THE VALIDATION OF A BATTERY OF REACTION TIME TESTS TO PREDICT RACQUETBALL ABILITY FOR COLLEGE MEN

By

ROBERT ALAN KLASS

Bachelor of Science
Indiana State University
Terre Haute, Indiana
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Master of Science
Indiana State University
Terre Haute, Indiana
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Thesis Approved:

Jay B. Harrison
Thesis Adviser

James H. Boyce

George R. O'Shea

John W. Creswell

Norman N. Durham
Dean of the Graduate College

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CHAPTER I

INTRODUCTION

Many members of the physical education profession today are of the opinion that testing and measuring are vital parts of a program and must be included in a sound curriculum. On the other hand, there are some that believe testing is a meaningless waste of time.

In any field of teaching there must be definite goals and there must be means of measuring the degree to which the goals have been achieved. This measuring of achievement provides a basis for judging teaching methods, and teaching methods themselves are improved when measurement becomes a part of the method.

No physical educator is today adequately prepared for his profession unless he recognizes the advantages and evils that exist in the measurement program. The teacher will need to know how to evaluate tests, know what tests are available to him, and know how to use tests and their results in his teaching.

The skill test has its greatest value when the results are used to improve instruction. It is concerned mainly with level of performance. With the aid of skill testing, prospective athletes may be discovered in a physical education class as well as isolating existing skill problems.

Important to physical education is the ability to analyze and compare human ability. If crucial factors can be isolated, it might be

possible to predict performance levels, select individuals with potential for skilled performance, or improve performance through special training.

When discussing racket games, the Doherty brothers[1] state alertness and quick reactions are a necessity. Davies claims[2] "... it requires split second timing and concentration." Metzler[3] says that timing is a great asset. Talbert[4] writes that speed and timing are essential. Murphy and Murphy[5] describe the expert play as requiring speed, fast reaction, and good basic coordination.

Other experts have implied or directly stated that timing, and the ability to react and move quickly are basic to skilled performance. Speed of response distinguishes the outstanding performer from the poor performer in many motor skills. Both reaction time and movement time would be very helpful in numerous ways to physical educators when working with students. Performers with fast reaction abilities, have certain advantages in activities such as track, tennis, swimming, baseball, and basketball. After studying the literature comparing reaction time with success in athletics, this author as a physical educator and coach decided to study the importance of reaction time within the sport of

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[1]Summers, Emory Floyd. "Tennis Ability and Its Relationship to Seven Performance Tasks," (unpublished Doctoral Dissertation, University of Oregon, Eugene, 1973), p. 2.

[2]Davies, Mike. Lawn Tennis, Arc Books, Inc., New York, 1963.

[3]Metzler, Paul. Advanced Tennis, New York: Sterling Publishing Co., Inc., 1968.

[4]Talbert, William F. and Bruce S. Old. The Game of Singles Tennis, New York: J. B. Lippincott Co., 1956.

[5]Murphy, B. and C. Murphy. Tennis Handbook, New York: The Ronald Press Co., 1962.

racquetball.

The speed of the response to a given stimulus, or reaction time, is an essential quality to success in many sports. In sports and games many movements are responses to signals, such as starting guns, movements of opponents, or flight of balls. The track man or swimmer who can start faster, the baseball baserunner who can react faster to the pitcher's motion, the tennis player who can react faster to the opponent's shots, all have a clear advantage over other performers.

According to Patrick[6] the faster reaction time to a visual stimulus shown by an individual, the more potential playing ability in basketball is indicated. After testing boys in various reaction time tests, he subjected the boys to ratings by their coaches in basketball playing ability. The coaches ranked their players from best to worst, and the top ranked players also had the fastest reaction times.

Reaction time and movement time are usually highly related to success found in champion track athletes. This theory was supported by Westerlund and Tuttle in their research comparing the relationship between running events in track and reaction time.[7]

The game of racquetball requires an individual to react instantaneously, much the same as a subject involved in a laboratory experiment. The player reacts to the racquetball which becomes the stimulus in this instance. While the game is played on a four-walled court which

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[6]Patrick, John. "Quick Reaction Time Means Athletic Ability," Athletic Journal, 30: 68, September, 1949.

[7]Westerlund, J. H. and W. W. Tuttle. "Relationship Between Running Events in Track and Reaction Time," Research Quarterly, 2: 95-100, October, 1931.

causes the ball to rebound at angles, a player must react immediately to the path of the ball and move quickly in order to have success in the game.

History of Racquetball

Racquetball is a game that originated at the University of Michigan in the early 1930's. Earl Riskey developed the sport after watching tennis players practice their shots in a handball court. He decided that an individual could play a game similar to handball that would include the skills of tennis, thus racquetball was born.[8]

For many years, the game of racquetball existed mostly among older men who no longer had the physical stamina to play handball. Then as a result of the increased interest in physical fitness during the 60's, many colleges and clubs revitalized the game under various names to the point where younger players became interested.

Racquetball has grown consistently since the late '60's and it appears the chances for growth will be bright. It is excellent physical exercise and it is a sport that all ages can enjoy. The racket is short enough that it feels like an extension of your hand. It is not cumbersome or heavy as a squash or tennis racket. The ball is large enough to follow easily and since the game is played within four walls (and a ceiling), you do not have to worry about chasing the ball across six courts and a highway or about hitting it over fences. Racquetball participation has increased over the last half-dozen years causing a severe shortage of courts. As a result, more than 250 clubs strictly

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[8]Allsen, Philip E. and Alan Witbeck. Paddleball, Dubuque, Iowa: Wm. C. Brown Company, Publishers, 1972, p. 1.

tailored for racquetball/handball have emerged from coast to coast. There are perhaps another 200 or more in combination with indoor tennis and health clubs.

There is a need for research concerning the game of racquetball. There have been numerous studies involving the racket games of tennis and badminton and the sport of handball, but very little in the direction of racquetball. Presently, there are no published skill tests for racquetball and no established means for determining a player's level of proficiency. McKie[9] studied racquetball players at Oklahoma State University in 1972 to determine the energy cost of racquetball during singles, cut-throat, and doubles play. Buschner[10] constructed a racquetball skills test at Oklahoma State University, involving specific skill of shots. Buschner's results indicated that a forehand/backhand continuous rally and the ceiling shot were the two most significant measures of beginning racquetball ability.

It is quite evident from looking at the literature that racquetball is now becoming popular. Until 1976 there was no valid battery of skill test items for racquetball. This clearly indicates that racquetball is now in the early stages of development

In 1976, Sciarra[11] proposed a skill classification rating form which, when completed, would place an individual in class A, or B, or C.

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[9]McKie, Thomas D. "Energy Cost of Racquetball," (unpublished Master's thesis, Michigan State University, 1972).

[10]Buschner, Craig Alan. "The Validation of A Racquetball Skills Test for College Men," (unpublished Doctoral Dissertation, Oklahoma State University, 1976).

[11]Sciarra, Frank. Racketball, Vol. 5, No. 3, May/June, 1976, p. 3.

