THE VALIDATION OF A RACQUETBALL SKILLS TEST FOR COLLEGE MEN

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CHAPTER I

INTRODUCTION

Formal education is organized to assist individuals in achieving excellence for a variety of purposes. With an increased emphasis on individual differences as they relate to learning, educators must assist students in achieving personal goals. Physical education, a vital part of general education, has its own purposes to educate individuals through the medium of movement. Our complex society requires maximum utilization of ones mental, social, and physical capacities. The educated person realizes he must sharpen both mental and physical skills.

An important means of achieving the goals and objectives of physical education is the acquisition of sports skills. Individual and team sports comprise a major portion of the curriculum in physical education especially at the high school and college levels. H. Harrison Clarke states, "accomplished performance in skills provides incentive for their continuance" (9:300). Perhaps individuals lacking sufficient skill in physical activities not only fail to meet the objectives of physical education but will eventually lose interest if psychomotor potential is not developed to some degree.

Learning physical skills encompasses the foundation of physical education as do carry-over sports such as racquetball. Teaching physical education requires systematic planning if students are to achieve the desired results. Also, accurate knowledge of the student's input or

incoming ability can assist the instructor in structuring and planning course work.

The nature and scope of physical education lends itself to various types of learning experiences. Classification schemes or taxonomies have been developed for three domains of behavior. The domains are: 1) cognitive domain, which uses intellectual skills; 2) affective domain, which exercises interests, attitudes, appreciations, and desires, and 3) psychomotor domain, the attainment of motor skills, which usually receives the primary emphasis in the field of physical education (45:37).

When stated in behavioral terms, the taxonomies or domains for planning produce a systematic procedure for developing knowledge, skills, and values for students. The field of physical education definitely shows trends of moving toward systematic planning for entire curricula and specific courses.

A significant component following the development of objectives, learning tasks, and implementation of programs is the evaluation process. Nelson states, "measurement and evaluation should be considered a means to an end and not ends in themselves" (31:4). Measurement procedures allow physical educators to determine if their goals are being accomplished. The actual evaluation procedure can be formative (during the unit), or summative (at the conclusion of the unit). Skill testing to measure sport performances utilize both formative and summative procedures.

The physical education profession has readily included measurement in conducting programs. The teacher of physical education uses testing as a means of learning and understanding student needs, personal attributes, and potential for learning. Measurement in physical education

includes tournaments, subjective ratings, written tests, attitude scales, and fitness measures to mention a few.

The future of physical education will rely heavily on testing, measuring and evaluation in years to come. The profession must direct its attentions to more objective, rather than subjective, modes of measurement for the purpose of defending and interpreting programs to parents, students, and administrators.

Institutions and teachers are being tested to demonstrate their effectiveness. To become "accountable" competence must be exhibited by student achievement. "If student achievement of motor performance is to be evaluated, measurement procedures must parallel the instructional objectives" (3:14-15). Motor performance tests are definitely one method for demonstrating "accountability."

Motor performance tests can measure such characteristics as general motor ability, motor educability, and skills in specific sports. The focus of this researcher deals with skill tests, which are generally used in physical education to evaluate fundamental skill performance.

The major values of a skill test for the instructor are to aid in determining needs of individuals and appraise the extent to which objectives have been accomplished. Also, a skill test or battery of tests can be utilized to: simulate game conditions without introducing actual game performances or pressures; rank students by assessing individual achievement in relation to others; classify students for instructional grouping or tournament seedings; identify individual strengths and weaknesses; predict ability; provide student motivation and interest; showcase positive and negative reinforcement; drill students during practice sessions; and finally to evaluate teaching methods and

effectiveness in guiding students through learning experiences.

All of the aforementioned values of skill testing are vital to the student and educational process. Physical education, and, specifically, newly introduced sports such as racquetball, need accurate measures of student progress and achievement.

Large numbers of high schools, junior/community colleges, colleges, and universities are offering racquetball instruction on a recreational/educational basis. Related educational experiences in racquetball can provide learning of concepts, practice sessions, and measurement of skill (24:2). Major goals of physical education include fitness for living, provision of recreational or carry-over values, and obtainment of new skill patterns. The field of physical education has traditionally accepted the task of developing organic, interpretive, neuromuscular, and personal-social growth in each individual (5:157).

The commonly listed objectives of physical education are easily recognized by the following values of racquetball: 1) physiological value - the use of large muscle groups provide cardiorespiratory and muscular endurance. Also, coordination, timing, agility, balance, and body control are fitness components which racquetball develops; 2) psychological value - racquetball provides the release of emotional stress and tension associated with every day life; 3) intellectual value - racquetball requires fast thinking and decision making, also, court strategy and ball placement require cognitive learning, and 4) sociological value - racquetball assists individuals in relating to others on an informal basis characterized by sportsmanship and fair play (41:7). The values of racquetball, consistent with physical education, have diffused and expanded throughout the brief history of the sport.

Racquetball is considered the ancestor of handball, tennis, and paddleball. In 1930 Earl Riskey at the University of Michigan began experimenting with a tennis paddle and a rubber ball attempting to adapt handball. During World War II, the Armed Forces included paddleball as a part of their fitness programs. From 1930 to 1965 the growth of paddleball was gradual but constant. The first 35 years included organization of the National Paddleball Association in 1952 with Earl Riskey as president (18:1-2). Another individual, Joe Sobek, is credited with modifying paddleball to include a stringed racquet. During the late 1960's racquetball grew in popularity, and the President of the United States Handball Association, Bob Kendler, helped organize the International Racquetball Association. Dr. Bud Muehleisen helped promote the sport into the 1970's as singles champion and expert clinician (41:11). Throughout the 46-year history of racquetball, few books, articles, or research characterizes the sport. In 1972, the IRA magazine Racquetball was published to provide up to date articles and information on racquetball. The future growth and popularity of racquetball is unlimited with new sources of information, instruction, interest, and facility construction.

The sport of racquetball (often confused with paddleball), is enjoyed by people of all ages and both sexes in an era of booming leisure sports. The past decade has witnessed the phenomenal growth of tennis, golf, handball, and now racquetball. Racquetball for the novice is enjoyable and easy to learn. The sport involves simple rules and requires little inate strength, size, or speed. Other people find racquetball appealing because of the potential fitness values it offers.

The rapid construction of four-wall handball/racquetball courts has

encouraged classes offered by colleges, YMCA's, municipal recreation centers, Jewish Community Centers, and private clubs (48:66). Oklahoma State University is uniquely gifted in having 12 four-wall handball/racquetball courts. Approximately 10 classes are offered during a six-week period each semester and over 300 men and women are provided instruction in the fundamentals of the sport.

The researcher believes that the continued growth of racquetball will gain additional acceptance as facilities, interest, and publicity dictate. Also, growth is contingent upon formal research and standardized procedures to measure proficiencies. Tabulating wins and losses is one method to measure competence in a sport. The disadvantages of using this method for evaluation are enormous to the physical educator and the lay person. The inclusion of racquetball into the physical education curriculum connotes the need for established testing standards to allow more precise skill assessment. Evaluation should reflect the agreement between objectives, goals, and outcomes concerning instruction. After an intensive literature search, the researcher could not locate a valid, reliable, and objective skill test to measure proficiency in the sport of racquetball.

Statement of the Problem

The purpose of this study was to construct a practical skills test or battery of tests to predict and classify beginning abilities of college men in the sport of racquetball. A major consideration was to obtain a valid, reliable, and objective measure of racquetball skill. The reliability was obtained for each skills test item by the test-retest method. Validity was determined by correlating the best trial

for each skills test item with round robin tournament success.

Limitations

The subjects selected for the study were not randomly selected, but limited to intact groups or classes. The investigation was limited to 53 college men enrolled in six sections of Racquetball/Tennis, HPER 2282, at Oklahoma State University during the 1976 spring semester. The 53 subjects ranged in age from 18 to 29 years, and all subjects were beginning level players.

The complete round robin tournament limited matches to eight minutes. During round robin matches players assumed the responsibility of refereeing their own matches.

The round robin tournament and skills testing was conducted on 11 courts at Oklahoma State University. Inconsistencies with regard to court maintenance (wall chips, loose boards, etc.), were realistic limitations of the study.

Delimitations

Each of the six sections were given seven weeks of instruction by the investigator. Four sections met on a Monday, Wednesday, Friday schedule, while two sections met on a Tuesday, Thursday schedule. Total instruction time and play was consistent for all six sections. Sections one, two, four, five, six, and seven of HPER 2282 were utilized for the study.

None of the sample population had previous instruction or frequent competition in racquetball, tennis, or handball prior to selection as a subject. The study investigated each subject's ability using

regulation (20' x 20' x 40'), four-wall handball/racquetball courts.

The racquetball skill test battery included items selected by the investigator. Consultation with a jury of experts assisted the researcher in determining the important skills of racquetball. The actual skill testing was administered by the researcher and 10 well-trained and qualified assistants.

Assumptions

The study was based on the assumption that a subject's racquetball ability could best be determined from the results of a complete round robin tournament. The investigator also assumed that skill in the ground stokes, ceiling, volley, and kill could be measured.

It was assumed that variability in environmental conditions, temperature, time of day, light intensity, and ball "life" were consistent when testing occurred. It was assumed all subjects received identical instruction from the investigator, who taught all participants. It was assumed the battery of tests measured fundamental skills and not motivation, aggressiveness, or fitness.

Additional assumptions of the study were: 1) the "Hawthorne Effect" did not significantly affect the investigation, 2) the examiners independently tested each subject void of spectators, 3) the most important skills of racquetball were evaluated, 4) the battery was interesting and meaningful to the subject, 5) the battery encouraged proper form, 6) fatigue was not a factor which affected test scores and round robin results, and 7) test directions were explicit and consistent for all six sections.

Definition of Terms

1) Battery: "A group of several tests standardized on the same population so that results on the several tests are comparable" (2:573).

2) Ceiling Shot: A shot which strikes the ceiling before hitting the front wall and ultimately rebounds deep into the court (41:196).

3) Criterion: An adjusted score determined by subtracting total points yielded from total points scored during the complete round robin tournament, also, winning percentage.

4) Drive Shot: Hitting the ball low and hard to the front wall.

5) Front-Wall, Side-Wall Kill: "A shot that hits the front wall, then rolls out from the side wall" (49:78).

6) IRA: The International Racquetball Association, the organization governing racquetball play.

7) Match: The term designating a complete contest. An eight minute match game of racquetball singles.

8) Objectivity: "The degree of uniformity with which various persons score the same tests" (2:582).

9) Paddleball: A game played with a solid paddle or one with small holes, which utilizes a pink or dark grey ball, usually manufactured by General Tire/Pennsylvania Athletic Products Company.

10) Pass Shot: A ball hit to one side past an opponent and out of reach (49:79).

11) Racquetball: The four-wall game played on a regulation handball/racquetball court (20' x 20' x 40'), in which each player has a stringed racquet with which to strike a hollow rubber ball (41:3).

12) Rally: A continuous series of returns to the front wall.

13) Reliability: "Dependability, if similar results will occur when the test is repeated by the same group under like conditions" (2:39).

14) Round Robin Tournament: The tournament used in the study in which each subject played against all other players involved.

15) Skill Test: The five-item battery of movement skills including: 1) forehand/backhand rally, 2) backhand rally, 3) volley shot, 4) ceiling shot, and 5) straight kill shot.

16) Straight Kill Shot: A ball which hit directly on the front wall so low it is practically unplayable (41:200).

17) Validity: "A test may be considered valid if it is measuring, as accurately as possible, what it is described as measuring" (2:42).

18) Volley Shot: "Playing the ball in the air before it has bounced" (18:9).

CHAPTER II

REVIEW OF LITERATURE

Historical Review of Measurement

A brief overview of the development of measurement and testing in physical education in the United States is the purpose of this section. The intent of the researcher was to establish justification for the current study concerning construction and implementation of a racquetball skills test. According to Massey, measurement is associated with the thought process, and, therefore, measurement had its origin with man's beginning (35:21).

Prior to 1850 there was very little formalized measurement in physical education, as the field was in its infancy. In 1861 Dr. Edward Hitchcock began anthropometric measuring as the first appointed Professor of Physical Education at Amherst College (2:18).

During the later 19th century Dr. Dudley Sargent was making similar body measurements which he later correlated to strength and endurance of college men at Harvard University (53:5). From the inroads accomplished by Sargent, Frederick Rogers developed a Physical Fitness Index which was considered a valuable tool for classifying levels of fitness in men (2:19). Willgoose states:

> Much of the early research on motor ability and physical fitness carried on by men like Brace, Cozens, Rogers, McCloy, Cureton, Larson, and Clarke was influenced to a considerable degree by Sargent's basic findings (53:7).

From 1900 to 1925, an interest in cardiovascular tests was predominant and a number of physiological studies provided the field of physical education with a scientific foundation. About 1920, E. C. Schneider was employed to measure the heart's response to mild exercise based on blood pressure and pulse rate. Other individuals including Crampton, Barach, Brouha, and Tuttle contributed significantly to fitness testing and measurement (35:26).

In the years between 1900 and 1930, interest in athletic ability testing supplemented the scientific and physiological approaches. Metcalf, Bliss, McCurdy, and Cozens were all leaders in this aspect of testing and eventually developed a variety of tests involving fundamental skills such as running, jumping, and throwing.

The earliest known motor performance tests stressing sport skills were originated in 1913 by the Playground and Recreation Association of America. The Athletic Badge Test evaluated playing ability in volleyball, tennis, baseball, and basketball. A tremendous surge in sports type programs in physical education occurred after 1921 and a greater effort was spent developing skills tests. In 1924, David K. Brace devised a six-item battery of skill tests to measure basketball ability. Also, Elizabeth Beall constructed a battery of tests for use in tennis. During the next 30 years, the development of skill testing was reflected by a steady growth in a variety of team and individual sports (31:12).

Between the years of 1920 and 1960 sport skill tests, knowledge tests, and fitness tests increased in popularity. Publication of the inaugural issue of Research Quarterly in 1930 further enhanced the construction of standardized tests and helped to stimulate interest in all aspects of tests and measurements (2:17).

In the 1960's the trends in physical education testing were enumerated by Barrow and McGee as follows (2:23-26):

1. Refinement in skill testing
2. More testing in the cognitive domain
3. More use of subjective grading
4. More sophisticated techniques for testing
5. Use of diagnostic testing to determine individual needs
6. Continued emphasis on cardiovascular testing for fitness
7. Emphasis on perceptual-motor evaluation
8. Greater use of proficiency tests

In light of the past 16 years the researcher can generally reflect that all of Barrow's and McGee's aforementioned trends were accurate.

An overwhelming majority of the sports skill test batteries have been constructed for high school or college levels. In 1962 the American Association for Health, Physical Education and Recreation (AAHPER) undertook a Sports Skill Project involving the development of batteries of skill tests for 17 different sports. The tests were designed to measure performance levels for school aged students. The skills selected for each sport were determined by expert consultants. All of these tests met the criteria of validity, reliability, objectivity in scoring, administrative feasibility, standardization of instructions, and variability. Because of racquetball/paddleball's minor acceptance during the early 1960's, the sport was not one of the 17 in which a battery of tests were devised.

From 1920 to 1960 standardized skill tests were constructed in most individual and team sports. Although there are a considerable number of skill tests available, many of the tests needed revision and modification.

During the 1970's a slight resurgence in the validation of sports skill testing has occurred due to the emphasis on graduate education and

the number of teachers working on terminal degrees. Constructing a new skills test or re-validating old tests have proven to be valuable post-baccalaureate learning experiences. Skill testing is a viable research project for fulfilling the thesis requirements for many graduate institutions.

After reviewing the literature, the investigator found few skill tests which revealed a high validity or reliability. Other limitations of previous skill tests were too much equipment, length of time to administer the items, lack of available norms, limited applicability, inability of the scores to differentiate performances or a range of individual ability. Another frequent criticism of tests measuring motor performance is the failure to measure the skills under similar game conditions. Upon reviewing the limitations described above, an examination of skills test construction and administration was warranted.

Skills Test Composition

The key to designing an adequate skills test depends on planning and organization. Low quality skills tests are usually inefficient due to careless item selection and poor evaluation procedures. Safrit believes the construction of skill tests will vary according to purposes used. Tests can be constructed to measure certain skills, combination of skills, playing ability, or contribution to a battery of tests (42:161). Baumgartner and Jackson mention "skill tests require the creation of an environment similar to the game environment and the standardization of procedures for administering the tests" (3:224).

Sheehan says the first decision an instructor should make for test construction is whether the process or the product of the skill test

should be assessed (45:204-206). In other terms, should the purpose of the skill test be to identify and measure fundamental skills involved in a performance or should the "how" to specific skills be assessed. Generally, the two most common methods for measuring psychomotor objectives are skill tests and rating scales. The researcher will identify a step-by-step outline for each method.

Safrit suggests the following procedures when constructing skill tests (42:169-172).

1) Decide on the purpose and use of the skills test.
2) Determine if mastery levels are needed (formative evaluation) or norms (summative evaluation).
3) Identify and rate principle skills involved in effective participation. Define a good performance.
4) Review the literature for previously validated tests and secure expert opinions.
5) Select the groups by age, sex, education, and skill level.
6) Design the test and select the items.
7) Standardize directions for use.
8) Determine test reliability.
9) Select and obtain a criterion for comparison (validity).
10) Develop a battery of skill tests by correlating test scores to a criterion to formulate an optimal regression equation in which each test is given a weighting.
11) Develop norms if the tests are reliable and valid.

