is: 1. 30-40, 2. deuce, 3. 30-30, 4. 40-30. _____

9. A fault is: 1. a let ball, 2. a served ball which fails to land in the proper court, 3. an error made by the net player, 4. an error made by the receiver. _____

10. The least number of games necessary to win a set is: 1. one, 2. five, 3. six, 4. eight. _____

11. Tennis was first played in America in: 1. 17th century, 2. 18th century, 3. 20th century, 4. 19th century.

_____

12. The first service of the game is made to the: 1. left service court, 2. right service court, 3. right back court, 4. left back court. _____

13. The score is 30-15. The server, A, in serving the second ball to B, steps on the baseline. The ball lands in the proper court, but B makes an unsuccessful return. The score now is: 1. 30 all, 2. 40-15, 3. deuce, 4. game for A.

_____

14. In the position of readiness the player stands: 1. with the left side of his body to the net with the weight on the right foot, 2. facing the net with weight on the balls of the feet, 3., with his right side turned toward the net, 4. with his body turned diagonally toward the net.

_____

15. The number of sets played in an official women's tournament is: 1. one, 2. three, 3. seven, 4. five. _____

16. The winner of the Davis Cup for the present year is: 1. England, 2. Australia, 3. Germany, 4. United States.

17. In doubles, for the first serve of the game, the server may stand: 1. where she chooses behind the line from the right of the center mark to the side line, 2. where she chooses behind the line from the left of the center mark to the side line, 3. any place between the side lines, 4. just inside the baseline on the right side of the court. _____

18. The height of the net in the center is: 1. four feet, 2. three feet, 3. height of one racket, 4. three feet five inches. _____

19. The center mark bisects the: 1. side line, 2. base line, 3. service line, 4. the net. _____

20. After playing a game of tennis the racquet should be: 1. hung on a nail by the strings, 2. put in a case, press, and laid flat, 3. placed upright on the floor with the handle down, 4. placed upright on the floor with the handle up.

_____

21. The most advantageous place to stand when serving a singles game is: 1. behind the base line near the alley, 2. with one foot on the base line, 3. inside the base line near the center mark, 4. behind the base line near the center mark.

_____

22. Famous personalities in the game of tennis are: 1. Bill Tilden, Babe Didrickson, and Johnny Weismuller, 2. Helen Wills Moody, Lou Warneke, and Bobby Jones, 3. Helen Jacobs, Donald Budge, Fred Perry, and Alice Marble, 4. Jean Borota, Suzanne Longlen, Ben Beirman, and Helen Driver. _____

23. The easiest height for returning the ball on the forehand

drive is: 1. chest high, 2. below the knees, 3. head high, 4. waist high.

24. A volley is a stroke taken: 1. in the back court, 2. before the ball is bounced on the court, 3. in the fore court, 4. after the ball has bounced on the court. _____

25. If both players have won five games in a set, the official score is called: 1. games-all, 2. five and five, 3. advantage all, 4. set point.

_____

Frequency Distribution of Scores Made on the Dyer Backboard Test

1. Frequency of Dyer Scores Showing the Median, Q_1 and Q_3

Frequencies	Scores	
1	75-78	
3	71-74	
4	67-70	
12	63-66	
16	59-62	
22	55-58	$Q_3 = 55.65$
32	51-54	
18	47-50	Median = 49.37
24	43-46	$Q_1 = 43.09$
23	39-42	
10	35-38	
6	31-34	
3	27-30	
1	23-26	

2. Frequency of Dyer Scores Showing the Standard Deviation ± 3SD

Frequencies	Scores	
1	75-78	
3	71-74	+ 3SD = 73.262
4	67-70	
12	63-66	+ 2SD = 65.753
16	59-62	
22	55-58	+ 1SD = 58.246

32	51-54	
18	47-50	
24	43-46	-1SD = 43.226
23	39-42	
10	35-38	-2SD = 35.717
6	31-34	
3	27-30	-3SD = 28.208
1	23-26	

3. Frequency of Dyer Scores Showing a Given Percent

Frequencies	Scores	
1	75-78	
3	71-74	
4	67-70	
12	63-66	7% = 65
16	59-62	18% = 60
22	55-58	
32	51-54	50% = 50.5
18	47-50	
24	43-46	
23	39-42	18% = 40.5
10	35-38	7% = 35.5
6	31-34	
3	27-30	
1	23-26	

Frequency Distribution of Scores Made on the Original Tennis Information Test

1. Frequency of Information Score Showing the Median, Q_1 and Q_3

Frequencies	Scores	
1	125-131	
1	118-124	
5	111-117	
11	104-110	
20	97-103	
23	90- 96	Q_3 = 90.26
32	83- 89	Median=83.03
25	76- 82	
19	69- 75	
18	62- 68	
4	55- 61	
6	48- 54	
5	41- 47	
3	34- 40	
2	27- 33	

2. Frequency of Information Score Showing the Standard Deviation ± 3SD.

Frequencies	Scores	
1	125-131	+3SD = 128.87
1	118-124	
5	111-117	+2SD = 113.07
11	104-110	
20	97-103	+1SD = 97.27
23	90- 96	
32	83- 89	

25	76- 82	
19	69- 75	
18	62- 68	-1SD = 65.66
4	55- 61	
6	48- 54	-2SD = 49.86
5	41- 47	
3	34- 40	-3SD = 34.05
2	27- 33	

3. Frequency of Information Scores Showing a Given Percent

Frequencies	Scores	
1	125-131	
1	118-124	
5	111-117	
11	104-110	7% = 109
20	97-103	18% = 98
23	90-96	
32	83- 89	50% = 83
25	76- 82	
19	69- 75	
18	62- 68	18% = 66
4	55- 61	
6	48- 54	7% = 52
5	41-47	
3	34- 40	
2	27- 33	