The form would be completed by an expert of racquetball. The following is the classification rating form proposed by Sciarra:

Name_____

Class_____

Efficiency Rating_____

	5-High	3-Medium	1-Low
Game Strategy	0	0	0
Aggressiveness	0	0	0
Endurance	0	0	0
Forehand	0	0	0
Backhand	0	0	0
Total Points:			

A = 21 to 25 points
B = 16 to 20 points
C = 5 to 15 points

Date_____

Signed _____

Position _____

The problem with the Sciarra Test is that it is subjective in nature, scored by a racquetball expert. The author of the present study is attempting to form an objective battery of skill test items, including reaction time, movement time, and the wall-volley in order to investigate the possibility that a better test might be produced. The addition of reaction time and movement time tests to the currently used skill tests will enable the researcher to explore the possibility of constructing a test with higher validity and one which is easier to administer.

Noticeably absent from the Sciarra rating form and the Buschner test is reaction time or timing, which the author feels should be present in evaluating player ability. It is the attempt of this study

to use reaction time as a test to predict playing ability in racquetball.

The wall-volley skill test is being employed within this study because of its high reliability and its ease of administration to test subjects. Wall-volleying is often a useful way of practicing a particular skill, in this instance, racquetball.

The computer age began its uphill climb from obscurity in the 1950's at the time when the space age came to the limelight of the American people. In an attempt to catch up with the Russian's Sputnik program, much energy and money was spearheaded toward a computer program that would aid in bringing the American's space program into equalization with that of the Soviet Union.

As computers became more complex and diversified, more and more industries utilized its usefulness in such jobs as programming, budgeting, and cost analysis.

An offspring from the growth of computers has been electronic amusement games. Most notable are the home versions of electronic games that can be affixed to a television set that in essence serve as the game board, with controls in the hands of the players. The popularity of these games has been overwhelming and in fact, amusement galleries of nothing but electronic games have been established throughout the United States.

Playing a game such as electronic tennis requires eye-hand coordination, space awareness, and quick reaction time in order to attain a high level of proficiency. With these thoughts in mind, the researcher inserted the use of this game as a potential test of racquetball skill into the study. How well an individual could react to an audio and visual stimuli appeared to be a determining factor in proficiency of

playing electronic tennis.

Although there is a long line of research concerned with different areas of reaction time and movement time, many questions may still be raised. The investigator searched the literature and found no studies relating reaction time to racquetball skill. Because of the author's interest in this rapidly growing sport, this study was conducted.

Statement of the Problem

The primary purpose of this study was to develop a battery of reaction time tests and the wall-volley skill test to predict playing ability in racquetball among college men.

A secondary purpose of this study was to determine the relationship of ability in racquetball to skill in playing electronic tennis.

Correlation methods were employed to determine relationships between individual reaction time tests and the racquetball round-robin tournament results. Multiple regressions were calculated and regression equations were formulated.

Limitation

(1) All players within the round-robin racquetball tournament refereed their own respective matches.

Delimitations

(1) The subjects were male Oklahoma State University students enrolled in HPER 2282 Tennis and Racquetball classes, during the fall semester, 1976.

(2) The study determined ability in racquetball using a regulation size (20' x 20' x 40') four-wall racquetball/handball court.

(3) Each of the eight sections used in the study were given six weeks of instruction in racquetball by the researcher.

(4) Four sections met on a Monday, Wednesday, Friday schedule. Four sections met on a Tuesday, Thursday schedule. All sections received the same instruction in racquetball whether meeting twice a week or three times per week.

(5) The reaction time tests and the round-robin tournaments were administered by the researcher with assistance from twelve qualified, trained assistants.

(6) The Round-Robin racquetball tournament matches were limited to eight minutes in order to facilitate ease of administration.

(7) The Round-Robin electronic tennis tournament was limited to matches of eleven points to determine a winner. The machine limited games to eleven points which was affixed up on manufacture of the game.

Assumptions

The following basic assumptions were made:

(1) That racquetball ability was best demonstrated from results obtained from a complete round-robin tournament.

(2) That liveliness of the racquetball was consistent throughout the round-robin tournament.

(3) That fatigue did not affect reaction time scores as well as results from the round-robin tournament.

(4) That the test procedures were designed so that factors such as motivation, maturation, and setting were controlled and were not factors which affected the outcome.

Definitions

Battery - "a group of several tests standardized on the same population so that results on the several tests are comparable."[12]

Criterion - For this study the two criteria were (1) an accepted measure which is used to determine validity, an adjusted score arrived at by subtracting total points allowed from total points scored during a complete round-robin racquetball tournament, and (2) percentage of matches won.

Electronic Tennis Match - a computerized electronic tennis game that simulates a game of racquetball, with the use of four walls, a racquet, and ball played by two people.

IRA - governing body for racquetball, the International Racquetball Association.

Movement Time - this term will be referred to as the interval of time from the initial movement in response to a stimulus until the completion of the specified movement.

Racquetball Match - term which represents a complete game. A game of singles that lasts eight minutes.

Reaction Time - The time from introduction of a stimulus to the start of a movement.

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[12]Barrow, Harold M. and Rosemary McGee. A Practical Approach to Measurement in Physical Education, Philadelphia: Lea & Febiger, 1971.

Round-Robin Tournament - Tournament in which every subject plays against all other subjects involved in the study.

Validity - refers to whether or not a test measures what it claims to measure.

Wall-Volley - continuous rally of the racquetball to the front wall, which constitutes a legal hit. A legal hit is where the ball contacts the front wall/side wall or side wall/front wall before contact with the floor.

CHAPTER II

REVIEW OF RELATED LITERATURE

The author found numerous studies dealing with different aspects of reaction time and movement time. Studies directly related to this investigation were covered in this chapter.

Westerlund and Tuttle[1] reported a positive relationship between speed of movement and reaction time. Twenty-two University of Iowa track team members were used in the study where the speed of movement was a 75-yard dash and reaction time was measured by a finger reaction to a light stimulus. A correlation between reaction time and running the 75-yard dash was .86. Results from the study revealed champions and record holders in the group reacted quicker than other subjects tested.

Participation and success in performance of physical education activities were investigated by Burpee and Stroll.[2] They used 46 men who regularly exercised at a local gymnasium and had them react to a visual stimulus with a hand movement and a whole body movement. Results indicated there was a negative relationship between hand movement time and success in physical education activities, and no significant relationship between whole body movement time and success in physical education activities.

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[1] Westerlund and Tuttle.

[2] Burpee, R. H. and Wellington Stroll. "Measuring the Reaction Time of Athletes," Research Quarterly, 7: 110-118, 1936.

Beise and Peaseley[3] reported that skilled performers were significantly faster in reaction time and speed of movement than unskilled performers. They tested 47 women who were skilled in archery, tennis, and golf and 14 unskilled women. A sprint of 17 feet 10 inches from a standing start was the speed of movement measured. The reaction time measure was an arm and leg response to depressing and releasing pressure on a floor plate in response to a light stimulus. The authors concluded within their study, "If skill in sports is an indication of athletic ability, then it would appear that these elements (reaction time, speed of movement, and agility) are fundamental to a valid measure of athletic ability."