The most important qualities of a skill test concern the reliability, validity, and objectivity. These concepts will be discussed in greater detail later. Emphasis on the important abilities, those listed

as educational objectives and covered during instruction, should be measured.

Many writers recommending skill tests have examined characteristics used in sports skills and categorized test items in a variety of ways. Eckert associates sports skills with the following groupings: 1) the application of maximal force, 2) accuracy of projection of objects, 3) receiving moving objects, and 4) speed of body movements while controlling an object (15:84-87).

Baumgartner and Jackson reported that skill tests used to evaluate learning can be categorized into four general groups: 1) accuracy tests, 2) wall-volley tests, 3) total bodily movement tests, and 4) throws, kicks, or strokes for power, time, or distance (3:224). Safrit states that all items can be designed to use a measurement of time, distance, number of executions, accuracy, velocity, or form as well as a variety of combinations of these measures (42:172). The strengths and weaknesses of each category and methods of measurement are obvious, but measures of accuracy in conjunction with measures of execution during a timed period seem most appropriate for the skills necessary in racquetball. The selection of test items must lend themselves to standardization, consistency, validity, and maximal control of outside variables.

Baumgartner and Jackson have established this criteria for selecting skill test items (3:100-104):

1) Does the test encourage good form?

2) Does the test sample a range of abilities?

3) Does the test differentiate at different levels of performance?

4) Is the test appropriate for mass testing?

5) Are the skills being measured familiar to students so a minimal amount of practice is needed?

6) Is the test easily prepared, administered, and scored?

7) Is each student individually tested and isolated?

8) Do the items measure single attributes?

9) Does the test require a minimal amount of equipment, time, personnel, and explanation?

10) Is the test challenging, enjoyable, safe, and meaningful?

The use of rating scales for subjective opinions and estimates of a sports skill are effective instruments when objective measures are impossible. Usually experts or judges are employed to assess abilities in well defined skills utilizing descriptive or numerical scales for each component measured. Barrow and McGee recommend the following preliminary factors to be considered when constructing a rating scale (2:558-562):

1) Determine the purpose of rating.

2) Determine the measurable traits.

3) Divide each trait into sub-traits.

4) Select and fully define categories.

5) Use number values for points on the scale.

6) Prepare rating sheets.

7) Employ well trained and qualified raters.

The criticism surrounding the use of skill tests in physical education has been a topic among physical educators over the past 40 years. As with any form of measurement, subjective or objective, a test is only as good as its objectives, organization, evaluative procedures, and the evaluator.

The researcher will report related research in tennis and handball since the striking patterns or movements are similar to those used in racquetball. The overhand, underhand, forehand, and backhand or non-dominent stroking are used in all three sports to various degrees. Also, the four-wall handball court is identical to the court used in racquetball, therefore the researcher can confidently state the games are analogous with respect to basic shots, strategy, and court positioning of the players.

Tennis Tests

Many attempts have been made in the last 40 years to develop objective skills tests to measure tennis ability. This section will survey the most appropriate tennis tests including related skill items which would be utilized in constructing a racquetball skill test.

The Dyer Backboard Test was one of the first motor performance tests constructed which was accepted by most authorities as reliable and valid. Dyer (14) developed the test in 1935 and revised it in 1938, to measure and classify progress made in tennis. The test consists of volleying a tennis ball above a specified line on a wall, while standing behind a restraining line during a 30 second time period. Dyer reported a correlation of .92 between scores on the skills test and the relative positions of the subjects following a round robin tournament. Reliability of this test ranged from .86 to .90. Over the years, many researchers in the tennis area felt the Dyer Test did not discriminate sufficiently at the beginner level of skill.

Various researchers have adapted the distance from the restraining line to the wall and the total volleying time of the test. The most

accepted revised form of the Dyer Test was developed by Scott and French. These authors stipulated a restraining line of 27½ feet as opposed to the Dyer Test of 5 feet. These authors felt better form would be encouraged. This test was constructed to measure general tennis ability of college students. The test measured the consistency with which the student was able to rally the ball against a wall during a 30-second trial. Scott and French found a validity of .61 with a criterion of subjective judges ratings on stroke form and footwork. The reliability coefficient yielded a .80 (2:331).

In 1965, Hewitt (27) revised the Dyer 1938 backboard test with the following revisions: The target area for the Hewitt Revision of the Dyer was 20 feet high and 20 feet wide. The restraining line was installed 20 feet from the wall. A net line was drawn on the wall three feet from the floor. The procedures included a two-minute warm-up period prior to testing. The student was to rally the ball against the wall for 30 seconds, using any stroke desired. Restrictions required the subject to stay behind the line and accurately place the ball above the net line to be awarded a point. The final score for the test was the average of three trials. The reliability was .93 for advanced players and .82 for beginners. The validity as compared to tournament standings ranged from .68 to .89.

In 1950, Broer and Miller constructed forehand and backhand drive tests for female college students of beginning and intermediate ability levels. The Broer-Miller Test allowed 14 placement or accuracy shots in designated scoring areas using the forehand and backhand strokes. The test was designed to measure the student's ability to drive the ball to the opposite baseline. Reliability was calculated by comparing the

subject's 14 forehand and backhand drives. The correlation coefficient was .80 for beginning players and .80 for intermediate students. Validity was computed by correlating subjective ratings on form with performance on the test. The correlation for intermediate students was .85. The beginning group had a correlation of .61 (2:334).

Hewitt's Tennis Achievement Test (26) was constructed in 1966 to evaluate the three fundamental skills in tennis: The serve (speed and placement), the backhand drive, and the forehand drive. The test was designed for beginning, advanced and varsity players. During the test the instructor hit balls to the students forehand and backhand and they returned the ball to zoned areas. The service portion of the test included measuring speed and accuracy of served balls. The reliability coefficients, using test-retest, ranged from .75 to .95 and validity coefficients from .52 to .93 when correlated with rankings after a round robin tournament.

In 1968, Hewitt (25) devised two classification tests for tennis which took 30 seconds to administer. The tests were:

1) Hewitt's Bounce Test: The subject used a forehand grip on the racquet to continually bounce the ball on the court to hip height or above in 30 seconds. Three trials were given and the best was recorded.

2) Hewitt's Shoulder Test: The subject would use the racquet to bounce the ball upward to a point above shoulder level alternating forehand and backhand grips on each successive hit. The score was the best point total on three 30-second trials. The test-retest reliability for the bounce was .88 and .83 for the shoulder test.

The Kemp-Vincent Rally Test (32) was developed in 1968 for the purpose of classifying students and to rate playing skill. The test was created to test students on rallying ability while under game conditions. The test was easy to administer and required no specific equipment or line markings. The major drawback concerning this test centers around the use of two subjects dependent on each other to score. The subjects would rally the ball across the net for a three minute period. The test-retest reliability was .86 for beginners and .90 for intermediate players. The validity was found to be .84 and .93 for beginning and intermediate players, respectively.

In 1969 the Digennario Tennis Battery was developed consisting of the forehand drive test, backhand drive test, and service test. Test-retest reliabilities were .80 for the backhand, .66 for the forehand, and the serve was .80. The validity coefficient using rank-order correlations between test scores and stroke success percentage was .40 for the forehand, .78 for the backhand, and .66 for the service test.

In 1972 Sherman (46) constructed a battery of tennis skill tests for beginning level students. She chose three main tests: 1) Untimed Consecutive Rally Test, 2) Untimed Consecutive Volley Test, and 3) Service Test. The single best estimate of tennis ability was the rally test, which yielded a validity coefficient of .60. Multiple correlations indicated the Untimed Consecutive Rally and Service Tests could be effectively combined into a battery. The validity of this battery was .62 and the reliability was .92.

Other significant studies using skill tests concerning tennis ability have been developed by Summers (50) and Fox (19). A survey of the literature indicated that many attempts have been made to devise

objective tennis tests. The researcher summarized only the most familiar and statistically significant studies.

Handball Tests

In 1938, Clayton Cornish (11) devised the most scientific and probably most valid procedure for measuring ability of college men in four-wall handball. Cornish selected six physical education classes that met three times a week for 30 minutes a day for 12 weeks. His test items consisted of: 1) power test, 2) back wall placement, 3) 30 second volley to the front wall, 4) service test, and 5) front wall accuracy placement. After one week of instruction, the five tests were administered to an experimental group of college males. After 10 weeks of practice and play the same tests were again administered to the same group. The final four weeks of class were used for tournament play in which all subjects played 23 games. A multiple correlation of .69 was obtained between the five tests using the total number of plus points during a 23-game round robin tournament. The total number of points each subject scored minus those scored against him served as the criterion. The power test correlated most highly with the criterion at .58. A multiple correlation of .67 was obtained between a combination of the power test and the 30-second wall volley. In light of the results, the power test has been used most extensively in the past 25 years. Reliability was not established.

Hemmer (24) replicated Cornish's Skill Test Battery in 1972. He attempted to determine reliability and validity of Cornish's tests in measuring handball ability when compared with the results of a round robin tournament. One hundred twenty-five college men were divided into

six groups at Eastern Kentucky University. All subjects took Cornish's battery and played round robin singles within their respective groups. The findings and conclusion of the study were as follows:

1) There was a significant difference in ability between the six groups.
2) The reliability coefficient for the Service Placement Test was .50. A computed $\bar{r}$ for the 30-second volley was .73. This item or a round robin singles tournament may be used to determine handball ability.
3) The Cornish Skill Test Battery was not a valid measure of handball ability due to the low reliability of the Service Placement Test.

Pennington and others (40) constructed a handball test, in 1967, using 17 strength, motor ability, and handball skill test items. Thirty-seven college subjects were tested to measure status and progress in acquiring handball skills. These researchers adapted Cornish's test items to include skills involving use of the non-dominent hand. Also a shuttle run and strength tests were included with this handball battery. The average scores per game obtained in a partial round robin tournament served as the criterion. A 15-point contest was considered as one game. The multiple correlation of .80 was obtained between the criterion and service accuracy, total wall volley, and the back-wall volley. A multiple r of .79 for the service placement and total wall volley was reported. Those two items were chosen as the final test battery for predicting status of handball ability.

Christ (7) attempted the construction of a valid skills test for one-wall handball in 1973. A one-wall round robin tournament was

conducted in which 13 subjects participated. A game consisted of 15 points and the average points scored per game by each subject was used as the criterion. The battery of handball skill tests items correlated to the criterion were: 1) Volley Test, 2) Volley-Speed Test, 3) Power Test, 4) Kill Shot, and 5) Service Placement Test. The findings disclosed the Kill Shot Test achieving the highest correlation with the criterion at .85. All five items correlated at .91 with the criterion. The lowest correlation involving a single test item was achieved by the Service Placement Test with a .37. Finally, the ideal battery including the speed volley, volley, and kill shot provided a multiple correlation of .96.

Sattler (43) developed a test battery in 1974 to classify beginning handball players. The investigator included seven skill test items requiring little equipment and time: 1) dominant front wall kill, 2) non-dominant front wall kill, 3) dominant overhand return, 4) non-dominant overhand return, 5) 30-second non-dominant hand volley, 6) 30-second dominant hand volley, and 7) one-minute continuous back wall volley. A multiple r of .92 was reported between items 1, 7, 5, 3, and 4 listed above. A multiple r of .90 was reported for items 1, 7, and 5 listed above. The researcher correlated the skill test scores with a partial round robin tournament based on total number of plus points earned by subjects. Reliability and objectivity were determined by test-retest and examiner changes. It was concluded that either a three or five item test battery would be appropriate for use to measure handball ability. This researcher felt that Sattler's study could serve as a basic model for developing a racquetball test battery for college men.

Paddleball/Racquetball Tests

In reviewing the literature on racquetball no scientifically constructed skill tests were found. However, the researcher will cite related studies in paddleball, the energy cost of racquetball, and a cinematographical analysis of racquetball serves. Also, two racquetball skills tests have been recommended, yet no standardized procedures were utilized.

In 1966, Walden Gurney (23) devised a paddleball skill test to measure ability in paddleball for college men. This study proceeded to: 1) determine the fundamental skills of paddleball, 2) determine the tests for measuring the basic skills, 3) verify validity and reliability, and 4) establish a table of norms.

Gurney selected a jury of experts to rank the fundamental skills of paddleball. A scale from 1 to 10 was developed, and the experts rated each proposed skill. A skill receiving a rating of five or greater was selected for use in the study. The following four tests were determined: 1) Service Test, 2) Front Wall Volley Test, 3) Corner and Front Wall Placement Test, and 4) Back Wall Recovery Test.

The test battery was administered to 25 male subjects at Brigham Young University on two different occasions. All subjects participated in a complete round robin tournament using the number of wins to rank the players. This procedure determined the criterion. Test-retest reliability obtained a mean total of .80 for three of the skill tests. Validity using three skills tests was .56 while the objectivity coefficient was .86.

A study not related to skill testing, yet worthy of remark, was a study performed by McKie (38) to determine the energy cost of racquetball

singles, cut-throat, and doubles. Four skilled racquetball players were tested by heart rate monitoring during activity. The use of bio-telemetry apparatus and oxygen intake were predicted from heart rate means. Predicted oxygen intake means were abstracted for all subjects during singles, doubles, and cut-throat play. Since racquetball can be a vigorous cardiovascular activity, the significant results revealed the following:

1) Mean heart rates were highest when playing singles.
2) Mean predicted oxygen intake was 2.4 liters per minute during singles, 1.75 liters during cut-throat, and 1.65 liters during doubles competition.
3) Caloric cost was 12 calories per minute during singles, 8.75 calories during cut-throat, and 8.15 calories during doubles.
4) A significant difference in energy cost was reported between singles and cut-throat, and singles and doubles. No significant difference was announced between doubles and cut-throat.

Another non-skills test study was reviewed by Reznik (41) entitled "A Cinematographical Analysis of Three Selected Serves in Three-Wall Racquetball." This study was conducted by William A. Mathews at the University of Florida. The study used two skilled and two unskilled performers. The subjects were filmed performing a power stroke, lob, and two-wall serve on outdoor three-wall racquetball courts. The film was assessed using a slow motion projector. The significant results of this study were:

1) Open, closed, and square stances did not significantly affect the outcome of the serve.
2) Skilled servers were found to project the ball farther away

from the body, upon contact, than unskilled servers.

3) Flexed- and straight-elbow strokes were used by both groups. Resultant velocities revealed that no one method was best.

4) All subjects exhibited wrist roll, yet the skilled performer's technique for wrist roll was more pronounced.

5) The skilled performers demonstrated better eye contact when stroking than the non-skilled performers.

6) Average ball velocities for a power stroke yielded 98.18 ft./sec. for unskilled as compared to 109.18 ft./sec. for skilled performers.

Wickstrom and Larson state "there are no standardized tests available for measuring skill in racquetball" (52:75). With this problem in mind these authors have devised a skills test for instructor use. The two-item test includes a Rally Test and the Volley Test. The writer's project the tests as valuable tools in measuring general player ability in racquetball. Also, these tests purport to indicate accuracy, control, and bodily movement to the ball. The items will be briefly described.

The Rally Test incorporates use of the forehand and backhand strokes to successively rally the ball off the front wall. The service line, 15 feet from the front wall is the restraining line and a four feet high taped line is stretched across the front wall for accuracy. The subject attempts to hit the ball beneath the four foot line with enough force to produce successive rebounds. The score is tabulated by the total number of successful hits in three 30-second trials.

The Volley Test includes a taped line stretched across the floor, 10 feet from the front wall. The subject attempts to volley the ball consecutively off the front wall, behind the restraining line. The

score for the test is the total of three 30-second trials.

Reznik (41) has constructed a five-item battery of tests to measure progress in racquetball. These tests are presently in use for students enrolled in racquetball courses at New Mexico State University. The test items include:

1) The Sixty Second Rally Test: This test, similar to the Wickstrom and Larson Rally Test (52), incorporates both forehand and backhand strokes to measure speed, accuracy, and control. The main differences suggest a 60-second rather than 30-second rally, and a 20-foot rather than 15-foot restraining line. Otherwise, all procedures are identical.
2) The Sixty Second Backhand Rally Test: This test is identical to the first test, except only backhand strokes are utilized.
3) The Power Drive Test: The floor of the court is divided into six areas beginning at a point behind the short line. The areas are numbered from one, the easiest, to six, the most difficult. Also, a four-foot high taped line is stretched across the front wall. The subject attempts 10 trials by stroking the ball to the front wall, followed by a power shot to the front wall trying to land the ball into one of the six zones or areas.
4) Shot Placement Tests: These tests included a front-wall and back-wall ball placement and similar procedures as stated in item three. The scoring zones were posted on the front wall with point totals from one to five.
5) The Service Placement Test: The floor of the backcourt is divided into five scoring zones. Points are awarded when a

serve strikes the front wall and legally rebounds into a scoring area. Ten trials are given.

Both skill tests previously described by Wickstrom/Larson and Reznik have not been standardized nor found to be statistically significant. Reliability, validity, and objectively coefficients have not been found for these tests in the literature. The investigator does feel both tests merit further investigation.

Summary

The researcher would like to reiterate the foundation and basis of Chapter I. Tests of motor performance should be developed in a scientific manner in order to assess student's abilities accurately. Also, for an instructor to determine whether the objectives of physical education are being accomplished, valid measuring devices are necessary in all sport skills.