In 1942, Keller[4] attempted to determine the relationship between quickness of movement and success in athletics. He used 277 non-athletes and 359 athletes in his research. After analyzing some common sports such as baseball, basketball, and football, Keller came to the conclusion that quick movements are required in three directions, namely forward, to the right, and to the left. The test decided upon was one consisting of a quick action of one arm, one foot, and the trunk combined into one movement, either to the right or to the left or forward. The subject was instructed to stand in a position with feet spread apart with hands on the knees. Three targets mounted on rigid movable standards approximately 4 feet high were placed, one on the left,

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[3] Beise, Dorothy and Virginia Peaseley. "The Relation of Reaction Time, Speed and Agility of Big Muscle Groups to Certain Skills," Research Quarterly, 8: 133-142, March, 1937.

[4] Keller, Louis F. "The Relation of Quickness of Bodily Movement to Success in Athletics," Research Quarterly, 12: 146-155, 1942.

one on the right, and the third directly in front of the subject at a distance of twenty-four inches from the extended fingers of the outstretched arms. The targets were oval in shape. The targets were connected electrically to a control box and stop clock in such a way that when any target was touched it fell down and the circuit was broken. Upon the illumination of a light bulb, the subjects would attempt to hit the target. Reaction time was related to success in athletics. The statistical analysis utilized in this study was the Pearson Product-Moment correlation which produced an $\bar{r}$ of .84, significant at the .05 level of confidence.

Numerous studies have attempted to link reaction time with track runners. One such study was that of Henry and Trafton[5] which attempted to show that the fastest track runners also had the fastest reaction times. They used 25 subjects in their study while examining sprint starts and the relationship to reaction time. Subjects ran a distance of 50 yards with gates set up every 5 yards. The runner momentarily broke an electric circuit by body contact with each member of a series of light bamboo sticks, one of them projecting across the track at each timing station about waist height. This allowed the "gate" to swing open momentarily and then re-close the electric circuit. Reaction times were recorded from starting out of the blocks after reacting to a starting signal until passing through the first gate. A very low correlation of .14 resulted, thus showing that fast runners are not always the fastest reactors.

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[5]Henry, Franklin M. and Irving Trafton. "The Velocity Curve of Sprint Running With Some Observations on the Muscle Viscosity Factor," Research Quarterly, 22: 409-422, December, 1951.

Henry[6] correlated the speed of a fifty-yard dash with reaction time to determine if a significant relationship existed. Using 18 male subjects, a low correlation of .18 was found indicating that there was no relation between reaction and movement time.

Physical education majors of college age were used by Slater-Hammel[7] to test the relationship between movement time and reaction time. Each subject was required to pass his arm and shoulder through an arc of 120 degrees on an instrument in a sideward rotation. Results indicated there was no significant relationship between movement time and reaction time.

Another noted author and researcher who conducted studies involving champion athletes was Cureton.[8] Within his study, Cureton used the vertical jump to measure an individual's ability to move the whole body off of a switch mat, using champion athletes as subjects. The athletes from the 1948 Olympic Games were tested using the vertical jump reaction test, with each subject having 15 practice trials before being tested on 15 trials using an audio stimulus, a visual stimulus, and finally a combination of both. The results of the tests were: 15 American track and field champions had the quickest reaction time average of .259 seconds; next quickest were the 15 Danish gymnasts with an average reaction time of .281 seconds; and the slowest average times were that of the 23 American swimming and diving champions at .303 seconds.

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[6] Henry, Franklin M. "Force Time Characteristics of the Sprint Start," Research Quarterly, 23: 301-318, October, 1952.

[7] Slater-Hammel, A. T. "Reaction Time and Speed Movement," Perceptual and Motor Skills Research Exchange, 4: 109-113, 1952.

[8] Cureton, Thomas Kirk. Physical Fitness of Champion Athletes, The University of Illinois Press, Urbana, 1951, pp. 94-102.

Racquetball and Paddleball Tests

In 1944, June Brasted completed a study on the game of squash.[9] Skills that were used within the study consisted of the following: forehand volley, backhand volley, lob and slice service, drop shot, corner shot, forehand back wall recovery, and backhand back wall recovery. Reliability and validity was checked in each of the tests mentioned. Of these tests, five had a reliability coefficient of .60 or above. Brasted also correlated the test scores for validity by using a round-robin squash tournament, and results recorded no test with a coefficient greater than .55. After completing the study, the author listed two condlusions which were:

(1) The backhand volley and the backhand back wall recovery were the only skill test items that proved to be both valid and reliable.

(2) Brasted expressed the opinion that a greater number of subjects were needed within the study, and that her population was inadequate.

In a study by Knapp,[10] twenty competitors of international caliber in squash were used in a study of reaction time. The group was compared to a group of twenty research students with regard to reaction time. She concluded the reaction times of the squash experts were shorter than those of the research students.

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[9]Brasted, June. "The Relationship of Certain Skills Tests to Playing Ability in Squash Racquets," (unpublished Master's thesis, Wellesley College, Wellesley, Massachusetts, 1944).

[10]Knapp, Barbara. "Simple Reaction Time of Selected Top-Class Sportsmen and Research Students," Research Quarterly, 32: 409-411, 1961.

The development of a workable paddleball skills test to measure basic skill for college men at Brigham Young University was conducted by Walden Gurney in 1966.[11] Specifically, Gurney attempted to determine beginning skills in paddleball, to construct a battery of tests that would measure beginning skills, and to validate the paddleball skills test by use of a round-robin tournament. Included in the test battery were Z-serve placement test, 30-second wall-volley test, kill-shot placement test, and back wall forehand recovery shot.

The test-retest method was used to determine reliability which resulted in a coefficient of .80 for the Z-serve placement serve, 30-second wall-volley, and the back wall forehand recovery test. A validity coefficient of .56 was calculated using three test items: the 30-second wall-volley, the back wall forehand recovery test, and the Z-serve placement serve. A final test battery was determined using the 30-second wall-volley and the back wall forehand recovery test. Usually a validity coefficient of less than a .70 indicates a low or inadequate measure for individual measures.

Wickstrom and Larson attempted to devise a racquetball skills test in order to evaluate general playing ability in the sport of racquetball.[12] The first skill to be included in the battery was a 30-second continuous wall-volley, with the total of three trials recorded for the subject's score. Subjects had to remain behind a restraining line marked on the floor ten feet from the front wall when hitting the ball.

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[11]Gurney, Walden O. "A Paddleball Skills Test for College Men," (unpublished Master's thesis, Brigham Young University, 1966).

[12]Wickstrom, Ralph and Charles Larson. Racquetball and Paddleball Fundamentals. Columbus, Ohio: Charles E. Merrill Co., 1971.

The second skill test included in the battery was a 30-second forehand/backhand volley test, with the score of three trials counted for the subject's score. Similar to the first test item, the subject had to rally the racquetball off the front wall, but from behind a line 15 feet from the front wall, and had to hit between the baseboard and a taped line located four feet from the floor. No statistical analysis was presented within the book correlating the items of the test battery to playing skill.