Chapter II encompasses a historical overview of measurement, how to construct and administer skill tests, and contains a description of published skill tests in tennis, handball, and paddleball/racquetball. Clarke states "from the time that physical education was first recognized as a discipline, physical educators have had a keen interest in measurement, particularly the construction of evaluation instruments" (9:4).

In this section the investigator offered a concise review of the history of testing in physical education in the United States beginning with the work of Hitchcock and Sargent and proceeding to the trends of the 1970's.

The early history of sports skill testing indicates a great need for updated, reliable, valid, and objective tests in a variety of activities.

After surveying the literature by measurement authorities concerning skill testing and rating scales, the researcher felt the suggestions mentioned would definitely assist instructors in constructing tests. Related tennis and handball studies have been investigated by reason of similarities to the sport of racquetball. Wall-volley items are generally well accepted methods of establishing playing skill in tennis and handball. A variety of validity criteria methods were used from sport to sport, some were: 1) subjective ratings by sports authorities, 2) other validated tests, and 3) tournament play in the sport. Partial or complete round robin tournaments seem most adaptable for individual sports. Coefficients of reliability have most often been determined by the test-retest method. Validity was generally determined by composite test scores, but comparing groups of known ability and subjective ratings have also been used.

A great need exists for continued efforts in the construction and revision of valid skill tests for all sports. Little research has been conducted concerning motor performance in racquetball, and therefore the lack of reliable and valid measures of racquetball ability are evident. Measurement problems will continue to exist until scientifically standardized tests are constructed. The background information in this section helped the researcher in designing his test for racquetball.

CHAPTER III

RESEARCH PROCEDURES

This chapter describes the methods used to collect and analyze the data. Also, a description of all skill test items and equipment utilized is presented.

Selection of the Sample

The population consisted of 53 male students enrolled in Racquetball/Tennis, HPER 2282 during the spring semester, 1976. Approximately 76 male subjects were initially enrolled in these coeducational courses taught by the investigator. All male students were prospective subjects, yet the attrition figure totaled 23 due to a variety of circumstances. The researcher used his expertise from previous teaching and play to exclude advanced subjects following the first week of instruction. Individuals having previous instruction or tournament participation were also excluded.

Six out of eight sections offered were used as intact groups. The six sections included in the final population produced the following enrollments: 7, 10, 11, 6, 10, and 9 subjects. The beginning level racquetball unit lasted the first seven weeks of the semester.

Equipment and Written Materials

The following equipment was utilized during the study:

1) Vittert (V-77) racquetballs were exclusively used for instruction, skill testing, and tournament play. The HPER department provided racquetball racquets and balls for class instruction. Six dozen new racquetballs were donated by the Recreation Department for skill testing and tournament play.
2) Regulation IRA racquets were checked out by the Colvin Center equipment room. A few subjects purchased their own regulation racquets.
3) The use of pencils, a yardstick, clipboards, stopwatches, 3/4 inch black electrical tape and coins were needed to conduct the study.
4) Scorecards, round robin tournament sheets, and round robin result sheets were constructed by the investigator for recording results.
5) An introductory letter to students was distributed on the first day of class informing subjects of the purpose of the study.
6) A preference sheet designating dates for outside of class round robin matches was devised and forwarded to each subject.
7) A list of procedures for administration of round robin matches were developed and used.
8) The investigator developed a rating sheet to solicit expert opinion from which to construct the skill test items.

Pilot Study

A pilot study was conducted during the fall semester, 1975, at Oklahoma State University involving 10 racquetball players. The pilot tests were administered to determine the feasibility of six test items with regard to beginner level ability, ease of administration, and test length. The pilot study assisted the researcher in test selection, in refining test directions, and administration.

Following an intensive search of pertinent literature the researcher believed the three most important strokes in racquetball were the forehand, backhand, and overhead striking patterns. With this in mind, the researcher's selection of tests for the pilot study included: 1) Forehand/Backhand Rally; 2) Backhand Rally; 3) Front-Wall Kill Shot; 4) Ceiling Shot; Volley Shot; and 6) Back-Wall Rally.

Coefficients of reliability were calculated by the investigator following the pilot study. The test-retest method using the Pearson Product Moment Method of correlation was used. The following $\bar{r}$'s were computed: 1) the Forehand/Backhand Rally--.74; 2) Backhand Rally--.87; 3) Front-Wall Kill Shot--.73; 4) Ceiling Shot--.94; 5) Volley Shot--.95; and 5) Back-Wall Rally--.43. A reliability coefficient of .70 was used to accept or reject each item for the final battery of tests. Therefore, the Back-Wall Rally was eliminated from the final study.

Skills Test Selection

The strokes in racquetball play resemble those of most racquet sports, which utilize the forehand, backhand, and overhead strokes. The battery of items were developed to measure the fundamental skills which

were identified by an analysis of the game through use of pertinent literature, consulting with OSU instructors, tabulating a frequency chart of skills used during a game situation, and consulting four experts with regard to the important skills of the game. The process of skill test construction involved decisions regarding target areas, scoring for target areas, test length, restraining lines, number of balls used, score sheets, and overall administrative ease. The criteria followed in the construction of the tests were those characteristics elaborated on by Safrit (42:169-172), and listed under the heading "Skill Test Composition" in Chapter Two. The tests were constructed with the hope of bringing them as close as possible to an actual game situation.

The selection of a jury of authorities was made by the investigator. The selected jury were all members of the IRA and were selected because of their knowledge of racquetball and their proficiency in playing the game. The availability of the jurors was also a factor influencing their selection. The investigator felt more significant results could be obtained from a select group of qualified experts, rather than a large number of people with less experience. The experts included: Myron Roderick, Randy Stafford, Roland Treat, and Tom McKie.*

The experts were asked to review a list of suggested skills which included three categories: 1) General Skills, 2) Basic Shots, and

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*Two of the four experts, Stafford and Roderick, have been nationally ranked racquetball players. Stafford (49) has authored a book on racquetball instruction used by the staff at Oklahoma State University. Tom McKie is current Executive Director of the IRA and active in singles and doubles competition on a national level. Roland Treat, from Stillwater, Oklahoma, is a well known regional and Oklahoma state player who has also taught courses in racquetball at Oklahoma State University.

3) Other Qualities. The experts were asked to priortize the important fundamentals of racquetball to assist the researcher in deciding on the best skills to measure beginner level ability. Through this process, it was hoped that the skills of greatest and least importance would be identified (see Appendix A). All four rating forms were returned prior to actual skill testing. From the rating given each skill, its mean rating, and final rank was computed as shown in Appendix A. Also, three of the four experts provided input after examining the researcher's finalized skill test battery. A review of significant literature concerning the most important racquetball skills follows.

Concerning racquetball play, Wickstrom and Larson state, "the forehand and backhand strokes are general skills, they become specific game skills by being used in particular ways in the game" (52:25). The four basic strokes have been mentioned, the pass, kill, lob, ceiling, and back-wall shots utilize these strokes from both defensive and offensive standpoints. The forehand and backhand strokes are used for serves, kill shots and passing shots. A forehand/backhand test would measure accuracy, court position, dominant and non-dominant stroking, eye contact, and reaction to rebounds and return angles. The overhead stroking pattern can be used for passing, lobbing and the ceiling shot. Volleying ability is useful for kills, passing, and lob shots. The kill shot can take many forms such as straight kill, corner kill, fly kill, and back-wall kill. The investigator concentrated on the elementary straight or the front-wall kill since beginning players comprised the study. The back-wall shot, which is used for passing, and the kill were omitted as a result of the pilot study.

In light of the information presented above, and reflection of

previous research in handball and tennis, the battery of motor performance tasks consisted of six items. The six items were: 1) Forehand/Backhand Rally, 2) Backhand Rally, 3) Ceiling Shot Placement, 4) Front-Wall Kill Placement, and 5) Volley test. Items 1 and 5 above were tests suggested in the text developed by Wickstrom and Larson (34). Items 2, 4, and 5 are skill tests previously used in tennis and handball having been modified to the needs of the investigator. The ceiling shot was created by the researcher due to the recent emphasis on the skill.

Reznik concluded that the ceiling shot has changed the sport dramatically. The technique used should incorporate an overhand stroke so that the ball strikes the ceiling first and proceeds to rebound in back court, yet not hard enough to rebound off the back wall (41:42).

Player success in racquetball was analyzed by Stafford:

> Before the ceiling ball was introduced in 1969, racquetball was more or less a one dimensional game. A premium was placed on kill shots, passing shots, and overall power. The ceiling ball revolutionized the game to put ones opponent at a disadvantage and to compete with power players. Power strokes are still important, but they no longer dominate the action (49:29).

The jury of experts rated the serve as the most important basic shot. The researcher did not include a service test item due to time considerations, extensive court markings and the inability to distinguish the criteria for a good service. The obvious characteristics of a good serve include accuracy with regard to direction and placement. However, the type of serve a player uses depends on his strengths and the opponents weaknesses. The various types of serves include: 1) lob serve, 2) low z-serve, 3) low drive serve, 4) v-serve, and 5) the high z-serve (49:21-28). All of these serves are performed for a specific purpose and each maintains certain characteristics.

Charles Brumfield states, "a good serve leaves the server well on his way to scoring a point while a weak one allows the opponent to move the server out of center court and gains control of the rally" (48:81). Fleming and Bloom state in their text, "a good serve permits the server to remain on offense and in control of the game. The best serve to use is one that bounces toward your opponent's weaker side" (18:52). It should be evident to the reader that no one type of serve is best. With this reasoning in mind the researcher concluded that accuracy and power could be measured using the Forehand/Backhand Rally and the Ceiling Shot.

Other factors for success in racquetball include a high fitness level, complete eye contact throughout each stroke, anticipation, correct position, variety and sequencing of shots, changing ball speed during play, footwork and body position, and the timing of strokes used. The investigator felt these qualities could only be assessed through subjective ratings, and therefore would not be included in the final battery of items. However, one or more of these qualities are encompassed in the skills items used in the study.

Description of the Tests

This section provides the reader with an opportunity to study the details and descriptions of the five racquetball skill tests constructed by the investigator. Also, illustrations and court markings are provided. These were the directions verbalized and demonstrated to all subjects and assistants.

1) Forehand/Backhand Rally: Stand behind the restraining line (short line) with two racquetballs in one hand. On the signal, "Ready, Begin," drop one ball to the floor, let it bounce, then hit the ball to

the front wall. Hit the ball with enough force so the ball will rebound back to you. Each time you hit the ball behind the service line causing it to strike the front wall, one point will be scored. Continue to rally the ball as quickly as possible without losing accuracy. The ball may bounce more than once after hitting the front wall. If both balls are lost you must retrieve one of the two balls started with. The score will be the greater number of legal hits for two 30-second periods. The forehand or backhand may be used, provided you contact the ball behind the short line. You may cross the end line to keep the ball in play, yet any scoring will not count. A legal hit must strike the front wall or side wall/front wall in the air. Volley shots will not count (see Figure 1).

2) Backhand Rally Test: The exact same procedures used in item 1 will be used for item 2, except only backhand strokes may be used. Also, it is suggested that the subject give himself plenty of room to perform the backhand skill (see Figure 1).

3) Ceiling Shot Placement: Stand behind the short line and stroke the ball using a lob serve to the front wall. When the ball rebounds, position your body to attempt a ceiling shot. Ideally, the ball should come off the ceiling, rebound near middle court, then rebound again in back court. When the ball hits the floor a second time upon rebounding from the ceiling, a point total or score will be assessed for ten trials. The following point totals will be assigned: the door and the baseboard to a 2½ foot line taped across the back wall is worth 5 points, the baseboard to a 5 foot line taped across the back wall is worth 3 points, the baseboard from a 2 foot line taped across the floor is worth 4 points, the baseboard from a 4 foot line taped across the floor is worth

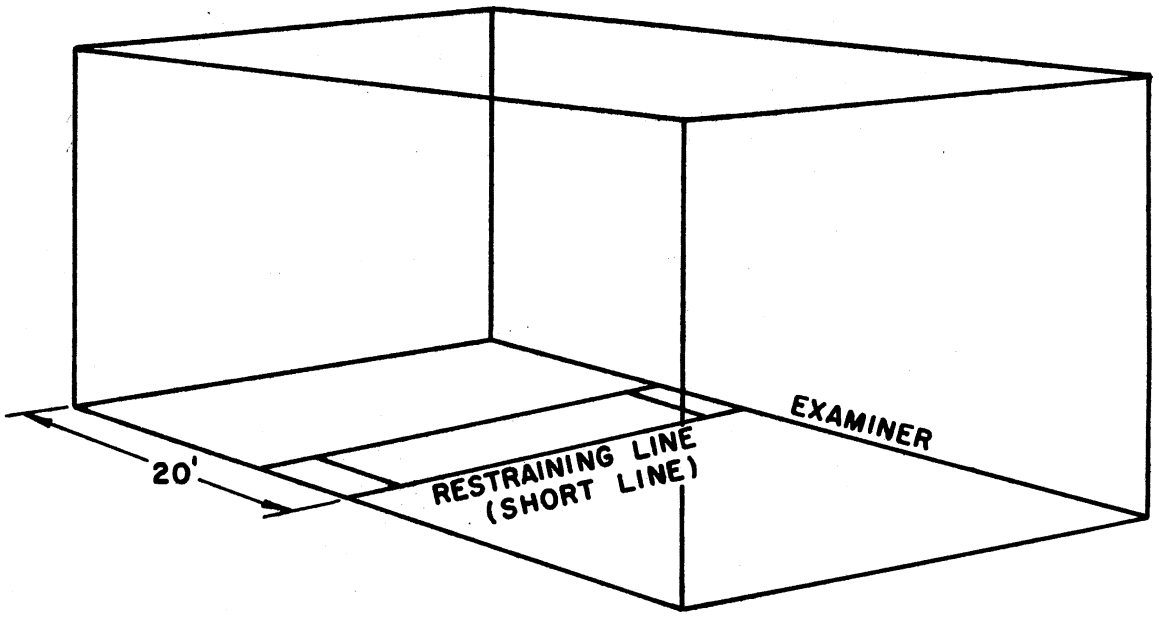

Figure 1. Forehand/Backhand Rally Test and
Backhand Rally Test

2 points, and the baseboard from a 6 foot line taped across the floor is worth 1 point. If the ball does not strike any of the zones, zero will be recorded for that particular trial. To be successful the subject must attempt to hit the ball following each of his set-ups for the 10 trials. No extra trials will be allowed. Also, a ball must hit the ceiling first, then front wall on the initial return. The total or sum of all 10 trials will be recorded. Fifty points are possible (see Figure 2). An attempt which strikes a taped line will be awarded the higher value.

4) Front-Wall Kill Placement: Stand behind the short line and drop the ball, proceed to stroke it to the front wall. Upon the ball's return, after bouncing once, use the proper forehand or backhand stroke to attempt a kill shot. The ball must hit the front wall, in the air, between the baseboard and the taped line located 2 feet from the floor. The player is not allowed to step across the short line to attempt the kill shot. The subject must attempt to hit the 10 trials he has served himself. No extra trials will be allowed. The front wall must be struck first, side/front combinations will count as unsuccessful. A ball striking the tape will count as successful. The successful attempts in 10 trials will be recorded (see Figure 3).

5) Repeated Volley Test: The restraining line is marked 10 feet from the front wall. Stand behind the line with two balls in one hand, at the signal, one ball is hit out of the hand against the wall. Each time the ball is returned against the wall without hitting the floor or other walls, 1 point will be scored. The ball may be struck after it has bounced to keep it in play, but the subsequent hit against the wall does not count. The score is recorded for the greater point total using two 30-second trials (see Figure 4).

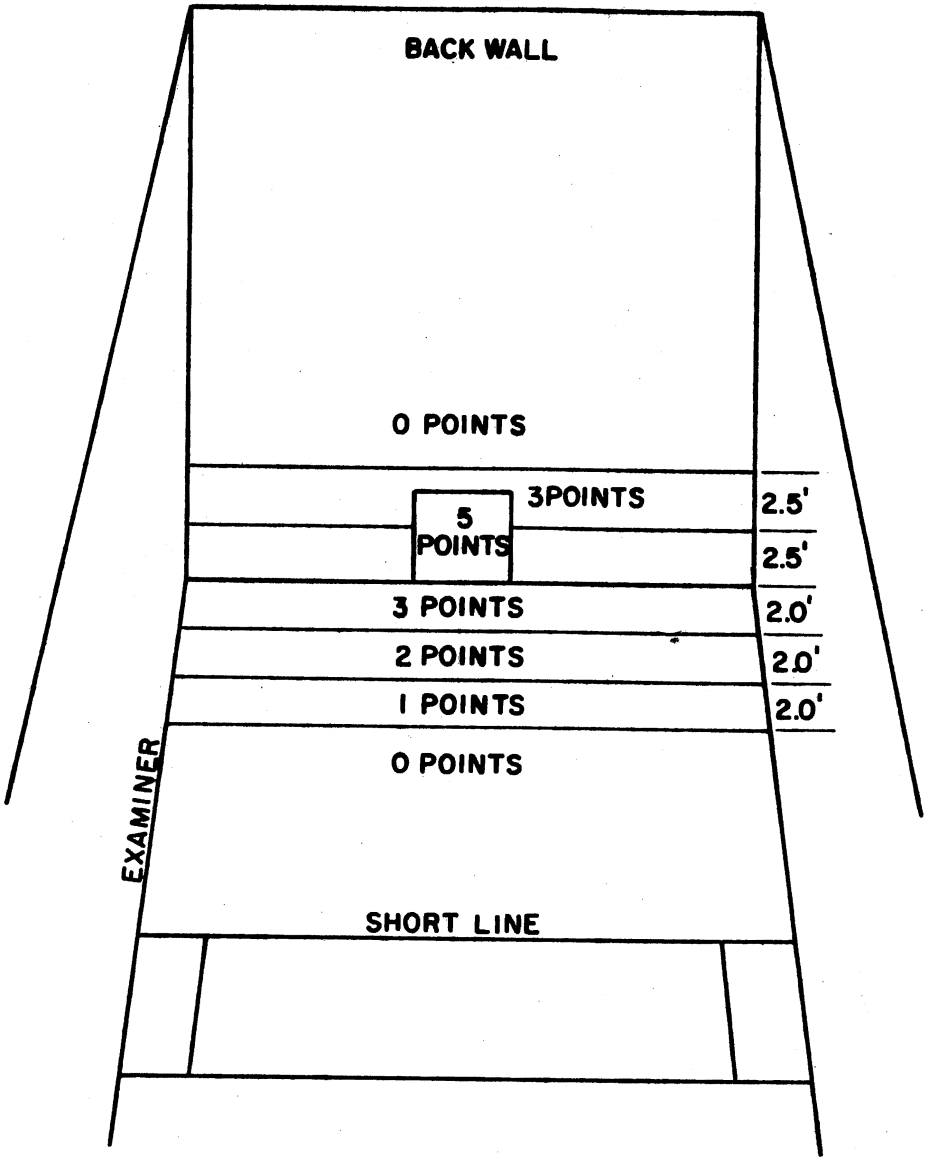

Figure 2. Ceiling Shot

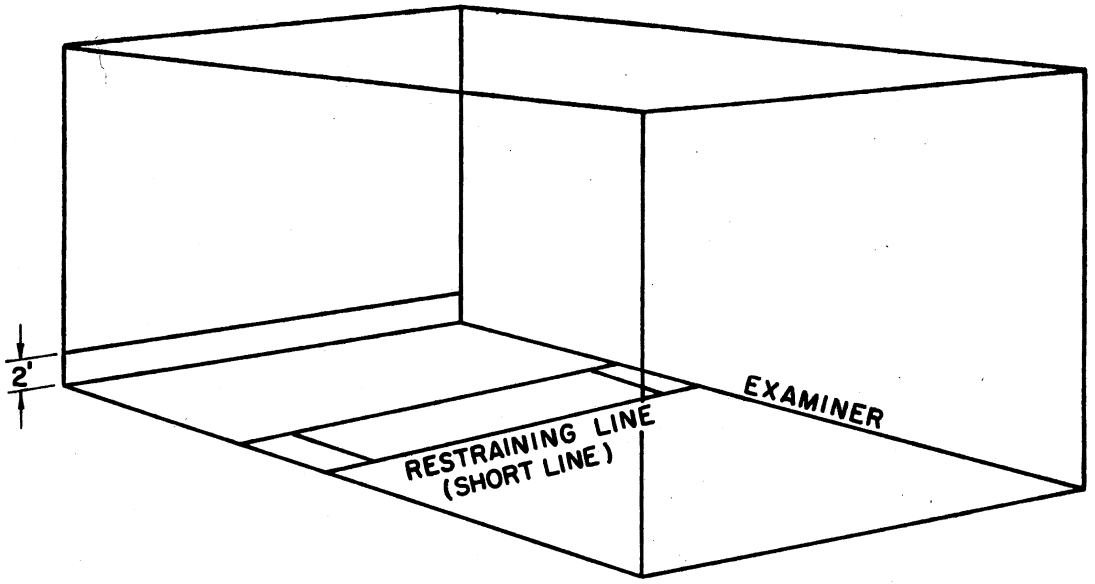

Figure 3. Kill Shot

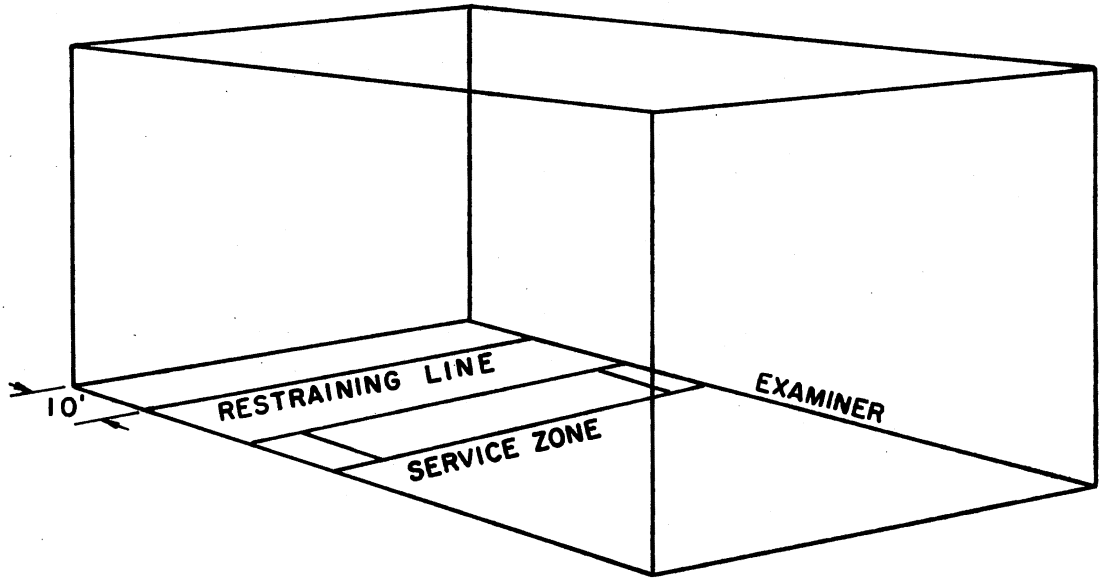

Figure 4. Volley Shot

Class Organization

During the first week of classes, January 12-16, 1976, all male students enrolled in the six sections were informed of the study. An introductory letter, constructed by the researcher, was distributed to all males during the first week of class (see Appendix B). Only those sections taught by the researcher were involved in the investigation.

The major content emphasis for the courses involved the four basic racquetball strokes which include the forehand, backhand, underhand, and overhand. Emphasis was also placed on general knowledge of the game itself; basic positioning for singles, doubles, and cut-throat; and beginning strategy to enable the student to play an enjoyable game of racquetball.

During the first three weeks or nine hours of instruction all students, both males and females received traditional instruction in racquetball fundamentals and skills practice. The fourth and fifth weeks plus one day were utilized for intraclass round robin singles for men and doubles for women. Two class sessions were alloted during week six for administration of the skills test battery to the selected subjects. Week seven was reserved for lecture and knowledge testing along with skill test make-ups.

Round Robin Tournament Organization

A complete round robin tournament using an abbreviated game was used as the criterion. Therefore, all 53 subjects involved in the study played one another during an "all out" eight-minute match. The formula $\frac{N(N-1)}{2}$ was utilized to determine the total number of matches needed for a complete round robin tournament. As the study included 53 subjects,

1,378 matches were played in order to collect the data.

As previously stated, intraclass singles were conducted during the fourth and fifth weeks of class. Also, additional interclass matches were required outside of the regular class period. The round robin tournament preference sheet and final interclass schedule are listed in Appendix C. The researcher devoted many hours for collating optimal tournament playing dates and times. Likewise, the researcher attempted to accommodate as many subjects as possible. The investigator received racquetball court time from the Colvin Center Director, Mr. Charles Schelsky, exceeding 330 court hours. The following procedures were used when organizing actual round robin play:

1) IRA racquetball rules were emphasized, clarified, and enforced for all matches.
2) All matches were started and stopped by the instructor's whistle.
3) Matches lasted exactly eight minutes, unless a tie score resulted. The match was terminated when the next point was scored. Eight-minute matches were decided upon by the researcher after reviewing previous studies. Two out of three games was obviously too time consuming. Past investigators have experimented with 15-, 10-, and 5-minute matches. Others have utilized 12-, 15-, 21-, and 30-point matches.
4) The two players on each court refereed their own matches and called their own hinders.
5) Subjects were encouraged to arrive five minutes ahead of the scheduled time to learn the rotation system.
6) Results sheets (see Appendix D), pencils, and coins were

distributed to home court players for the purpose of recording game scores and deciding first serve. Home court players remained on one court throughout the two-hour dual competition, while visiting players rotated.

7) No subject participated in more than 11 eight-minute matches during a two-hour session. Also, three-minute rest intervals were allotted between games.

8) Absent players were rescheduled in other sections. Matches in which players experienced injury or sickness were scratched and played at a later date.

9) Two new balls were stationed at each court in case one ball left the playing area.

10) The goal of the eight-minute matches was to score as many points as possible, while preventing the opponent from scoring.

Skills Test Organization

Ten assistants, all Oklahoma State University students majoring in HPER and experienced racquetball players, were selected to help in collection of the skills test data. Their primary function was to administer the five item battery during the sixth week of the course. Five days preceeding the skill testing an orientation session was held to familiarize the assistants with the tests. The research assistants were given background information on the nature and purposes of the study and were furnished with a written description of the tests.

Test instructions, procedures, restrictions, and scoring were emphasized to the assistants. All items were explained and demonstrated by the researcher, with all questions being answered. While one

examiner attempted the skill items, the others practiced counting successful attempts and collecting data. The researcher arranged schedules and times to coordinate the necessary examiners for each section involved in the study. Efficiency and accuracy in skills test administration were stressed. Also, hypothetical problems were anticipated so that no doubts or questions were left unexplained.

The researcher taped courts nine, 10, 11, and 12 the mornings prior to testing. Seven 20-foot lines were taped to each court using the 3/4 inch electrical tape. Each court required approximately five minutes preparation. A yardstick was used to measure distances.

The complete skills battery was administered on two consecutive class periods to determine test-retest reliability. As previously stated, all sections were given a verbal and visual demonstration by the researcher. The test directions were explicit and identical for all subjects. Then student questions were answered and clarified. The subjects were allowed to practice all test items for 20 minutes following the explanation. With the warm-up period over, students were randomly grouped and assigned to a research assistant or the instructor stationed at the four courts used for testing. Complete testing was accomplished within one class period.

The following standardized procedures were utilized in order to eliminate any variables that might have produced biased data collection, they were:

1) To insure that motivation and fatigue failures would remain constant, all subjects were administered the Forehand/Backhand Rally first, the Backhand Rally second, the Volley Shot third, the Ceiling fourth, and the Kill Shot fifth.

2) The subjects completed all trials of one test item before subject replacement and movement to the other tests.

3) All subjects were isolated with the assistant during skill testing.

4) The observation windows were covered during testing.

5) Objectivity was computed by the instructor and one research assistant simultaneously testing a subject. The scorecards were correlated using the Pearson-r.

6) The observation balcony was cleared during testing.

7) The results for each subject were recorded on scorecards (see Figure 5). New scorecards were supplied to the assistants for the second testing period.

Criterion of Validity

When instruments such as skill tests are developed a primary concern should be the validity and reliability of the test. Upon reviewing the various types of validity, a criterion or dependent variable was established for use in this investigation. Eckert describes five often used techniques, they are: 1) logical or face validity, 2) subjective ratings, 3) composite scores, 4) concurrent validity or comparisons to previously validated tests, and 5) tournament placement (15:134-138).

This study included two criterions determined from complete as opposed to partial round robin scores. The validity criterion chosen was calculated using a system adopted from Sattler's study (43). A points made versus points lost formula was utilized. The total number of points yielded by each subject were subtracted from total points

NAME: _____ DATE: _____

SECTION: _____ COURT: _____ EXAMINER: _____

	TRIAL #1	TRIAL #2
TEST #1 - 30-Second Forehand/Backhand Rally (Circle Best)		
TEST #2 - 30-Second Volley Shot (Circle Best)		
TEST #3 - 30-Second Backhand Rally (Circle Best)		

TEST #4 - Ceiling Shot Placement

#1	#2	#3	#4	#5	#6	#7	#8	#9	#10

Total _____

TEST #5 - Front Wall Kill Shot

✓ = successful
O = missed shot

#1	#2	#3	#4	#5	#6	#7	#8	#9	#10

Total _____

Figure 5. Scorecard

earned to obtain a total score. Point totals yielded positive and negative values depending on player ability. An adjusted score was determined by converting all point totals to positive values. Also, the investigator reviewed Safrit's four classes of criterion bias before considering the criterion score. Safrit's classes were: 1) criterion deficiency - which includes omitting important elements from the criterion, 2) criterion contamination - which fails to control extraneous variables, 3) criteria scale unit bias - which includes inequality of scale units, and 4) criterion distortion - which involves improper weightings of criterion elements (42:120).

Treatment of the Data

The SAS computer program was utilized to statistically analyze the data. A major objective of the study was to predict the criterion or dependent variable from the five-item test battery or the independent variables. The computer program used was designed to compute the following: 1) validity of each test item by correlating individual test scores to adjusted scores determined from round robin competition, 2) intercorrelation coefficients between independent variables, 3) validity of each test item by correlating individual test scores to winning percentages compiled from round robin competition (cross validation process), 4) pictorial plots of the dependent and independent variables, 5) summary statistics including standard deviation, variances and means of each skills test, 6) multiple correlations to determine the possible combinations of tests for the battery, and finally, 7) multiple regression equation to determine the best combination of tests to predict the criterion.

The validity was calculated by correlating the criteria with the best trial for each skill test. Objectivity and reliability were determined by the Pearson Product Moment method of correlation. Besides the 53 subjects involved in the study, 47 additional male students enrolled in HPER 2282 were administered the skill tests for the purpose of establishing norms for the ideal test battery.

CHAPTER IV

RESULTS

The purpose of this study was to construct a valid, reliable, and objective skills test to predict and classify beginning racquetball ability. Fifty-three male students enrolled in elective physical education courses at Oklahoma State University served as subjects. A complete round robin singles tournament was conducted, using eight minute matches. Five skills were given with the results being used as the criteria.

This chapter will provide an analysis of the data for all tests and the criterion. The final battery of skill test items determined from the regression equation will be described.

Jury Rankings

A jury of five experts was consulted to assist the researcher in determining the most important skills necessary for racquetball play. With the prioritized rankings and a review of literature the researcher was able to justify the construction of the skills test battery. The rankings are identified in Appendix A.

In category one, entitled--General Skills, the forehand was ranked first, backhand second, overhand third, and underhand stroke ranked fourth in importance. These results were not surprising to the researcher. The five skill test items developed by the researcher required the use of all four general skills or strokes.

In category two, entitled--Basic Shots, the serve was ranked first. However, a service test was not constructed by the researcher for the reasons stated in Chapter III. The kill was ranked second, pass third, ceiling fourth, backwall fifth, volley sixth, lob seventh, and the overhead smash eighth. Tests for four of the seven aforementioned basic shots were initially developed for use by the investigator. The pass or drive shot which measures accuracy and power relates to the characteristics of the forehand/backhand rally, therefore, a test was not specifically developed for this item.

In category three, entitled--Other Qualities, court position, footwork, shot placement, eye contact, and anticipation were ranked one through five. The researcher believes the five item skill test indirectly measured all 10 qualities with the exception of physical conditioning and variety and sequence in shot selection.

Descriptive Statistics

The SAS computer program contained a brief review of descriptive statistics for the five skill tests and criterions. Composite means, standard error $\bar{x}$, standard deviations, the low scores, high scores, and possible scores of all 53 subjects are illustrated in Table I. The standard deviation reflects the dispersion or variability of scores around the mean. It is significant to point out the following:

1) The three timed items (Forehand/Backhand Rally, Backhand Rally, and Volley Shot) revealed a low range of seven to a high range of 39. Standard deviations were fairly small from 3.0 to 6.83.

2) The ceiling shot reported a standard deviation of 9.59, the

highest among the skill tests. The lowest score was zero and highest 33 out of a possible 50 points.

3) The kill shot had a small variance due to the narrow range of scores. Zero was the lowest while seven successful trials was the highest. Approximately four out of 10 kill shots was the average.

4) The largest standard deviation computer was for the adjusted scores at 297.99. This indicates a wide heterogenous range of beginner level abilities.

TABLE I

DESCRIPTIVE STATISTICS

Variables	Means	SE	SD	Low Scores	High Scores	Possible Score
Forehand/Backhand Rally	17.43	.42	3.00	10.0	23.0	NM*
Backhand Rally	14.55	.49	3.53	7.0	26.0	NM
Volley Shot	23.74	.95	6.83	9.0	39.0	NM
Ceiling Shot	13.96	1.94	9.59	0.0	33.0	50
Kill Shot	3.74	.52	1.72	0.0	7.0	10
Adjusted Score	560.87	77.79	297.99	1.0	1377.0	NM
Winning Percentage	49.56	6.87	25.94	3.8	98.1	100

*No Maximum

Reliability and Objectivity

A test can be reliable and not valid, yet a test can never be valid and not reliable. The concept of reliability is best expressed by the term consistency.

There are four main procedures to determine reliability, they are: 1) test-retest, 2) parallel forms, 3) odd-even, and 4) split-halves. Skill tests have generally used the test-retest method, while the others are basically employed for knowledge testing.