The development of a battery of racquetball skill test items to determine ability in racquetball was completed by Reznik.[13] Included in the battery were:

(1) 60-second Backhand Wall Volley Test. The subject is given a span of 60 seconds to rally the racquetball, using only the backhand stroke, against the front wall from behind a line 20 feet away from the front wall.

(2) 60-second Forehand/Backhand Wall Volley Test. This skill incorporates the same rules as the first test except that both the forehand and/or backhand strokes can be implemented.

(3) Service Placement Test. Lines on the floor, from short service line to back wall, divide the floor into five separate zones. Each zone is given a specific point value and for each serve that rebounds off the front wall and lands into a zone, points are awarded accordingly. The total points received from ten trials constitutes a subject's score. This test battery was merely a suggested battery by Reznik, as no testing was reported.

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

In 1976 Buschner[14] investigated the validation of a racquetball skills test for college men at Oklahoma State University. The main purpose of the study was to construct a battery of skill tests to predict and classify beginning racquetball players. The population included 56 males enrolled in racquetball classes and the test battery included:

(1) Forehand/Backhand Rally. Basically this test is identical to the wall-volley test that allows the subject to stand behind the short service line and volley the racquetball against the front wall, recording total legal hits within a span of 30 seconds.

(2) Backhand Rally. This test administration is exactly the same as test #1, except only backhand strokes are counted as legal hits.

(3) Ceiling Shot. The subject lobs the ball to the front wall and as the ball rebounds, the subject positions himself to strike the ball again. The ball is stroked toward the front of the ceiling which then strikes the front wall, causing the ball to rebound toward the back wall. The initial bounce will be about midcourt and the second bounce as close to the back wall as possible. Tape lines dividing the backcourt into sections that assessed point totals to different areas as follows: Between the backwall and a line 2½ feet out is worth five points, the back wall to a line 5 feet out is worth three points, the back wall to a line 2 feet out is

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[14]Buschner, op. cit.

worth four points, the back wall to a line 4 feet out is worth two points, and the back wall to a line 6 feet out is worth one point. Ten trials are attempted by each subject with a total score of 50 points possible.

(4) Front-Wall Kill Placement. The subject stood behind the short service line and lobbed the ball against the front wall. Upon its rebound from the front wall, the subject attempted to strike the ball in a manner to cause the ball to strike the front wall between the floor and a line two feet high marked on the front wall. Ten trials were attempted and the number of successful attempts would represent that subject's score.

(5) Repeated Volley Test. This test attempted to have the subject keep the racquetball in play (volley) for a period of 30 seconds. The ball could rebound off the back wall and then could be rallied against the front wall, causing the ball to rebound back toward the center of the court. The subject tried to use any stroke that would enable him to keep the ball in play.

The criterion selected for the study was a round-robin tournament. After analyzing the data, the following conclusions were made:

(1) The range of reliability for the forehand/backhand rally, backhand rally, ceiling shot, and volley shot was from .63 to .76.

(2) Results indicated the kill shot was not a valid or reliable measure of beginning racquetball ability. Coefficients ranged from .12 to .41.

(3) Validity for the forehand/backhand rally was .68, for the

backhand rally was .49, for the volley shot was .64, and for the ceiling shot was .67.

(4) The best test battery included the forehand/backhand rally and the ceiling shot, which produced a multiple correlation coefficient of .76. These two skills test items appeared to measure beginning racquetball ability among college men.

Summary

A review of the literature showed that a reliable objective and valid measure of an individual's ability in racquetball, based on tests of reaction time which are necessary for proficiency, still does not exist.

Of all skills utilized in racquet sports, only the wall-volley has proven to be valid in a majority of the research. With all the importance and emphasis being placed on the "fast reactor" with regard to athletic ability, it seems only natural to include reaction time and movement time tests in a proposed battery. The researcher believes that fast reaction time and movement time will enable the player to retrieve a greater number of shots and therefore become a better player.

Chapter II provides an historical background of the growth of racquetball, from its infant stage to the popular position racquetball now exhibits. Also included is a description of current skill tests of racquetball.

Various criteria used for validity measures were covered in this section and some were: 1) partial round-robin tournament play, 2) complete round-robin tournament play, and 3) subjective ratings of experts. The most often used reliability measure was reported to be the

test-retest method. Validity was most often determined by use of a round-robin tournament of some kind.

Utilizing the information found in Chapter II aided the researcher in constructing his test battery for further investigation.

CHAPTER III

METHODS AND PROCEDURES

Within this chapter, various procedures, selection of test items and selection of a criterion utilized in the investigation are described.

Selection of the Sample

The population consisted of 67 male students enrolled in fall classes of HPER 2282 (Racquetball/Tennis) at Oklahoma State University, 1976. Eight sections of this class were used in the study. The classes met on a Tuesday/Thursday schedule or a Monday/Wednesday/Friday schedule. Classes meeting twice a week met for a period of 90 minutes each and classes meeting three times per week met for 60 minutes each session. A total of three hours per week of class time was realized by every student, no matter which days he attended classes. The students traditionally enrolled in HPER 2282 classes were freshmen and sophomores and the make-up of students was consistent with past history. Racquetball classes were offered thus, all students enrolled were used in the study. Beginning, intermediate, and advanced players were enrolled in the same sections and all players were used, eliminating no one.

Equipment

The items required for the study were as follows:

(1) Seamco, Trenway Z-Ball, and AMF-Voit racquetballs were used

for the wall-volley and round-robin tournament.

(2) Scorecards were drawn up for recording results of matches.

(3) Pencils.

(4) Vittert racquetball rackets were furnished for all players who did not own their own.

(5) Clipboards.

(6) Stopwatches.

(7) One flim-flam electronic tennis game.

General Procedures

During the first class meeting of the sections of HPER 2282, all students were informed of the study. An introductory letter, prepared by the researcher, was distributed and discussed. During the first eight weeks of the semester, instruction of basic skills was given. The last eight weeks were reserved for wall-volley tests and round-robin tournaments.

The wall-volley test was administered during class time, with out-of-class time used for the reaction time tests and round-robin tournaments. The wall-volley was used as the lone skill item, as it has been proven in the literature to be a valid, acceptable means of measuring skill level in a striking activity.[1]

Oklahoma State University HPER majors were used as testing assistants in recording results on reaction tests. These assistants were oriented to the procedure that had been determined by the researcher. All assistants went through the testing procedures prior to the study as

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[1]Hewitt, Jack E. "Revision of the Dyer Backboard Tennis Test," Research Quarterly, 36: 153-157, May, 1965.

though they were subjects within the investigation.

Criterion

The validity criterion was the results of the round-robin racquetball tournament.

The round-robin tournament was played outside of class time at a time prescribed by the researcher, convenient for both subjects involved in the match. All subjects played each other, using a shortened game of eight minutes to determine the winner.

The criterion used in this study was the round-robin tournament which had two different facets. Winning percentage within the tournament and differential scores were calculated in order to make correlations with individual reaction time tests. The differential score was arrived at by taking the difference between total points scored and total points allowed by each subject, then the lowest negative total was added to each subject's score in order to have all positive numbers. This final total represented the differential score. The winning percentage was merely the percent of games won of the total games played.

Players within the tournament flipped a coin for first service and adhered to the rules of the International Racquetball Association (IRA).

Measuring Devices

Following is a description of the measuring devices used in the reaction time tests.

(1) Dekan Automatic Performance Analyzer. The model used in this study was #631. A time indicator which is calibrated to time in 1/100ths of a second was used to measure reaction time.

Markings on the dial facing were easily viewable and recordings were rounded to the nearest .005 of a second. The analyzer allowed the researcher several options in testing, specifically, instant start or delayed starts, stop on make contact and stop on break contact. As in test item #2, stop on break contact was used. Another important aspect of the analyzer was the option of the researcher to delay the stimulus by setting the delay adjustment at the specified time interval desired. Delay intervals ranging from slow to fast enabled the audio stimulus to be transmitted at various times, keeping the subjects from anticipating the buzzer signal to react.

(2) Lafayette Clock/Counter. This timer, model 54417, was used in test items 3 and 4. Essentially, it served as a timer and recorder of elapsed time the subject requires to react to the stimulus. The read-out was very clear enabling the researcher to make precise and accurate readings. Reaction time readings were rounded off to the nearest .005 of a second.

Description of Test Items

A description of test items with illustrations is presented in this section.

(1) Forehand/Backhand 30-second Wall-Volley. In this test, the subject stood behind the short service line, holding the racquetball in the non-dominant hand. Whenever the subject was ready, the ball was dropped to the floor and hit toward the front wall after the initial bounce. The ball was hit

with enough force so it rebounded off the front wall back to the subject being tested. The stopwatch, operated by the researcher, was activated upon the initial contact of racket and ball. Each time the ball was hit from behind the short service line and made contact with the front wall, one point was scored. This action was continued for a period of 30 seconds, with the total number of volleys counted. Continuous volley of the ball was important as well as accuracy. The ball could be hit using both the forehand and backhand strokes, and the ball could bounce more than once or be played in the air off the front wall without bouncing.

An acceptable hit must strike the front wall or side wall before being volleyed again. If the ball made contact with the side wall before front wall, the volley was counted and the subject continued to volley (Figure 1). The total of two 30-second trials was recorded as the score for the volley test.

The subject took the designated starting position, which was explained prior to the study in an introductory meeting of all subjects and testing assistants. After this position was employed, a verbal "ready" command was given by the researcher which enabled the subject to prepare for each trial. When the "ready" command was given, the subject could then begin the 30-second wall volley test. The researcher started the stop-watch when the racquet contacted the ball.

Between the two test trials there was a delay of 30 seconds to allow the testing assistant to record the score for the first volley trial, and to allow the researcher time to

reset the stopwatch back to zero time. One minute of practice was allotted to the subject prior to being tested.

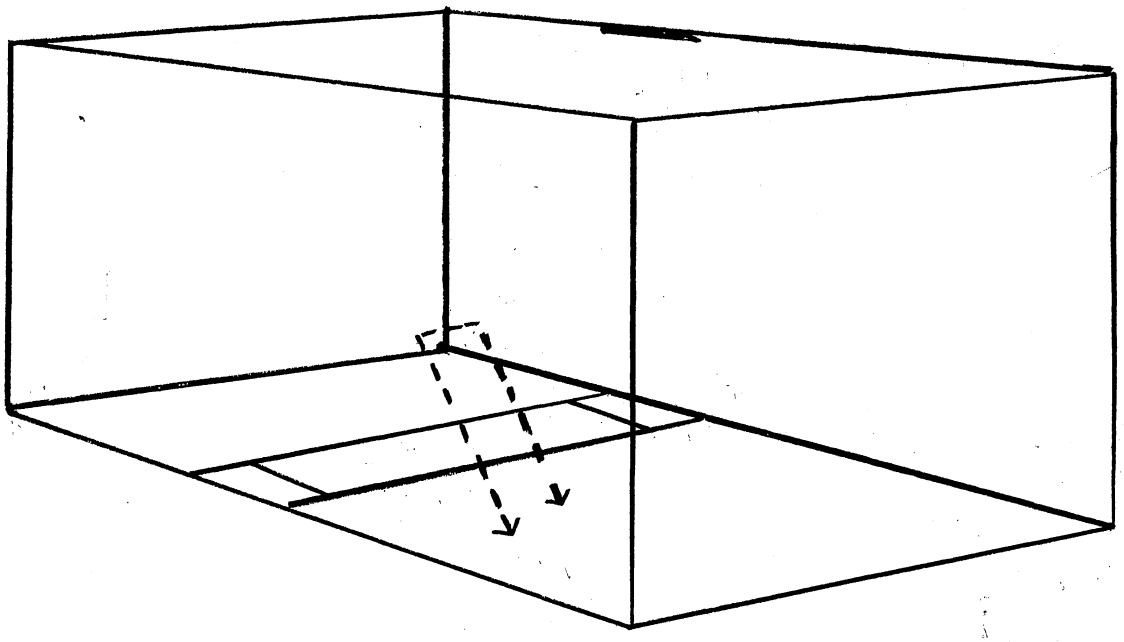


Figure 1. Fore/Backhand Volley Test

(2) Vertical Jump Reaction Time. Vertical jump reaction times were recorded by using a floor mat, which had a switching device imbedded throughout the mat. The subject stood on the mat with both feet and could have his knees flexed in a ready position.

After activating the Dekan Athletic Performance Analyzer (to be discussed in this chapter) the subject then waited for

a buzzer to sound which activated the timer. Upon hearing the buzzer, the subject jumped up off the mat with both feet, which stopped the timer as the subject broke contact with the switch mat. This reaction-time to an audio stimulus was recorded to the nearest 1/100th of a second. Subjects were allotted five practice trials prior to the actual testing, which consisted of ten vertical jump trials. The ten trials were averaged to determine vertical jump reaction time.

Between test trials there was a delay span of ten seconds to allow the testing assistant to record reaction times for each trial, and to allow the researcher to reset the timer and reactivate the stimulus for the next successful trial.

(3) Four Choice/Multiple Choice Reaction Time. In this particular reaction time test, the subject reacted to a visual stimulus with one of four possible responses acceptable. The timing device was a Lafayette Clock/Counter, model 54417. A choice box has four different colored lights: red, green, white, and blue. Located under each light was a button that corresponded to each light (i.e., when the green light came on, the subject depressed the button located directly under the green light). Practice was limited to five trials with the actual testing consisting of ten trials. The subject placed his dominant hand fingertips upon the base of the choice box and then, upon viewing the stimulus, extended his hand to depress the correct button. After a verbal "ready" command was given, a delay of two seconds occurred before the stimulus appeared.