Baumgartner and Jackson (3:76) stated that reliability would be enhanced by the use of large groups, heterogenous populations, and competent test administrators. These authors also listed eight factors which can affect reliability, they were: 1) scoring accuracy, 2) number of test trials, 3) test length and intervals between trials, 4) task difficulty and motivation, 5) instructions used, 6) testing environment, 7) outside distractions, and 8) subject familiarity with the task. The researcher attempted to control and standardize the items listed above to obtain precise reliability measures.

In order to determine reliability of the five racquetball skill tests it was necessary to have the test administered to the same group of subjects on two separate occasions. The best score the subject received on each test, the first time the test was administered, was correlated with the best score received on the second administration. The statistical technique employed to obtain reliability was the Pearson Product Moment method of correlation.

The reliabilities were computed by a hand calculator using the Pearson raw-score formula. The highest reliabilities achieved for

individual test items involved the Backhand Rally and the Volley Shot with an $\bar{r}$ of .76. The single test item having the lowest reliability coefficient was the Kill Shot with an $\bar{r}$ of .41. The Forehand/Backhand Rally and Ceiling Shot received $\bar{r}$'s of .66 and .63, respectively. The reliabilities were computed using 70 of the initial subjects prior to round robin competition. The final population was limited to 53 as a result of attrition. The correlation coefficients computed for each test item are presented in Table II. The raw scores for the test-retest reliability are found in Appendix E.

TABLE II

RELIABILITY OF SKILL TEST DATA

Test	Correlation Coefficient
Forehand/Backhand Rally	.66
Backhand Rally	.76
Volley Shot	.76
Ceiling Shot	.63
Kill Shot	.41

When attempting to determine which authority to cite for interpreting reliability coefficients the investigator found a multitude of different interpretations. Barrow and McGee ascertained that arbitrary standards are prepared because of the various uncontrollable factors

influencing correlation coefficients (2:38). It was decided by the researcher that Weber and Lamb (51) would be the reference to interpret correlat on coefficients. Weber and Lamb propose the following labeling system for correlations (51:182-183):

.95 to .99	Very high correlation.
.90 to .94	High correlation.
.80 to .89	Fairly high or modest correlation. Adequate for individual measures.
.70 to .79	Rather low for individual measures. Adequate for group measures.
Below .70	Low. Not satisfactory for individual measures. Useful for group averages and school surveys.

By using the above standard the researcher concluded that four of the five skill test items were low, yet adequate for the intact group involved in the investigation. The Kill Shot obviously showed little consistency revealing an $\bar{r}$ of .41.

The researcher co-tested 10 subjects simultaneously, with each of the 10 assistants. This procedure was to ascertain objectivity in scoring of the composite skill testing items. The Pearson Product Moment method of correlation was applied and generated an objectivity coefficient of .85. Since the same criteria for reliability generally applies to objectivity, the researcher deduced the fact that .85 is an acceptable degree of agreement or rather reliability.

Validity Coefficients

The various types of validity were discussed in Chapter III along with the various types of criterion bias. As stated before, validity is related to the reliability of a test. The type of criterion selected and group characteristics such as age, sex, and experience can affect validity (3:91).

The SAS computer program correlated all test scores with the two criteria. The criteria used to validate the racquetball skill tests were obtained through a round robin tournament. The validity was obtained by using the best trial on day one of the five skill tests and correlating those with winning percentages and the adjusted scores. Appendix F contains this data as processed through the computer and results of complete round robin tournament. The researcher looked for high correlations between each skill test and the criteria. The data is exhibited in Table III.

TABLE III

SKILLS TEST CORRELATION WITH THE CRITERIA

Test	Correlation		Difference
	Win. Pct.	Adj. Score	
Forehand/Backhand Rally	.63	.68	.05
Backhand Rally	.47	.49	.02
Volley Shot	.59	.64	.05
Ceiling Shot	.65	.67	.02
Kill Shot	.15	.12	.03
Winning Pct.	1.00	.96	.04
Adj. Score	.96	1.00	.04

The highest correlation of an individual test item was .68 for the Forehand/Backhand Rally. The lowest correlation involved was the Kill Shot at .12. After examining the validity coefficients the researcher would tend to believe that the Forehand/Backhand Rally, Volley Shot, and Ceiling Shot would produce the ideal test battery. All reference to validity from this point onward will only include the adjusted scores.

When establishing validity scores Baumgartner and Jackson concede the validity of an acceptable sports skill test is usually .70 to .85 (3:99). Generally, validity coefficients are lower than reliability coefficients. Both criteria winning percentage and the adjusted score correlated very highly at .96. The significance of this coefficient demonstrates that either criterion could be used to assess player abilities in a round robin tournament. Barrow and McGee report a scale, as shown below, that is frequently used to interpret the criteria for a valid test (2:38).

.85 - .89	Excellent.
.80 - .84	Very Good.
.70 - .79	Acceptable.
.65 - .69	Questionable except for very complex tests.
.60 - .64	Questionable.

Intercorrelations of the Independent Variables

Intercorrelations were computed by the SAS program for the five selected skill tests. The purpose of examining the data in this fashion was to assist the researcher in resolving which test items could be eliminated by virtue of high intercorrelations. The results of the intercorrelation matrix are illustrated in Table IV. The only moderate intercorrelation worthy of note was the relationship between the Forehand/Backhand Rally and the Volley Shot at .72.

TABLE IV

INTERCORRELATION MATRIX

Test	F/B	B	V	C	K
Forehand/Backhand Rally	1.00	.62	.72	.58	.29
Backhand Rally		1.00	.53	.48	.37
Volley Shot			1.00	.56	.20
Ceiling Shot				1.00	.17
Kill Shot					1.00

Multiple Correlations and Regression Equations

The multiple correlation processed by the SAS (Statistical Analysis System) computer program generally reflect the relationship between the skill test scores (predictors or independent variables) and the criterion (dependent variable). The researcher would like to emphasize use of two highly correlated criterions: 1) the points won minus points yielded, converted to an adjusted score; and 2) winning percentage calculated through wins and losses.

The multiple correlation reflected possible combinations of independent variables to arrive at an optimal battery yielding the highest validity. Each test going into a battery should have a high validity coefficient, but should have a minimum relation to the other independent variables. The multiple correlation coefficients do not weight the optimal battery of tests as this procedure is accomplished by a regression analysis. Based on a single inspection the data reflected in

Tables II and III indicates the Volley Shot is the best single measure of racquetball with a reliability of .76. This test achieved a coefficient of .64 with the round robin tournament adjusted scores. The intercorrelations between the Forehand/Backhand and Ceiling tests was .58, between the Forehand/Backhand and Volley was .72, and between the Volley and Ceiling was .56. The various combinations of test items and coefficient correlations with the adjusted score may be found in Table V. The adjusted score is utilized as the main criteria with the percentage of successful wins used for cross validation.

TABLE V

MULTIPLE CORRELATIONS

Items	Adjusted R-Square	Adjusted R	Number in Model
Forehand/Backhand Rally	.46	.68	1
Backhand Rally	.24	.49	1
Volley Shot	.41	.64	1
Ceiling Shot	.45	.67	1
Kill Shot	.14	.37	1
Forehand/Backhand Rally, Volley Shot, and Ceiling Shot	.60	.77	3
Forehand/Backhand Rally, and Ceiling Shot	.58	.76	2
Forehand/Backhand Rally, Backhand Rally, Volley Shot, Ceiling Shot, and Kill Shot	.61	.78	5

The SAS stepwise procedure for regression adds variables one by one to the model until no variables produce a significant F-statistic. The F-statistic reflects that variable's contribution to the model if it was included. This technique finds the one variable which produces the largest R-square statistic. The researcher's data revealed a .45 for the Ceiling Shot and a .46 for the Forehand/Backhand Rally. R-squared is the square of the multiple correlation coefficient. The stepwise procedure looked at all the variables included in the model and those not producing a significant F-statistic were deleted. The Kill and Backhand Rally were excluded due to the low validity coefficients with the criteria.

Based on the results of the SAS computer program, the best battery appears to include the Forehand/Backhand Rally and Ceiling Shot with a multiple correlation of .76. When all five test items were included in the final battery the multiple correlation would be .78, yet only .02 difference by adding the other three tests. If the Volley Shot, Forehand/Backhand Rally, and Ceiling Shot were utilized for the final battery the multiple correlation would be .77. This coefficient reveals a .01 difference when comparing it to the two- and five-item test batteries. On the basis of these results the researcher concludes the Forehand/Backhand Rally and Ceiling Shot would be the best two items, omitting the other three tests since the .01-.02 difference would not be worth the time necessary to administer the tests. In other words, these two variables are the best predictors of the criterion (round robin success), or beginning racquetball ability. A multiple correlation of .76 is neither high nor low yet adequate for the group or population involved in this study.

Appendix G contains the final two item test battery and the residuals. The residuals can be considered the standard deviation or the degree of variance from the ideal regression line. Utilizing the regression equation from each subject's skill test scores, the computer determined predictive values. These values were subtracted from the observed values producing the residual or difference.

Eckert states "the purpose of developing a regression equation is to enable one to predict the level of performance of an individual on the basis of the levels of performance of other individuals who have previously been tested on the same variables" (15:246). The regression takes into account the variability of the raw scores on each test and the relative value of each test in the total battery.

The SAS program assisted the researcher in determining the optimal regression equation by assigning a beta weight or value to each test in the battery. The beta weights computed by the program revealed regression constants or coefficients. The beta weightings, standard deviations, and regression equations for the three possible test batteries are presented in Table VI.

After analyzing the results the regression equation including the beta weightings for the Forehand/Backhand Rally and Ceiling Shot provides the optimal battery to predict round robin success. Therefore, when raw scores for the two-item test battery are inserted into the regression equation a predicted score or criterion value is calculated and ready for interpretation.

TABLE VI

BETA WEIGHTINGS, STANDARD DEVIATIONS, AND REGRESSION EQUATIONS FOR THREE TEST BATTERIES

Multiple Correlations	Beta Weightings	Standard Deviation
Battery Number 1		
Forehand/Backhand Rally and	43.14	.434
Ceiling Shot	13.08	.421
Constant or Intercept	-373.54	.000
Regression Equation: Predicted Score = -373.54 + 43.14(F/B) + 13.08(C)		
Battery Number 2		
Forehand/Backhand Rally,	30.84	.310
Ceiling Shot, and	11.71	.377
Volley Shot	9.00	.206
Constant or Intercept	-353.80	.000
Regression Equation: Predicted Score = -353.80 + 30.84(F/B) + 11.71(C) + 9.0(V)		
Battery Number 3		
Forehand/Backhand Rally,	31.64	.318
Ceiling Shot,	11.46	.369
Volley Shot,	8.61	.197
Kill Shot, and	-16.41	-.095
Backhand Rally	4.22	.050
Constant or Intercept	-355.25	.000
Regression Equation: Predicted Score = -355.25 + 31.64(F/B) + 11.46(C) + 8.61(V) - 16.41(K) + 4.22(B)		

Norms Construction

A raw score or set of scores is generally not meaningful to students or administrators unless accurate comparisons are made with similar populations taking the same test(s). Baumgartner and Jackson described performance "norms" as standards based on data analysis differing from arbitrary standards or scales (3:328).

One method to interpret scores for beginning racquetball ability is to administer the two-item test battery proposed by the investigator. Then the administrator converts the raw scores or point totals in Col. A for each test item into constants in Col. B as illustrated in Table VII. The constants are those determined by the optimal regression equation from this study of 53 subjects including the range of points possible on the two tests. The next step would be to add these two constants to the intercept, -373.54, to reveal a predicted score. Finally the test user should consult Table VIII which easily provides a classification for predicted scores by using a sigma scale. For example, a student scoring 17 points on the Forehand/Backhand Rally and 13 on the Ceiling Shot (Col. A) would receive constants (in Columns B and C) of 733.38 and 170.04. These two figures added to -373.54 would total a predicted score of approximately 530 and a Sigma Score of 48. A score of 560 would indicate the mean or average score.

Caution should be used when interpreting raw scores from Tables VII and VIII. The test user must be aware of the limitations of this study, especially the use of intact groups and a finalized population of 53 subjects. However, this scale will give the administrator a very good index to quickly assess beginning player ability.

TABLE VII

CONVERSION OF POINTS SCORED ON THE FOREHAND/BACKHAND RALLY AND CEILING SHOT INTO VALUES BASED ON REGRESSION EQUATION CONSTANTS

Raw Score Points Scored	Forehand/Backhand Rally	Ceiling Shot
Column A	Column B	Column C
1	43.14	13.08
2	86.28	26.16
3	129.42	39.24
4	172.56	52.32
5	215.70	65.40
6	258.84	78.48
7	301.98	91.56
8	345.12	104.64
9	388.26	117.72
10	431.40	130.80
11	474.54	143.88
12	517.68	156.96
13	560.82	170.04
14	603.96	183.12
15	647.10	196.20
16	690.24	209.28
17	733.38	222.36
18	776.52	235.44
19	819.66	248.52
20	862.80	261.60
21	905.94	274.68
22	949.08	287.76
23	992.22	300.84
24	1035.36	313.92
25	1078.50	327.00
26		340.08
27		353.16
28		366.24
29		379.32
30		392.40
31		405.48
32		418.56
33		431.64
34		444.72
35		457.80

TABLE VIII

SIGMA SCALE FOR TWO-ITEM TEST BATTERY

Sigma Score		Predicted Score	Sigma Score		Predicted Score
100	-	1153.99	50	-	560.89
95	-	1049.14	45	-	501.64
90	-	1034.89	40	-	442.39
85	-	975.64	35	-	383.14
80	-	916.39	30	-	323.89
75	-	857.14	25	-	264.64
70	-	797.89	20	-	205.39
65	-	738.64	15	-	146.14
60	-	679.39	10	-	86.89
55	-	620.14	5	-	27.64

$\bar{x}$ = 560.89 SD = 197.50 N = 53

The sigma scale method was also used to construct tables for individual test items. This method provided a scale score for each raw score made by 100 individuals on the two-item battery. These tables enable the test user to quickly assess individual skill by knowing the raw score or point totals on the Forehand/Backhand Rally and Ceiling Shot. The scales were based on the formula (2:86):

$$\text{Constant} = \frac{3(SD)}{50}$$

The mean score was given a scale score of 50. For each interval of five

above or below 50 the constant was added or subtracted. Then the calculated scores were rounded to the nearest whole number for easy interpretation of the scale. Tables IX and X provide the sigma scales for the Forehand/Backhand Rally and the Ceiling Shot. As with the first sigma scale utilized in Table VIII, the scales constructed for Tables IX and X require careful interpretation realizing the limitations of this investigation.

TABLE IX

SIGMA SCALE FOR FOREHAND/BACKHAND RALLY

Sigma Score		Raw Score	Sigma Score		Raw Score
100	-	26	50	-	17
95	-	25	45	-	16
90	-	24	40	-	15
85	-	23	35	-	14
80	-	22	30	-	13
75	-	21	25	-	12
70	-	20	20	-	11
65	-	20	15	-	10
60	-	19	10	-	9
55	-	18	5	-	8

$\bar{x}$ = 17 SD = 3.0 N = 100

TABLE X

SIGMA SCALE FOR CEILING SHOT

Sigma Score		Raw Score	Sigma Score		Raw Score
100	-	42	60	-	19
95	-	39	55	-	16
90	-	36	50	-	13
85	-	33	45	-	10
80	-	30	40	-	7
75	-	28	35	-	4
70	-	25	30	-	1
65	-	22	29-0	-	0

$\bar{x}$ = 13 SD = 9.59 N = 100

Summary

Based on the analysis of data presented in this chapter a multiple correlation of .76 on the Forehand/Backhand Rally and Ceiling Shot was determined by the researcher as being acceptable for this study. The reliability coefficients were .66 for the Forehand/Backhand Rally and .63 for the Ceiling Shot. The researcher realizes the reliability and validity coefficients are basic weaknesses of the study and lacking highly convincing or significant findings. However, the reader or test user is encouraged to analyze and personally interpret the findings when considering the battery for future use.

The large variance computed for the Ceiling Shot indicates the

complex nature of the test item. The inference drawn is that this item differentiates between levels of beginning player ability. The researcher concludes that the Ceiling Shot is an advanced skill for the raw beginner, yet an acceptable test item for students possessing moderate to upper beginning levels of ability.

Extensive research has not been conducted in the sport of racquetball. When one realizes that no valid or reliable skills test has been constructed, the proposed two-item battery merits consideration as a beginning effort in this direction.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter focuses on a summary of the investigation, conclusions based on the results, and recommendations for future studies.

Physical education has a universal goal to project permanent and measurable changes in psychomotor behavior in a variety of motor skills (3:223). Measurement of these changes or skill development in racquetball or other sports can be evaluated through subjective ratings by experts or judges, frequent competition, and/or skill tests.

Skill tests can be utilized to serve a variety of purposes for the benefit of both students and teachers. Some of these purposes are: 1) teacher effectiveness, 2) student classification, 3) motivation, 4) diagnosis, and 5) determining progress and achievement. Overall, a well constructed skill test can enhance the teaching learning environment.

Skill tests have been both beneficial and detrimental to the field of physical education over the past 50 years. When constructed and implemented properly their value is unlimited. It is obviously impossible to test all skills involved in racquetball, yet a battery of the fundamental skills can easily be administered to assist in determining playing ability.

The increasing popularity of racquetball in the United States for both sexes and most age levels generates the need for improved

evaluation procedures.

Problem

The purpose of this study was to construct a practical skills test or battery of tests to predict and classify beginning abilities of college men in the sport of racquetball. The need to obtain a valid, reliable, and objective measure of beginning racquetball skill was the major consideration.

Procedures

The reader is reminded that 53 male students involved in six racquetball/tennis classes at Oklahoma State University provided the data upon which the findings were based. The subjects received identical instruction and playing time by the investigator during the first seven weeks of the spring semester, 1976. A complete round robin singles tournament was conducted both during and outside of the required class time. Also, all subjects were required to take a five-item battery of skill tests during the final two days of instruction.

Skills Test Selection

A battery of tests must be practical in terms of ease of administration, time, objectivity, and degree of difficulty. Also, the test should simulate game conditions and provide motivation and stimulation as a learning experience for students.

To determine the basic skills of racquetball it was necessary to consult a jury of experts and have them review a list of suggested skills. From the list the jury was asked to prioritize the skills which

were most important for the beginning level racquetball student. This information combined with data from a pilot study, through literature search and the investigator's background and teaching experience in racquetball provided a five-item battery which included: 1) Forehand/ Backhand Rally, 2) Backhand Rally, 3) Ceiling Shot, 4) Front-Wall Kill Placement, and 5) Volley Test. The tests selected were those fundamental skills vital to the proper execution of the game and those used most frequently.

Skills Test Administration

During the sixth week of class the five-item test battery was administered to all subjects. The battery was administered on two consecutive class periods to determine test-retest reliability. Using the Pearson Product Moment method of correlation, six sections were given a verbal and visual demonstration by the researcher. The test directions were explicit and identical for all subjects.

The researcher taped four of the eleven courts the mornings prior to testing. Seven 20-foot lines were necessary to prepare each court. Ten well trained assistants were selected to help in collecting the skill test data.

Round Robin Tournament

The criterion selected for the study was a complete round robin tournament with eight minutes constituting a completed match. All 53 subjects played one another during an "all out" effort attempting to score as many points as possible during the time limit. As the study included 53 subjects, 1,378 matches were played in order to collect the

data. Success of a player was determined by a points made versus points lost formula to arrive at an adjusted score or the criterion score. Also, winning percentages were calculated from round robin competition as a cross validation process.

Treatment of the Data

The investigation attempted to predict the criterion from the five-item test battery. An SAS computer program was utilized to statistically analyze the data. The program was designed to compute the following: 1) validity of each test item with the criterions; 2) intercorrelations of the independent variables; 3) descriptive statistics to include means, standard deviations, possible scores, and ranges of scores for each of the five skill tests presented; 4) multiple correlations; and 5) the optimal regression equation. Upon obtaining the final two-item test battery, beta weightings were reported and norms were constructed using the sigma scales. Norms were also constructed using 100 scores on the Forehand/Backhand Rally and Ceiling Shot to determine individual sigma scale scores for each test item.

Conclusions

Based on the findings and within the limitations of the study, the following conclusions were drawn:

1) A .76 multiple correlation was produced for the Forehand/Backhand Rally and Ceiling Shot, and therefore these items are the most valid measures of beginning racquetball ability.
2) A high correlation between dependent variables, the adjusted score and winning percentage produced a .96 coefficient.

Therefore these two items are measuring the same attribute-playing ability.

3) The test-retest correlations indicated reliabilities for the Forehand/Backhand Rally, Backhand Rally, Ceiling Shot, and Volley Shot as low yet adequate for the intact group involved in the investigation. The range of reliability for these four items was from .63 to .76.

4) The Kill Shot was not a reliable item indicating a coefficient of .41; therefore it was not a valid item either. It is possible that this low reliability may have been due to the scoring technique and procedures required by the test format.

5) The correlations of individual test items with the criterion were .68 for the Forehand/Backhand Rally, .49 for the Backhand Rally, .64 for the Volley Shot, .67 for the Ceiling Shot, and .12 for the Kill Shot.

6) The jury utilized in selecting the fundamental skills of racquetball were in uniform agreement as to important skills necessary for beginning players.

7) The intercorrelation matrix did not produce high correlations between independent variables.

8) Since no valid or reliable skills test has been constructed for the sport of racquetball, the proposed two-item battery, to include the Forehand/Backhand Rally and Ceiling Shot merits consideration as a beginning effort in this direction.

Recommendations

Based on the analysis of data and the observations during testing, the following recommendations for further study were made:

1) The two-item battery which includes the Forehand/Backhand Rally and Ceiling Shot should be adopted by physical education instructors for racquetball courses as a device to evaluate student ability.
2) That additional studies be conducted involving large numbers of students to establish valid sigma scale scores for the Forehand/Backhand Rally and Ceiling Shot.
3) In order to improve the validity of the battery of skill tests, attempts should be made to include other possible combinations to the present battery such as a service test, reaction time, etc.
4) Attempts should be made to further improve the reliability and validity of each test item.
5) The investigator recommends that the tests be administered to intermediate and advanced players so that the usefulness of the tests could be determined at all levels of ability.
6) Repeat the rally tests and volley test using a 60-second time restriction instead of a 30-second time restriction.
7) Utilize a ball machine to consistently lob the ball off the front wall to set up the shots for the Ceiling and Kill tests.
8) Revamp the Kill Shot to include 20 trials, point totals for better accuracy, and side-front kill combinations rather than the basic front wall kill.

SELECTED BIBLIOGRAPHY

1) Allsen, Philip E. and Alan Witbeck. Racquetball/Paddleball. Dubuque, Iowa: Wm. C. Brown Company, 1972.

2) Barrow, Harold M. and Rosemary McGee. A Practical Approach to Measurement in Physical Education. Philadelphia: Lea and Febiger, 1971.

3) Baumgartner, Ted A. and Andrew S. Jackson. Measurement For Evaluation in Physical Education. Boston, Mass.: Houghton Mifflin Company, 1975.

4) Bischoff, David C. "A Skill Grading System Using A Modified Ladder Tournament." Journal of Health Physical Education and Recreation, Vol. 34, No. 4 (April, 1963), pp. 16-17.

5) Bucher, Charles A. Foundations of Physical Education. 5th Ed. St. Louis: C. V. Mosby Company, 1968.

6) Casady, Donald R. Sports Activities For Men. New York: Macmillan Publishing Co., Inc., 1974.

7) Christ, Michael. "Development and Validation of a Skills Test For One-Wall Handball." (Unpub. Master's thesis, Western Illinois University, 1973.)

8) Clarke, David H. and H. Harrison Clarke. Research Processes in Physical Education, Recreation, and Health. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970.

9) Clarke, H. Harrison. Application of Measurement to Health and Physical Education. 4th Ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1967.

10) Clarke, H. Harrison and David H. Clarke. Advanced Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972.

11) Cornish, Clayton. "A Study of Measurement of Ability in Handball." Research Quarterly, Vol. 20, No. 2 (May, 1949), pp. 215-222.

12) Digennario, Joseph. "Construction of Forehand Drive, Backhand Drive, and Service Tennis Tests." Research Quarterly, Vol. 40, No. 3 (October, 1969), pp. 496-501.

13) Dowell, Linus J. Strategies For Teaching Physical Education. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1975.

14) Dyer, Joanna T. "The Back Board Test of Tennis Ability." Research Quarterly, Vol. 6, No. 1 (March, 1935), pp. 25-29.

15) Eckert, Helen M. Practical Measurement of Physical Performance. Philadelphia: Lea and Febiger, 1974.

16) Farrell, Joan E. "The Classification of Physical Education Skills." Quest, Vol. 24 (Summer, 1975), p. 63.

17) Feldt, Leonard S. and Mary Ellen McKee. "Estimation of the Reliability of Skills Tests." Research Quarterly, Vol. 29, No. 3 (October, 1958), pp. 279-293.

18) Fleming, A. William and Joel A. Bloom. Paddleball and Racquetball. Pacific Palisades, Calif.: Goodyear Publishing Company, 1973.

19) Fox, Katharine. "A Study of the Validity of the Dyer Backboard Test and the Miller Forehand-Backhand Test For Beginning Tennis Players." Research Quarterly, Vol. 24, No. 1 (March, 1953), pp. 1-7.

20) Franks, B. Don and Helger Deutsch. Evaluating Performance in Physical Education. New York: Academic Press, Inc., 1973.

21) Fruchter, Benjamin and J. P. Guilford. Fundamental Statistics in Psychology and Education. 5th Ed. New York: McGraw-Hill, 1973.

22) Godleski, Edith E. "Paddleball For Girls." Journal of Health, Physical Education, and Recreation, Vol. 39, No. 3 (March, 1968), p. 62.

23) Gurney, Walden O. "A Paddleball Skills Test For College Men." (Unpub. Master's thesis, Brigham Young University, 1966.)

24) Hemmer, John C. "A Determination of the Relationship and Validity of the Cornish Handball Test." (Unpub. Ph.D. dissertation, Texas Women's University, 1967.)

25) Hewitt, Jack E. "Classification Tests in Tennis." Research Quarterly, Vol. 39, No. 3 (October, 1968), pp. 552-555.

26) Hewitt, Jack E. "Hewitt's Tennis Achievement Test." Research Quarterly, Vol. 37, No. 2 (May, 1966), pp. 231-240.

27) Hewitt, Jack E. "Revision of the Dyer Backboard Tennis Test." Research Quarterly, Vol. 36, No. 2 (May, 1965), pp. 153-157.

28) Hicks, Joanna V. "The Construction and Evaluation of a Battery of Five Badminton Skills Tests." (Unpub. Ph.D. dissertation, Texas Women's University, 1967.)

29) Holt, Lawrence E. "A Comparative Study of Selected Handball Techniques." Research Quarterly, Vol. 40, No. 4 (December, 1969), pp. 700-703.

30) Hubbard, Alfred, W. (ed.). Research Methods in Health, Physical Education, and Recreation. 3rd Ed. Washington, D. C.: American Association For Health, Physical Education, and Recreation, 1973.

31) Johnson, Barry L. and Jack K. Nelson. Practical Measurements For Evaluation in Physical Education. 2nd Ed. Minneapolis, Minnesota: Burgess Publishing Company, 1974.

32) Kemp, Joann and Marilyn F. Vincent. "Kemp-Vincent Rally Test of Tennis Skill." Research Quarterly, Vol. 39, No. 4 (December, 1968), pp. 1000-1004.

33) Larson, Lea A. "The Development of a Golf Putting Test." (Unpub. Ph.D. dissertation, Oklahoma State University, 1972.)

34) Lester, Lita M. "The Development of a Badminton Skill Test." (Unpub. Master's thesis, Oklahoma State University, 1956.)

35) Massey, Benjamin H. et al. "Principles and Operational Practices." An Introduction to Measurement in Physical Education, ed. Henry Montoye, Vol. 1. Indianapolis, Ind.: Phi Kappa.

36) Mathews, Donald K. Measurement in Physical Education. 4th Ed. Philadelphia: W. B. Saunders Company, 1973.

37) McCollum, Robert H. and Richard B. McCorkle. Measurement and Evaluation: A Laboratory Manual. Boston, Mass.: Allyn and Bacon, 1971.

38) McKie, Thomas D. "Energy Cost of Racquetball." (Unpub. Master's thesis, Michigan State University, 1972.)

39) Miller, Frances A. "A Badminton Wall Volley Test." Research Quarterly, Vol. 22, No. 1 (May, 1951), pp. 208-213.

40) Pennington, G. G., James Day, John Drawatsky, and John Hanson. "A Measure of Handball Ability." Research Quarterly, Vol. 38, No. 2 (May, 1967), pp. 247-253.

41) Reznik, John W. (ed.). Championship Racquetball. Cornwall, New York: Leisure Press, 1976.

42) Safrit, Margaret J. Evaluation in Physical Education. Englewood Cliffs, New Jersey: Prentice-Hall, 1973.

43) Sattler, Thomas P. "The Development of an Instrument to Measure Handball Ability of Beginning Level Players in Physical Education Class." (Unpub. Ph.D. dissertation, Oklahoma State University, 1974.)

44) Scott, M. Gladys. "The Use of Skill Tests." Journal of Health, Physical Education, and Recreation, Vol. 9, No. 6 (June, 1938), pp. 364-266.

45) Sheehan, Thomas J. An Introduction to the Evaluation of Measurement Data in Physical Education. Massachusetts: Addison-Wesley Publishing Company, 1971.

46) Sherman, Patricia A. "A Selected Battery of Tennis Skill Tests." (Unpub. Ph.D. dissertation, University of Iowa, 1972.)

47) Singer, Robert N. "Methodological Controls For Social Psychological Problems in Experimentation." Quest, Vol. 14, No. 20 (June, 1973), pp. 32-38.

48) Slaughter, Mary. "Racquetball." Journal of Health, Physical Education and Recreation, Vol. 45, No. 7 (September, 1974), p. 66.

49) Stafford, Randy. Racquetball: The Sport For Everyone. Memphis, Tennessee: S. C. Toof and Company, 1975.

50) Summers, Emory F. "Tennis Ability and Its Relationship to Seven Performance Tasks." (Unpub. Ph.D. dissertation, University of Oregon, 1973.)

51) Weber, Jeome C. and David R. Lamb. Statistics and Research in Physical Education. St. Louis: C. V. Mosby Company, 1970.

52) Wickstrom, Ralph and Charles Larson. Racquetball and Paddleball Fundamentals. Columbus, Ohio: Charles E. Merrill Company, 1972.

53) Willgoose, Carl E. Evaluation in Health Education and Physical Education. New York: McGraw-Hill Book Company, 1961.

APPENDIX A

RACQUETBALL SKILLS RATING FORM AND

MEAN RACQUETBALL SKILLS RATINGS

RACQUETBALL SKILLS RATING FORM

From: Craig A. Buschner
Department of HPER
Oklahoma State University
Stillwater, Oklahoma

To: _____
_____
_____
(address)

Purpose: I am attempting to devise a skills test to measure the important abilities necessary for beginning racquetball players. I am soliciting your expert opinion to prioritize or rank 3 categories of motor performance necessary for beginning players. Your participation will assist me in determining the most important abilities necessary for constructing the skills test.

Category 1 - General Skills (strokes) Rank from 1 to 4 the most important strokes in racquetball. (1 being most important.)

_____ UNDERHAND
_____ FOREHAND
_____ OVERHAND
_____ BACKHAND

Category 2 - Basic Shots Rank from 1 to 9 the most important shots. (1 being the most important.)

_____ PASS (Drive Shot)
_____ KILL
_____ LOB
_____ CEILING
_____ BACKWALL
_____ SERVE (Including Power, Lob, Overhead, Crosscourt, etc.)
_____ VOLLEY
_____ OVERHEAD SMASH
_____ OTHER _____(Write In)

Category 3 - Other Qualities Rank from 1 to 11 the most important qualities. (1 being the most important.)

_____ PERIPHERIAL VISION
_____ ANTICIPATION
_____ COURT POSITION
_____ VARIETY AND SEQUENCING IN SHOT SELECTION
_____ SHOT PLACEMENT
_____ CHANGING BALL SPEED
_____ TIMING
_____ EYE CONTACT THROUGHOUT EACH STROKE
_____ FOOTWORK (Including Body and Feet Position)
_____ PHYSICAL CONDITION
_____ OTHER _____ (Write In)

Mean Racquetball Skills Ratings

	Judges Ranking					
	MR	RS	TM	RT	$\bar{X}$ RATING	FINAL RANKING
GENERAL SKILLS						
Underhand	4	4	4	4	4.0	4
Forehand	1	1	1	1	1.0	1
Overhand	3	3	3	2	2.8	3
Backhand	2	2	2	3	2.3	2
BASIC SHOTS						
Pass (Drive Shot)	6	2	2	3	3.3	3
Kill	2	3	6	1	3.0	2
Lob	8	9	8	6	7.8	7
Ceiling	4	4	4	4	4.0	4
Backwall	5	7	3	8	5.8	5
Serve	3	5	1	2	2.8	1
Volley	7	6	5	7	6.3	6
Overhead Smash	9	8	7	9	8.3	8
Other						
OTHER QUALITIES						
Peripherial Vision	10	11	6	8	8.8	9
Anticipation	4	5	5	7	5.3	5
Court Position	1	3	3	2	2.3	1
Variety & Sequencing in Shot Selection	7	4	7	9	6.8	7
Shot Placement	5	2	8	1	4.0	3
Changing Ball Speed	9	8	9	10	9.0	10
Timing	6	9	4	3	5.5	6
Eye Contact	2	10	2	4	4.5	4
Footwork	3	6	1	5	3.8	2
Physical Condition	8	7	10	6	7.8	8
Other						

APPENDIX B

INTRODUCTORY LETTER FOR PROSPECTIVE SUBJECTS

Introductory Letter for Prospective Subjects

January 12-13, 1976

To: All Male Students
HPER 2282 (Racquetball/Tennis)
Sections 1, 2, 4, 5, 6, & 7
Oklahoma State University

From: Craig A. Buschner
HPER Department
Oklahoma State University

The males in this section along with five other classes at OSU have been selected to participate in a doctoral dissertation study. The study will be conducted by your instructor, Mr. Craig A. Buschner, a member of the HPER staff at OSU.

The purpose of this study is to construct and administer a battery of skills test items in racquetball to beginning male subjects. With this information, along with complete round robin tournament performances, player ability could be predicted if the study is statistically significant. To my knowledge no valid or reliable skills test in racquetball has been established.

During the first three weeks of class you will receive traditional instruction in racquetball. The fourth and fifthe weeks will be utilized for an in class round robin tournament within your section or class. Also, additional out of class time will be necessary so all sections can play one another. Matches will be eight minutes in length. Hopefully, 50 or more subjects will become involved in the study.