After a color was chosen, the researcher then activated the timer that started as the colored light came on. The subject then depressed the correponding button which stopped the timer indicating reaction time. When the correct button was depressed, the Lafayette Clock/Counter stopped and the reading was the reaction time required to react to the stimulus. The recorded time was scored in 1/100ths of a second. Between test trials there was a delay span of ten seconds to allow the testing assistant to record reaction times for each trial, and to allow the researcher to reset the timer and reactivate the stimulus for the next trial. The researcher had the option to choose the color light that acted as the stimulus for each given trial. This was made possible by a device that the researcher had in his control, hidden from the subject being tested. Four colors (red, green, blue, and white) were marked on the device with a knob enabling the researcher to choose a color as the stimulus.

The sequence in light order allowed for five inside light stimuli and five outside light stimuli. The stimulus lights were turned on by the experimenter in the same predetermined order for each subject. The order was determined prior to any testing. The ten trials were averaged to determine Multiple Choice Reaction Time.

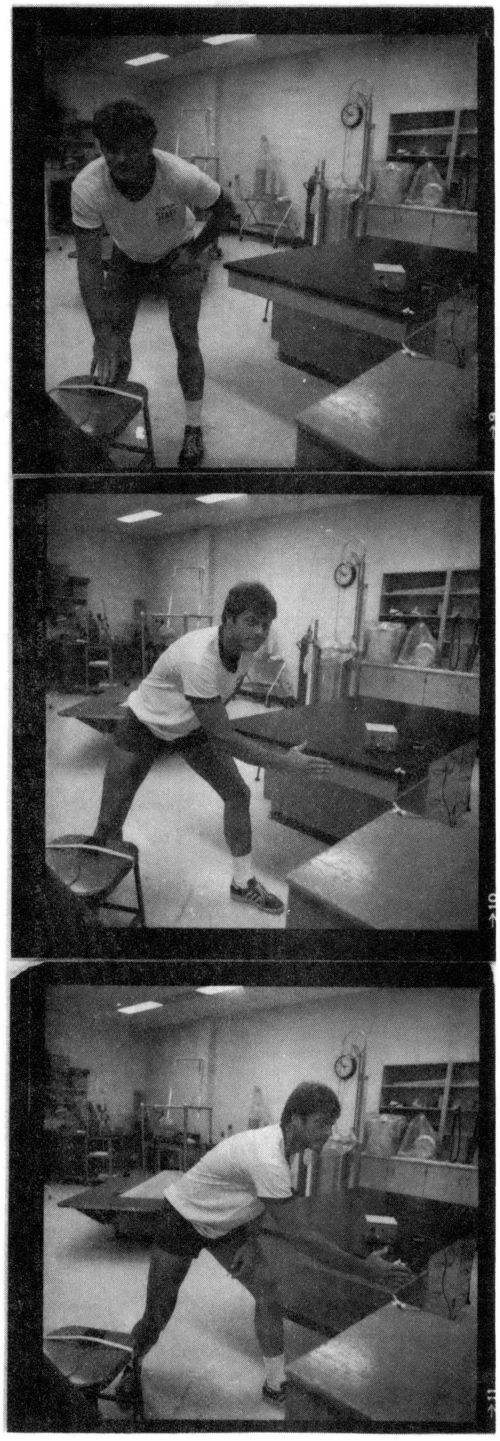
(4) Forehand Movement Time Test. In this test, the subject will be required to depress a lever with his dominant hand and move the dominant hand through a designated area of photo-cells using the forehand motion as in racquetball. A switch, placed

on a bench at knee level height, was depressed by the test subject with his dominant hand using the fingertips. After the subject released the switch, he moved with the foot closest to the photo-cell field a distance of three feet, making the motion of a forehand racquetball swing. Moving the hand through the field of photo-cells stopped the timer, whereas releasing the depressed switch activated the timer. Thus, the recorded movement time was the time from release of switch by the fingers to movement of hand through the photo-cell field. Five practice trials were administered to each subject with the actual testing consisting of ten trials. The ten trials were averaged to determine movement time.

Between test trials there was a pause of 30 seconds to allow the testing assistant to record the score for the previous trial and to allow the researcher to reset the timer and reactivate the switch for the next successive trial (Figure 2).

(5) Electronic Flim-Flam Tennis. Flim-flam is a coin-operated video amusement device which simulates the experience of a singles match. The game was operated by two subjects and accommodated players who had differing degrees of skill.

The two player game consisted of a playfield bounded by walls on all four sides, resembling a racquetball/handball court. A dotted line separated the players' courts with each player operating his own paddle, on his half of the court. The ball was automatically served from the middle of the screen and was manipulated by placing the paddle directly in the path of the ball. The direction and the ball rebounded



A

B

C

Figure 2. Forehand Movement Time Test

was controlled by where the ball struck the paddle. For instance, if the ball encountered the uppermost portion of the paddle, it bounced upward at the maximum angle. Striking the ball with a moving paddle did not produce a greater or different effect than simply placing the paddle in the path of the ball.

Won/lost records were calculated for the round-robin tournament with games determined by a subject winning eleven points. This total represented the score that the game computer was set by the manufacturer. Total points scored by each subject were determined and used as a criterion to correlate with the other variables in the study. Subjects were allowed two practice games against any other subject within this study before playing the actual test matches.

Reliability was determined by randomly selecting ten subjects for a second round-robin tournament. Comparisons of scores on the initial tournament and the second tournament were made and players were ranked as to their respective order of finish.

Selection of Stimuli

Individuals respond to various types of stimuli with different speed, depending upon which particular sense organ receives the stimulus. In the game of racquetball, both auditory and visual stimuli are transmitted by the racquetball and, for that reason, reaction time tests using both forms of stimuli were used. Reacting to the flight of the ball by sight might be easier for some subjects than reacting to the sound of

the racquetball rebounding off the walls of the court.

In the vertical jump test the stimuli used was a buzzer to initiate reaction by the subject. The multiple choice test utilized a flashing light to initiate the movement of the subject and the movement time made use of depressing a switch.

Treatment of Data

The data was analyzed by a computer program after the researcher studied the possible choices of SAS and BMD-10.

In order to find the relationships or correlations between individual reaction time tests and the criterion, correlation for ungrouped data was used. The Pearson Product Moment Method for correlation was implemented, and according to Smithells and Cameron,[2] greater accuracy is obtained through this method.

Multiple regression calculations were determined using the beta values to predict relative ranking by total points scored within the racquetball round-robin tournament. Finally, multiple correlations were calculated using the variables (reaction time tests) and the criterion.

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[2]Smithells, Philip A. and Peter E. Cameron. Principles of Evaluation in Physical Education, New York: Harper and Brothers, Publishers, 1962, p. 218.

CHAPTER IV

RESULTS

The purpose of this study was to develop a battery of reaction time tests and the wall-volley skill test to predict playing ability in racquetball among college men. A secondary purpose of this study was to determine the relationship of ability in racquetball to skill in playing electronic tennis. Sixty-seven male students enrolled in beginning Tennis and Racquetball classes at Oklahoma State University were used as subjects. All subjects participated in a complete round-robin racquetball tournament, with matches lasting eight minutes. Also, a complete round-robin electronic tennis tournament was conducted, with matches lasting until one player scored eleven points. Each subject was given three reaction time tests and one movement time test and results were recorded for each.

This chapter provides an analysis of the data collected for all tests and criterion, reliability and objectivity of the test items and a battery of reaction time tests that best determines racquetball ability. How compatible the electronic tennis was to racquetball also was analyzed.

Descriptive Statistics

The computer program chosen for this study was the SAS program which analyzed descriptive statistics for the reaction time and movement time

tests and the criterion. The program revealed sums, standard error, standard deviations, low and high scores, and possible potential scores of all 67 subjects, which are presented in Table I. Some significant findings are presented as follows:

(1) The two timed tests of reaction time (vertical jump and multiple choice) revealed a range of a high of .589 sec. on the multiple choice to a low score of .150 sec. on the vertical jump. The standard deviations were extremely small with a variance from .041 to .06.

(2) The movement time test resulted in a high score of .447 sec. and a low score of .129 sec. and a standard deviation of .068.

(3) The wall volley skill test reflected a range of an average of 24.5 volleys to a low of 10.5 volleys within two (2) thirty second time trials. The score represents an average of two wall volley trials. This test had a standard deviation of 3.527.

(4) The racquetball differential score showed a large variance which in fact was due to the wide range of scores. The highest score was 999 with the lowest score one (1). The average for this variable was 499 points. An extremely large standard deviation, 189.095, was recorded for this variable. This frame indicates a wide range of player ability within the subjects in this study.

Reliability

The author considered the possible choices of test-retest, split halves, parallel forms, and odd-even as tests of reliability. Due to

TABLE I

DESCRIPTIVE STATISTICS

Variables	Means	SD	Low Scores	High Scores
Vertical Jump (sec.)	16.643	0.041	.150	.361
Multiple Choice (sec.)	0.0396	0.061	.284	.489
Movement Time (sec.)	0.256	0.068	.129	.447
Wall-Volley (average for 2 trials)	18.821	3.527	10.5	24.5
Electronic Tennis % won	49.657	10.952	20.6	82.3
Electronic Tennis Differential Sc.	307.810	113.065	1	636
Electronic Tennis Differential Rank	33.313	19.184	67	1
Racquetball % Won	43.736	14.031	18.2	100
Racquetball Differential Sc.	342.045	189.095	1	999
Racquetball Differential Rank	34.000	29.484	67	1

the fact that the test-retest procedure is generally utilized in skill tests, it was chosen to check reliability of the skill test variables within this study.

The vertical jump and multiple choice reaction time tests, the movement time test, and the wall-volley skill test were administered to the same group of ten subjects on two different days. The average scores on the initial ten trials in each variable were then correlated with the average scores from each variable revealed by the second set of ten trials. Calculations were computed by utilizing the Product-moment correlation formula for small groups.

Reliabilities were calculated by a hand calculator using the small group Product-moment correlation formula. There was a range of reliability coefficients with an $\bar{r}$ of .78 to a high $\bar{r}$ of .99. The highest reliability coefficient appeared for the vertical jump, an $\bar{r}$ of .99. The individual test that produced the lowest reliability coefficient was the movement time test which had an $\bar{r}$ of .78. The multiple choice reaction time test and the wall-volley test revealed $\bar{r}$'s of .97 and .98, respectively. Presented in Table II are the correlation coefficients for each individual test variable.

TABLE II

RELIABILITY OF SKILL TEST DATA - MEAN OF TEN TRIALS

Test	Correlation Coefficient
Vertical Jump	.99
Multiple Choice	.97
Movement Time	.78
Wall-Volley	.98

There are numerous interpretations available when attempting to isolate an acceptable reliability coefficient. Glassow and Broer[1] make reference to a reliability table that follows:

.95 to .99	Very high--rarely found among present tests.
.90 to .94	High--equalled by a few of the best tests.
.80 to .89	Fairly high--fairly adequate for individual measurement.
.70 to .79	Rather low--adequate for group measurement but not very satisfactory for individual measurement.
below .70	Low--entirely inadequate for individual measurement although useful for group averages and school surveys.

This table was adopted by the researcher as a reference point to evaluate correlation coefficients.

By utilizing the table above the researcher inferred that three out of the four tests were high. The movement time test was a little lower resulting in a $\bar{r}$ of .78.

Validity Coefficients

Validity coefficients are important criterions of a test and it should be emphasized that a test can be no better than its validity, regardless of its reliability and objectivity.

All test scores were correlated with the criteria, which were acquired through the round-robin racquetball tournament. Averages were calculated for the trials of each test item and correlated with the

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[1]Glassow, Ruth B. and Marion R. Broer. Measuring Achievement in Physical Education, Philadelphia: W. B. Saunders Co., 1938, p. 22.

winning percentage and differential scores of the subjects. The complete results for each individual in the study can be located in Appendix G. Data obtained from using the SAS computer program is found in Table III.

TABLE III

TEST ITEMS CORRELATION WITH CRITERIA

Test	Correlation		Difference
	Win. Pct.	Diff. Score	
Vertical Jump	.16	.08	.08
Multiple Choice	.07	.08	.01
Movement Time	.21	.28	.07
Wall-Volley	.56	.53	.03

Sport skill tests that produce correlations above .80 with the criterion in a specified study are usually considered valid. In this study the researcher found that the criteria, racquetball winning percentage and racquetball differential score, were highly related ($r = .90$).

The lowest correlation involving a single test item was a .07 for the multiple choice reaction time test. The highest correlation resulted from the wall-volley test used separately, a .56. When observing the results the researcher concluded that the wall-volley test and the movement time test would produce the best battery of tests to predict

racquetball ability.

When attempting to determine when a test criteria results in a valid correlation, various authors present differing figures. Barrow and McGee[2] suggest the following in relation to the test validity.

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

Intercorrelation Matrix

Intercorrelations were calculated for the three reaction time tests, wall-volley and the three electronic tennis variables. The main purpose of observing the data in this step was to help determine which individual test correlated highest with any of the other variables within the study. The intercorrelations also helped to alleviate any duplication of a test item and how significantly it correlated, so that one could be eliminated. A high correlation would suggest that two variables were measuring the same measure. Results of the intercorrelations are presented in Table IV.

As can be seen in Table IV, the correlations revealed through the reaction time, movement time, and wall-volley tests are very low. The low correlations verify that each individual test was measuring a different quality. No two variables were measuring the same measure. The only high intercorrelations found were those involving the electronic tennis variables with each other.

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

TABLE IV

INTERCORRELATION MATRIX

Test Items	1	2	3	4	5	6	7
1. Vertical Jump	1.000	.365	.230	.145	.252	.290	.253
2. Multiple Choice		1.000	.238	.131	.232	.220	.228
3. Movement Time			1.000	.265	.155	.216	.219
4. Wall-Volley				1.000	.183	.233	.251
5. Electric Tennis %					1.000	.921	.891
6. Electric Tennis Differential Score						1.000	.950
7. Electric Tennis Differential Rank							1.000

Multiple Correlations

The SAS (Statistical Analysis System) computer program was employed to determine multiple correlations in this study. This procedure determined the relationship between one or more variables (reaction time, movement time, and wall-volley tests) and the dependent variable, which is the criteria (racquetball differential score and percentage winning).