An out of class time will be mutually arranged, preferably on 2 or 3 consecutive Saturdays or Sundays during the 5th, 6th, and 7th weeks of the Spring term. Also, during the 6th week of the course,each male subject will be administered the test battery on two consecutive class days. It is extremely important that each subject be in attendance each day of the tournament and during the testing period. In other words, weeks 4 through 6 and the mutually arranged tournament will require your attendance.

I encourage your participation and concerted effort to assist me in this valuable study. Enjoy a successful semester and thank you for becoming involved in this research project.

APPENDIX C

ROUND ROBIN PREFERENCE SHEET AND

FINAL ROUND ROBIN SCHEDULE

Round Robin Tournament Preference Sheet

To: All Male Students
HPER 2282 Racquetball
Sections 1, 2, 4, 5, 6, & 7
OSU

From: Craig A. Buschner

* Important - Please return this preference sheet for all outside of class round robin matches by the end of this week, Thursday and Friday.

I am trying to find out which times are best for the majority of the people involved in the study, for competition in eight minute matches against the other sections involved in the study. It will take no more than 10 hours of your time to play the matches. Please study this closley and anticipate your activities for the next few weeks. I will combine all schedules to arrive at an appropriate time.

Please rank your choices concerning the out of class times you prefer.

_____ Sat. & Sun. Feb. 14-15 (5 hrs. each day)

_____ " " " 21-22 "

_____ " " " 28-29 "

_____ " " Mar. 20-21 "

_____ " " " 27-28 "

_____ Early Mornings (weekdays) 6-8 AM 5 days a week for 3 weeks each section would appear 5 times for 2 hrs. each

_____ Late Nights (weekdays) 9-11 PM " " "

_____ Other Times _____

Name: _____ Section: _____

Final Round Robin Schedule

Purpose: To complete the Round Robin Matches for Dissertation Study.

Dates: March 16 to March 31

Court Time Needed: 15 (2 hr. sessions including a minimum of 9 courts and a maximum of 12 courts)

Colvin Center Building Hours

March 15 thru May 4

Mon. thru Thurs.	8-10PM
Friday	8-9PM
Sat.	9-6PM
Sun.	2-9PM

SCHEDULE

DATE	SECTION	TIMES
Tues. March 16	4&5	7-9AM
Wed. " 17	5&1	7-9AM
Thurs. " 18	7&2	7-9AM
Sat. " 20	5&7	6-8PM
Sun. " 21	1&2,6&4	8-9:30,9:30-11:30PM
Mon. " 22	1&7	9-11PM
Tues. " 23	6&2	9-11PM
Wed. " 24	7&4	9-11PM
Thurs. " 25	4&2	9-11PM
Sun. " 28	2&5,1&4	6-8,8-10PM
Mon. " 29	1&6	9-11PM
Tues. " 30	6&5	9-11PM
Wed. " 31	6&7	9-11PM

*I also reserved the following hours in case of schedule changes:

March 29 7-9AM
" 30 "
" 31 " & 9-11PM

Student Approved _____

Student Disapproved _____

_____
(Correction Needed)

APPENDIX D

ROUND ROBIN TOURNAMENT RESULT SHEET

Round Robin Tournament Result Sheet

DATE: _____ COURT NUMBER: _____

SECTIONS COMPETING: _____ HOME COURT PLAYER: _____

	NAMES/SCORES			NAMES/SCORES	
	Home Court Player	Score			
1.			7.		
	Opponent	Score			
2.			8.		
3.			9.		
4.			10.		
5.			11.		
6.			12.		

APPENDIX E

RAW SCORES FOR TEST-RETEST RELIABILITY

Subject	Day #1 Forehand/Back-hand Rally	Day#2 Forehand/Back-hand Rally	Day#1 Backhand Rally	Day#2 Backhand Rally	Day#1 Volley Shot	Day#2 Volley Shot	Day#1 Ceiling Shot	Day#2 Ceiling Shot	Day#1 Kill Shot	Day#2 Kill Shot
01	15	17	13	16	14	24	19	11	04	02
02	20	20	16	16	27	24	12	14	04	07
03	12	15	07	15	18	15	04	04	02	03
04	21	19	18	16	27	25	23	18	06	05
05	20	20	20	13	30	22	31	25	05	06
06	15	17	12	14	27	31	22	21	04	04
07	17	15	11	15	15	23	26	26	05	05
08	23	18	16	19	30	33	16	23	05	06
09	20	14	14	16	24	26	19	31	04	01
10	21	18	17	17	32	30	18	16	03	02
11	20	23	12	18	30	30	13	23	02	08
12	20	23	20	18	33	30	15	04	06	03
13	22	16	18	16	32	34	17	32	04	04
14	15	17	15	17	19	13	17	11	04	06
15	16	16	17	16	15	18	27	06	08	06
16	17	22	15	13	35	37	23	18	04	04
17	17	12	13	15	24	20	08	08	04	04
18	17	20	16	11	15	21	06	17	06	05
19	19	20	17	18	28	19	11	26	04	04
20	18	21	26	20	18	29	27	21	05	05
21	15	20	15	12	22	29	05	11	05	06
22	20	22	17	14	25	29	28	24	05	05
23	21	23	16	16	30	34	23	35	07	03
24	14	18	11	14	19	32	00	03	04	03
25	10	12	08	12	09	08	05	07	01	01
26	11	13	08	06	16	14	03	07	01	02
27	19	17	14	16	24	22	07	02	05	04
28	18	19	18	15	20	12	02	17	02	05
29	23	20	19	21	39	34	33	22	03	06
30	13	15	09	14	13	19	01	06	01	05
31	18	20	16	18	20	19	00	09	02	04
32	18	15	12	12	20	24	20	24	06	06
33	18	18	13	18	20	22	06	10	03	03
34	13	13	12	10	16	16	00	03	01	03
35	18	18	18	19	25	28	16	21	04	02
36	17	19	09	13	18	16	11	21	04	01
37	17	17	14	12	22	26	09	10	03	06
38	19	20	14	19	20	21	19	05	03	05
39	21	20	17	16	31	30	09	13	06	04
40	16	23	17	16	28	42	06	17	06	04
41	16	19	11	13	19	26	14	16	06	04
42	15	14	14	11	16	22	05	04	04	04
43	16	20	13	19	28	35	15	04	06	02
44	14	13	16	17	22	24	13	06	03	01
45	17	20	20	14	36	32	26	14	05	03
46	18	18	12	16	25	32	03	16	04	06
47	19	18	16	17	22	27	29	21	00	02
48	21	21	15	16	32	31	33	32	02	02
49	20	21	14	17	35	40	27	41	01	01
50	13	12	12	13	20	13	04	02	02	02

Subject	Day #1 Forehand/Back-hand	Day #2 Rally	Day #1 Backhand Rally	Day #2	Day #1 Volley Shot	Day #2	Day #1 Ceiling Shot	Day #2	Day #1 Kill Shot	Day #2
51	15	15	11	10	15	17	01	05	02	01
52	20	20	16	17	32	25	23	16	01	04
53	16	19	12	13	23	23	11	05	03	06
54	17	16	16	15	26	33	14	14	03	04
55	17	17	17	18	25	19	19	21	04	03
56	19	20	15	17	30	27	33	14	02	03
57	16	16	14	14	31	31	10	05	05	05
58	8	10	12	16	16	22	00	00	02	02
59	17	14	15	16	18	18	13	31	01	04
60	19	18	18	13	20	30	16	08	04	06
61	21	18	18	17	32	37	33	23	08	06
62	22	16	16	17	26	26	08	02	06	06
63	18	23	19	19	28	31	16	17	05	04
64	23	22	20	19	37	39	22	19	06	06
65	21	19	15	17	15	19	23	14	06	05
66	15	20	19	18	28	24	28	15	02	05
67	15	17	09	12	19	21	23	04	04	05
68	17	19	13	09	27	22	07	13	07	05
69	13	10	09	10	19	15	01	00	01	03
70	14	16	12	10	13	20	00	01	06	04

APPENDIX F

COMPUTER DATA AND RESULTS OF THE COMPLETE ROUND ROBIN TOURNAMENT

CODE		F/B Rally	B Rally	Volley	Ceiling	Kill	Subs.	Opp.	Total	Adj.	W.	L.	Pct.
#1													
JC	01	15	13	14	19	4	348	381	- 33	530	21	31	.404
GG	02	20	16	27	12	4	506	359	+147	710	34	18	.654
CK	03	12	7	18	4	2	200	690	-490	73	2	50	.038
MM	04	21	18	27	23	6	788	174	+614	1177	49	3	.942
GR	05	20	20	30	31	5	402	326	+ 76	639	31	21	.596
BR	06	15	12	27	22	4	433	284	+149	712	37	15	.712
JS	07	17	11	15	26	5	487	270	+217	780	42	10	.808
#2													
JA	08	23	16	30	16	5	672	176	+496	1059	48	4	.923
RC	09	20	14	24	19	4	293	467	-174	389	16	36	.308
GH	10	21	17	32	18	3	362	478	-116	447	18	34	.346
RH	11	20	12	30	13	2	394	333	+ 61	624	35	17	.673
KS	12	20	20	33	15	6	449	363	+ 86	649	29	23	.558
ML	13	22	18	32	17	4	493	326	+167	730	33	19	.635
MR	14	17	13	24	8	4	333	433	-100	463	23	29	.442
SS	15	16	16	18	6	6	363	510	-147	416	19	33	.365
GS	16	17	15	35	23	4	540	214	+326	889	45	7	.865
PM	17	15	15	19	17	4	381	402	- 21	542	25	27	.481
#5													
JM	18	17	16	15	6	6	435	474	- 39	524	31	21	.596
GS	19	19	17	28	11	4	293	478	-185	378	19	33	.365
DM	20	18	26	18	27	5	518	309	+209	772	39	13	.750
DW	21	15	15	22	5	5	341	420	- 79	484	19	33	.365
SU	22	20	17	25	28	5	357	439	- 82	481	24	28	.462
FS	23	21	16	30	23	7	360	474	-114	449	25	27	.481
#4													
BA	24	14	11	19	0	4	296	601	-305	258	11	41	.212
GA	25	10	8	9	5	1	155	718	-563	1	2	50	.038
JB	26	11	8	16	3	1	255	751	-496	67	6	46	.115
BC	27	19	14	24	7	5	273	581	-308	255	9	43	.173
DL	28	18	18	20	2	2	385	555	-170	393	17	35	.327
DM	29	23	19	39	33	3	787	165	+622	1185	44	8	.846
KM	30	13	9	13	1	1	183	679	-496	67	3	49	.058
RV	31	18	16	20	0	2	432	427	+ 5	568	32	20	.615
AW	32	18	12	20	20	6	326	500	-174	389	18	34	.346
MW	33	18	13	20	6	3	525	355	+170	733	33	19	.635
HP	34	13	12	16	0	1	211	676	-465	98	6	46	.115

CODE		F/B Rally	B Rally	Volley	Ceiling	Kill	Subs.	Opp.	Total	Adj.	W.	L.	Pct.
#6													
PB	35	18	18	25	16	4	355	420	- 65	498	23	29	.442
RD	36	17	9	18	11	4	357	436	- 79	484	18	34	.346
LJ	37	17	14	22	9	3	346	418	- 72	491	18	34	.346
KK	38	19	14	20	19	3	473	286	+187	750	31	21	.596
JM	39	21	17	31	9	6	430	374	+ 56	619	21	31	.404
CR	40	16	11	19	14	6	325	492	-167	396	21	31	.404
SM	41	16	17	28	6	6	443	308	+135	698	35	17	.673
KS	42	15	14	16	5	4	263	581	-318	245	10	42	.192
AS	43	16	13	28	15	6	355	490	-135	428	19	33	.365
JT	44	14	16	22	13	3	248	523	-275	288	7	45	.135
#7													
AS	45	17	20	36	26	5	540	267	+273	836	41	11	.788
LS	56	18	12	25	3	4	455	355	+100	663	34	18	.654
BW	47	19	16	22	29	0	667	233	+434	997	47	5	.904
DS	48	21	15	32	33	2	616	241	+375	938	44	8	.846
JS	49	20	14	35	27	1	959	145	+814	1377	51	1	.981
PR	50	13	12	20	4	2	301	498	-197	366	16	36	.308
RM	51	15	11	15	1	2	205	581	-376	187	9	43	.173
BC	52	20	16	32	23	1	475	336	+139	702	32	20	.615
FC	53	16	12	23	11	3	526	256	+270	833	44	8	.846

ROUND ROBIN RESULTS SECTIONS 4 AND 5

	25	30	32	31	29	28	27	24	33	26	34
18	3/16	7/13	7/8	15/11	18/1	4/7	5/8	2/13	8/9	10/13	5/12
22	4/9	1/12	8/7	4/7	15/3	4/10	5/7	3/10	7/5	7/12	4/10
21	1/6	3/4	8/7	11/5	12/2	3/17	4/5	1/8	7/4	1/3	4/10
19	5/12	3/9	3/7	9/6	14/1	7/8	9/6	2/10	20/1	7/11	4/9
23	7/6	3/11	3/9	9/2	13/4	5/7	1/16	4/5	5/9	5/6	2/10
20	1/21	3/12	4/9	2/10	16/1	9/18	1/5	4/17	5/15	7/10	3/15

SECTIONS 1 AND 5

	02	04	01	07	06	03	05
21	11/5	16/3	1/11	10/3	7/5	5/11	2/4
23	7/5	25/1	16/2	7/8	2/2	5/7	2/3
18	7/12	19/5	13/1	11/5	3/3	1/4	2/4
20	4/13	15/1	2/3	5/4	4/2	1/8	7/2
19	11/2	2/1	5/2	11/3	9/2	4/2	10/7
22	3/9	1/3	5/9	13/8	7/5	5/11	1/8

ROUND ROBIN RESULTS SECTIONS 7 AND 2

	51	47	46	49	45	48	53	52	50
10	8/9	15/3	10/5	24/1	4/10	11/4	17/0	19/6	4/6
14	2/10	16/1	11/2	23/3	15/4	10/8	13/3	7/6	8/6
13	3/10	6/3	13/5	23/2	7/9	12/6	6/5	1/9	4/15
12	2/8	18/4	9/5	14/8	11/5	13/3	11/4	6/7	4/16
16	1/4	9/3	3/6	8/2	4/12	8/2	6/7	3/6	1/9
09	1/13	12/5	14/9	19/1	6/5	10/4	14/1	11/5	6/3
17	6/13	15/3	14/5	21/3	6/3	11/4	14/4	4/6	5/8
11	4/2	16/4	10/4	19/4	9/6	13/3	12/6	9/4	6/8
08	2/17	4/7	3/17	9/3	1/5	4/2	2/12	9/17	7/21
15	6/5	15/2	11/5	21/1	10/3	12/1	12/4	10/2	5/7

SECTIONS 7 AND 5

	48	46	50	51	53	47	45	49	52
23	18/6	15/7	7/11	3/16	15/3	18/2	15/7	12/10	9/8
21	13/3	12/8	8/9	4/7	12/5	14/4	9/8	25/2	7/1
18	14/4	14/2	4/15	6/8	10/4	14/6	15/4	24/1	12/9
22	15/3	12/6	8/11	5/8	15/4	19/4	11/1	23/2	10/8
20	6/10	6/11	4/20	4/19	10/5	11/7	12/0	19/5	5/6
19	13/3	7/8	7/8	4/7	9/1	18/7	10/2	22/3	8/10

ROUND ROBIN RESULTS SECTIONS 2 AND 1

	10	17	13	15	16	09	14	12	11	08
06	4/9	1/10	6/10	7/8	7/6	3/9	1/13	4/5	7/4	8/4
04	2/2	1/8	5/10	6/10	5/11	0/22	6/7	2/19	1/6	2/7
03	10/3	13/4	12/5	14/1	22/0	9/5	11/7	16/2	13/1	17/3
01	8/7	7/6	9/2	5/9	13/0	3/9	7/6	5/6	8/6	8/3
07	4/6	4/12	6/7	4/9	6/4	2/16	5/3	9/9	7/12	5/9
02	10/8	4/5	9/14	14/11	7/3	4/10	7/8	7/9	1/11	11/4
05	5/9	9/5	6/9	7/2	9/1	8/7	4/5	3/7	5/8	9/5

SECTIONS 4 AND 6

	31	25	34	28	24	27	29	30	33	32	26
37	9/5	2/11	7/4	6/10	9/10	4/12	17/1	4/7	6/3	6/4	3/11
42	13/5	16/6	14/9	10/4	9/5	15/1	18/1	9/3	12/0	6/5	5/7
43	7/4	5/12	2/20	12/8	0/10	2/6	23/3	4/15	12/9	11/7	4/25
40	7/8	1/12	5/9	8/11	12/4	13/7	17/3	5/6	17/0	12/3	6/13
36	11/5	3/9	4/14	11/6	5/13	3/18	15/4	4/6	12/4	7/3	1/22
38	7/5	1/16	3/23	3/12	3/12	9/12	14/1	2/17	6/10	1/15	5/17
39	10/9	5/5	5/6	2/8	5/9	4/12	6/2	4/10	9/5	4/11	0/21
41	4/8	1/13	1/13	7/8	5/14	4/8	12/2	3/12	8/11	7/12	1/15
35	9/5	3/12	3/12	7/11	7/8	10/6	19/3	0/19	9/4	7/8	4/10
44	9/5	5/8	5/8	7/5	6/4	5/5	15/2	0/14	17/1	6/4	5/9

ROUND ROBIN RESULTS SECTIONS 1 AND 7

	02	04	01	05	07	06	03
48	3/15	8/5	1/12	8/9	6/4	6/10	0/25
53	7/10	4/6	5/13	3/7	4/9	1/12	2/8
52	8/6	11/2	3/9	11/9	6/3	7/3	1/17
47	4/10	6/7	1/12	5/9	5/11	4/9	2/19
50	11/7	12/2	4/6	6/7	7/5	12/2	5/13
46	4/8	13/3	7/3	7/10	15/2	7/4	1/11
49	5/16	6/9	6/10	5/17	3/6	3/6	1/20
51	18/0	19/0	7/4	11/2	21/0	13/1	5/6
45	10/9	10/9	1/11	9/7	3/4	1/13	2/16

SECTIONS 6 AND 2

	37	40	35	38	36	42	43	39	41	44
13	8/4	7/11	4/8	3/4	6/10	1/23	1/15	2/7	4/12	2/14
15	12/4	4/12	8/10	5/8	8/3	2/18	3/12	10/9	9/8	8/10
09	10/4	5/1	11/5	14/5	4/12	3/12	8/2	14/1	5/4	7/12
11	2/12	2/10	4/8	5/12	5/12	2/19	4/12	7/5	7/2	1/11
17	2/5	3/8	7/9	11/5	2/10	4/14	7/8	7/9	9/7	5/6
10	11/3	8/6	7/9	10/5	9/7	4/11	8/6	15/7	13/4	2/10
14	8/9	6/7	9/10	7/3	9/4	11/8	5/8	7/3	4/11	5/6
12	7/3	3/8	5/10	9/7	7/8	3/11	3/13	12/4	6/5	2/12
16	2/15	2/11	0/13	4/5	5/9	2/20	3/2	6/7	5/9	4/11
08	3/2	1/0	2/10	7/10	5/8	2/15	3/11	2/13	4/4	5/19

ROUND ROBIN RESULTS SECTIONS 4 AND 7

	30	24	28	29	32	25	27	34	26	33	31
52	3/13	4/14	5/11	5/6	5/12	3/18	6/14	7/10	3/28	5/9	2/7
49	0/25	1/33	1/24	4/12	1/21	0/33	1/24	2/22	2/31	1/27	4/15
50	5/8	4/5	16/6	9/1	6/11	4/9	6/9	3/11	4/12	6/8	11/9
46	2/13	1/21	5/10	2/3	3/9	1/17	0/14	2/11	2/21	9/5	7/10
53	0/22	3/14	5/9	14/0	3/11	6/14	5/11	2/18	1/20	3/11	4/8
48	4/23	0/28	1/15	5/10	2/14	3/16	3/21	3/11	1/22	2/10	13/5
45	2/11	4/10	3/9	4/7	4/12	1/17	6/11	3/10	5/21	5/13	2/11
51	3/8	5/7	13/6	18/1	4/9	4/9	4/5	4/8	6/13	19/2	12/8
47	3/17	2/19	3/17	12/7	3/16	1/18	5/19	3/18	6/12	3/6	4/15

SECTIONS 4 AND 2

	24	28	33	30	27	32	31	29	25	26	34
01	3/0	5/0	9/7	5/9	4/13	6/7	10/8	8/3	1/7	4/7	4/16
09	4/5	14/2	7/1	0/14	7/8	5/8	12/6	17/1	1/8	12/0	5/6
15	4/12	4/8	11/8	2/0	4/9	6/10	9/4	22/2	1/9	4/20	2/15
13	3/13	12/6	6/7	1/14	3/13	4/6	7/9	11/5	2/12	7/22	1/20
11	3/10	5/7	3/8	1/12	4/11	5/7	5/7	15/1	3/8	1/15	2/9
14	0/14	8/6	13/3	3/11	4/14	7/5	9/3	26/3	1/11	1/0	6/13
16	2/12	4/5	2/8	4/17	1/13	2/10	3/6	5/6	0/4	3/0	0/22
08	4/14	0/2	4/3	2/15	1/15	2/23	3/0	12/6	0/23	1/8	4/11
12	7/5	3/12	9/5	2/11	3/9	7/5	7/9	15/4	2/13	1/6	8/5
17	14/3	8/9	7/0	3/8	4/7	6/5	7/5	9/3	1/23	7/11	1/7

ROUND ROBIN RESULTS SECTIONS 2 AND 5

	09	14	08	10	16	11	12	17	13	15
18	16/3	7/4	15/5	8/10	13/6	9/6	11/3	8/10	15/5	5/10
21	10/2	3/9	13/5	9/10	11/6	6/2	6/3	9/1	7/5	6/11
20	2/14	3/11	8/1	7/11	6/7	7/4	5/2	5/7	7/11	2/15
23	6/8	8/7	14/1	7/8	11/5	2/5	8/11	17/3	12/5	6/13
22	3/5	7/8	9/5	7/11	6/4	6/8	8/6	6/7	13/3	11/8
19	6/8	7/6	12/2	7/11	6/4	8/6	8/6	6/8	12/6	11/5

SECTIONS 4 AND 1

	31	27	34	24	28	32	29	30	33	26	25
02	6/2	4/12	3/14	8/2	4/14	3/8	11/5	3/13	14/7	4/2	7/0
05	8/9	2/10	7/8	7/11	2/7	6/9	9/2	2/10	8/7	6/7	2/12
06	2/10	1/11	2/15	6/13	5/14	4/14	9/11	3/14	8/7	2/13	2/12
04	4/10	0/26	2/19	2/15	3/36	0/17	5/10	0/19	3/15	2/31	2/15
07	5/12	2/7	3/12	5/13	9/10	6/9	12/6	6/13	5/18	6/5	1/13
01	7/5	4/10	4/14	5/9	7/5	4/8	14/2	3/14	12/4	2/18	3/8
03	15/6	12/8	10/6	12/6	12/6	9/6	25/0	8/7	9/7	6/12	8/7

SECTIONS 6 AND 1

	43	42	36	44	35	41	39	40	37	38
01	13/10	12/4	3/11	8/7	3/10	6/5	4/10	7/11	5/13	9/3
02	2/16	7/12	3/11	3/6	1/12	6/10	3/12	5/16	8/9	8/6
03	10/5	15/7	12/3	6/9	10/5	11/0	7/2	14/2	18/5	12/5
07	5/12	5/15	5/8	2/18	5/8	8/9	5/11	6/8	5/12	7/12
04	0/34	6/21	4/10	3/15	3/14	6/9	2/12	4/19	5/10	5/10
05	7/5	6/10	1/7	2/11	9/6	5/6	7/9	5/12	2/3	3/7
06	3/8	6/7	5/11	5/9	6/7	8/5	2/12	16/0	5/7	1/6

ROUND ROBIN RESULTS SECTIONS 6 AND 5

	41	44	39	35	42	40	38	43	36	37
21	6/5	11/7	3/8	4/10	6/10	9/7	8/3	8/6	9/5	4/5
22	3/5	2/11	7/4	11/8	7/6	12/9	7/4	8/9	6/8	5/6
23	8/7	6/9	12/4	10/9	8/9	8/5	18/3	12/11	3/11	7/8
18	4/11	6/8	8/11	4/7	5/17	4/13	15/1	7/8	7/8	6/10
20	7/6	5/6	3/10	7/9	10/6	4/10	5/8	5/14	4/7	2/15
19	12/5	6/10	10/1	10/6	13/6	11/3	12/2	11/7	6/8	8/9

SECTIONS 6 AND 7

	38	44	42	37	43	41	40	39	35	36
46	5/11	8/9	6/10	6/8	11/2	2/5	6/8	13/3	8/2	12/7
52	6/2	3/9	5/7	4/10	7/8	6/8	3/14	12/5	2/14	9/7
47	5/9	2/12	5/10	4/14	4/10	4/6	4/11	8/2	3/9	7/12
45	4/8	2/12	1/10	2/15	1/14	6/7	7/16	8/5	2/9	2/15
53	7/8	2/9	2/12	3/7	7/9	5/7	5/18	4/7	8/7	5/7
48	2/9	4/6	2/15	8/10	4/13	5/4	3/17	7/8	8/15	2/14
50	5/4	8/5	6/8	12/1	6/7	12/4	7/5	14/15	8/6	7/5
49	?2	2/21	0/24	1/11	4/16	4/15	1/19	6/18	2/11	3/17
51	0/2	5/6	4/1	10/4	10/4	13/1	8/5	10/5	8/6	7/6

ROUND ROBIN RESULTS-INTRA CLASS

SECTION 1

	01	02	03	04	05	06	07
01		12/7	1/12	12/9	7/8	12/4	13/2
02	7/12		1/24	12/6	9/4	8/6	14/6
03	12/1	24/1		45/0	13/3	9/3	12/2
04	9/12	6/12	9/45		6/12	6/14	3/11
05	8/7	4/9	3/13	12/6		7/10	10/6
06	4/12	6/8	3/9	14/6	10/7		13/5
07	2/13	6/14	2/12	11/3	6/10	5/13	

SECTION 2

	08	09	10	11	12	13	14	15	16	17
08		3/23	2/18	6/16	1/5	3/13	2/14	5/20	2/7	2/12
09	23/3		13/6	8/6	12/5	10/5	5/4	3/10	15/4	14/3
10	18/2	6/13		11/7	14/4	9/6	10/5	5/14	12/5	11/6
11	16/6	6/8	7/11		7/6	1/3	12/6	7/5	6/7	5/7
12	15/1	5/12	4/16	6/7		7/17	3/17	4/18	10/8	6/19
13	13/3	5/10	6/9	13/6	17/7		4/13	2/17	9/7	4/12
14	14/2	4/5	5/0	6/12	17/3	13/4		2/4	10/5	4/14
15	20/5	16/3	14/5	8/7	18/4	17/2	4/21		14/1	18/6
16	7/2	4/15	5/2	7/6	8/10	4/9	5/10	1/14		4/13
17	12/2	3/14	9/11	5/5	19/6	7/4	12/4	6/18	13/4	

ROUND ROBIN RESULTS-INTRA CLASS

SECTION 4

4	24	25	26	27	28	29	30	31	32	33	34
24		2/19	8/10	7/10	10/17	26/3	4/15	13/12	13/4	13/4	8/14
25	19/2		17/3	15/0	30/2	24/2	14/3	20/4	15/2	31/4	12/6
26	10/8	3/17		8/9	17/7	21/2	4/15	13/7	8/12	18/6	7/14
27	13/7	10/15	9/8		10/8	28/2	6/14	13/4	14/8	29/2	5/12
28	17/10	2/30	7/17	8/10		18/2	5/13	15/10	16/7	20/5	7/14
29	3/26	2/24	2/21	2/28	2/18		0/35	1/23	0/24	2/14	0/39
30	15/4	3/14	15/4	14/6	13/5	35/0		9/5	16/9	23/3	11/10
31	12/13	4/20	7/13	4/13	10/15	23/1	5/9		11/15	22/4	2/15
32	4/13	2/15	12/8	8/14	7/16	24/0	9/16	15/11		6/4	7/11
33	4/13	4/31	6/18	2/29	5/20	14/2	3/23	4/22	4/6		4/19
34	14/8	6/12	14/7	12/5	14/7	39/0	10/11	15/2	11/7	19/4	

SECTION 5

5	18	19	20	21	22	23
18		4/17	15/3	7/15	2/19	8/10
19	17/4		10/4	9/7	9/8	6/12
20	3/15	4/10		8/11	8/9	8/6
21	15/7	7/9	11/8		8/9	10/8
22	19/2	8/9	9/8	9/8		6/4
23	10/8	12/6	6/8	8/10	4/6	

ROUND ROBIN RESULTS-INTRACLASS

SECTION 6

	35	36	37	38	39	40	41	42	43	44
35		5/6	7/6	14/2	7/10	8/10	13/5	1/14	9/8	4/5
36	6/5		10/9	10/3	13/7	10/6	13/4	3/13	5/15	3/9
37	6/7	9/10		9/2	8/11	6/16	9/8	3/8	6/4	7/16
38	2/14	3/10	2/9		3/11	4/11	9/8	4/12	5/14	5/13
39	10/7	7/3	11/8	11/3		14/10	12/11	6/12	6/9	3/12
40	10/8	6/10	16/6	11/4	10/14		13/3	4/7	10/2	8/10
41	5/13	4/3	8/9	8/9	11/12	3/13		1/14	2/12	3/5
42	14/1	13/3	8/3	12/4	12/6	7/4	14/1		3/6	6/9
43	8/9	15/5	4/6	14/5	9/6	2/10	12/2	6/3		2/10
44	5/4	9/3	6/7	13/5	12/3	10/8	15/3	8/6	10/2	

SECTION 7

	45	46	47	48	49	50	51	52	53
45		4/10	12/4	12/7	17/6	8/12	3/25	3/10	4/9
46	10/4		11/5	15/6	24/0	3/8	1/15	12/7	9/6
47	4/12	5/11		7/15	12/6	2/21	3/21	6/5	4/10
48	7/12	6/15	15/7		10/4	3/12	3/14	6/10	5/13
49	6/17	0/24	6/12	4/10		1/37	3/19	2/24	1/7
50	12/8	8/3	21/2	12/3	37/1		3/6	12/9	10/3
51	25/3	15/1	21/3	14/3	19/3	6/3		12/4	12/1
52	10/3	7/12	5/6	10/6	24/2	9/12	4/2		10/9
53	9/4	6/9	10/4	13/5	17/1	3/10	1/2	9/10	

APPENDIX G

TWO-ITEM TEST BATTERY WITH CRITERIONS AND RESIDUALS

Subject	Criterion	Predicted Criterion	Residual	F/B Rally	Ceiling Shot
01	530	521.80	8.20	15	19
02	710	645.89	64.11	20	12
03	73	196.27	-123.27	12	4
04	1173	832.86	344.14	21	23
05	639	894.35	-255.35	20	31
06	712	561.03	150.97	15	22
07	780	699.59	80.41	17	26
08	1059	827.57	231.43	23	16
09	389	737.43	-348.43	20	19
10	447	767.47	-320.47	21	18
11	624	658.96	-34.96	20	13
12	649	685.12	-36.12	20	15
13	730	797.52	-67.52	22	17
14	463	464.20	-1.20	17	8
15	416	394.92	21.08	16	6
16	889	660.36	228.64	17	23
17	542	495.65	46.35	15	17
18	524	438.05	85.95	17	6
19	378	589.68	-211.68	19	11
20	772	755.79	16.21	18	27
21	484	338.72	145.28	15	5
22	481	855.12	-374.12	20	28
23	449	832.86	-383.86	21	23
24	258	230.21	27.79	14	0
25	1	123.10	-122.10	10	5
26	67	140.07	-73.07	11	3
27	255	537.38	-282.38	19	7
28	393	428.87	-35.87	18	2
29	1185	1049.88	135.12	23	33
30	67	200.16	-133.16	13	1
31	568	402.71	165.29	18	0
32	389	664.25	-275.25	18	20
33	733	481.17	251.83	18	6
34	98	187.09	-89.09	13	0
35	498	611.94	-113.94	18	16
36	484	503.43	-19.43	17	11
37	491	477.28	13.71	17	9
38	750	694.30	55.70	19	19
39	619	649.78	-30.78	21	9
40	396	499.54	-103.54	16	14
41	698	394.92	303.08	16	6
42	245	338.72	-93.72	15	5
43	428	512.62	-84.62	16	15
44	288	400.21	-112.21	14	13
45	836	699.59	136.41	17	26
46	663	441.94	221.06	18	3
47	997	825.07	171.93	19	29
48	938	963.63	-25.63	21	33
49	1377	842.04	534.96	20	27
50	366	239.39	126.61	13	4
51	187	286.41	-99.41	15	1
52	702	789.73	-87.73	20	23
53	833	460.31	372.69	16	11

VITA 2

Craig Alan Buschner

Candidate for the Degree of

Doctor of Education

Thesis: THE VALIDATION OF A RACQUETBALL SKILLS TEST FOR COLLEGE MEN

Major Field: Higher Education

Minor Field: Health, Physical Education, and Recreation

Biographical:

Personal Data: Born in Washington, D.C., September 13, 1951, the son of Mr. and Mrs. James G. Koch. Married to Patti Lee Clayton.

Education: Graduated from Fairfax High School, Fairfax, Virginia, in June, 1969; received Bachelor of Science degree in Physical Education from Virginia Commonwealth University, Richmond, Virginia, in August, 1974; received Master of Science in Physical Education from Western Illinois University, Macomb, Illinois, in August, 1974; completed requirements for the Doctor of Education degree at Oklahoma State University in December, 1976.

Professional Experience: Assistant Health Club Director, Arlington, Virginia YMCA, 1969-1971; Youth Recreation Leader, Fairfax, Virginia, and Stillwater, Oklahoma, Summers 1970, 71, 75; Adult Recreation Leader, Richmond, Virginia, Summer 1973; Elementary Physical Education Teacher, Macomb, Illinois, 1973-1974, Lincoln Elementary; Movement Education Specialist, Macomb Park District, Macomb, Illinois, Summer 1974; Teaching Assistant, Oklahoma State University in HPER, 1974-1976. Member of American Alliance of Health, Physical Education, and Recreation; Oklahoma Association of Health, Physical Education, and Recreation.