Often it is advantageous to know how effectively several variables can estimate the results on a single variable. This enables the researcher to determine which set of skill tests formed the best reliable and valid battery. The data in Tables II and III shows the highest correlation of any one individual test item that tended to measure racquetball ability was the wall-volley. A reliability coefficient of

.98 was produced and coefficients of .56 and .53 were revealed when the wall-volley was related to the racquetball winning percentage and racquetball differential score, respectively. The numerous combinations of text items and the correlation coefficients are presented in Table V.

TABLE V

MULTIPLE CORRELATIONS

Items	Racquetball Diff. Score	Racquetball Diff. Rank	Racquetball Winning %	# in Model
Wall-Volley	.53	.49	.56	1
Movement Time and Wall-Volley	.55	.49	.57	2
Movement Time, Wall-Volley, and Electronic Tennis % Winning	.56	.49	.57	3
Movement Time, Wall-Volley, Electronic Tennis % Winning, Electronic Tennis Differential Score	.57	.50	.58	4
Vertical Jump, Movement Time, Wall-Volley, Electronic Tennis % Winning, Electronic Tennis Differential Score	.57	.50	.59	5
Vertical Jump, Movement Time, Wall-Volley, Electronic Tennis % Winning, Multiple Choice, Electronic Tennis Differential Score	.57	.50	.59	6
Vertical Jump, Multiple Choice, Movement Time, Wall-Volley, Electronic Tennis % Winning, Electronic Tennis Differential Score, Electronic Tennis Differential Rank	.57	.50	.59	7

It is evident from the preceding table that after two variables were correlated with the criteria, a near maximum correlation had been attained. The addition of several other variables enabled the coefficient to rise only slightly, .01-.02, which is not that significant. Therefore, it is necessary to consider the best battery of test items to be the wall-volley and movement time test to predict playing ability.

Based on the results of utilizing the racquetball differential score used as the dependent variable, an $\bar{r}$ of .53 resulted when correlated with the wall-volley. When this criterion was correlated with two variables, the wall-volley and movement time test, an $\bar{r}$ of .55 resulted. These two reaction time tests revealed the highest correlation with the dependent variable. The next highest $\bar{r}$ was a .54, which resulted when the wall-volley and electronic tennis percentage were correlated with the dependent variable.

When utilizing a total of three reaction time tests and correlating them with the dependent variable of racquetball differential score, the following results were recorded:

(1) The highest $\bar{r}$ of .56 was disclosed correlating movement time, wall-volley and electronic tennis winning percentage.

(2) Next highest revealed an $\bar{r}$ of .55 correlating movement time, wall-volley and electronic tennis differential rank.

Combining four variables with the racquetball differential score uncovered an $\bar{r}$ of .57. The variables were movement time, wall-volley, electronic tennis winning percentage, and electronic differential score.

The next most valid battery was produced when vertical jump, movement time, wall-volley, and electronic tennis percentage were combined. An $\bar{r}$ of .56 was produced when correlated with the dependent variable

racquetball differential score.

Five independent variables intercorrelated showed an $\bar{r}$ of .5679. These five tests were vertical jump, movement time, wall-volley, electronic tennis winning percentage, and electronic tennis differential score, which were correlated with the criterion. The next highest $\bar{r}$ that was recorded using five variables was .5677; these items were multiple choice, movement time, wall-volley, electronic tennis winning percentage, and electronic tennis differential score.

Utilizing six variables, vertical jump, multiple choice, movement time, wall-volley, electronic tennis winning percentage, and electronic tennis differential rank, an $\bar{r}$ of .57 was revealed when correlated with racquetball differential score.

All seven variables also produced an $\bar{r}$ of .57 when correlated with the criterion. The results can be found in Table VI.

TABLE VI

MULTIPLE CORRELATIONS WITH RACQUETBALL DIFFERENTIAL SCORES

Number of Variables	$\bar{r}$
1	.53
2	.55
3	.56
4	.57
5	.57
6	.57
7	.57

The racquetball willing percentage was then used as the criterion and coupled with the multiple correlations of independent items. When one variable was correlated with the criterion an $\bar{r}$ of .56 was produced. The test item that was selected by the computer program was the wall-volley.

When two variables were correlated with racquetball winning percentage, vertical jump, and wall-volley, an $\bar{r}$ of .57 resulted. The next highest correlation coefficient was produced when wall-volley and electronic tennis differential score were correlated with the criterion. This revealed an $\bar{r}$ of .57 also.

Utilizing three variables produced another coefficient of .57. Individual variables were wall-volley, electronic tennis differential score, and electronic tennis differential rank.

When a fourth variable was added the correlation coefficient increased only .01 to an $\bar{r}$ of .58. The four tests were the vertical jump, wall-volley, electronic tennis differential score, and electronic tennis differential rank.

Combining the five tests of vertical jump, movement time, wall-volley, electronic tennis differential score, and electronic tennis differential rank, an $\bar{r}$ of .59 was found when correlated with racquetball winning percentage.

A six item multiple correlation was compiled with the criterion that produced an $\bar{r}$ of .59. These six items were vertical jump, multiple choice, movement time, wall-volley, electronic tennis differential score, and electronic tennis differential rank. And when all seven variables were combined, an $\bar{r}$ of .59 was recorded. The results can be found in Table VII.

TABLE VII

MULTIPLE CORRELATIONS WITH RACQUETBALL WINNING PERCENTAGE

Number of Variables	$\bar{r}$
1	.56
2	.57
3	.57
4	.58
5	.59
6	.59
7	.59

Regression Equation

The main use of a regression equation is to predict the most likely measurement in one variable from the known measurement in another.

The SAS computer program aided the author in arriving at scores utilizing the wall-volley to predict racquetball winning percentages and racquetball differential scores within the round-robin tournament. In order to obtain a predicted score in winning percentage, the B value for wall-volley (2.2287) was multiplied by the number of volleys for each subject and added to the intercept (1.789). This final figure represents the winning percentage that was predicted by using the actual wall-volley score. The number of volleys and the predicted winning percentage for each score are presented in Table VIII.

TABLE VIII

REGRESSION PREDICTION OF PERCENTAGE WINNING IN TOURNAMENT

Average Number of Volleys on 2 Trials	Predicted % Wins in a Round-Robin Tournament With 67 Players	Average Number of Volleys	Predicted % Wins
30	68.65%	19.5	45.25%
29.5	67.54%	19	44.13%
29	66.42%	18.5	43.02%
28.5	65.31%	18	41.91%
28	64.2%	17.5	41%
27.5	63.1%	17	39.7%
27	62%	16.5	38.56%
26.5	61%	16	37.45%
26	59.7%	15.5	36.33%
25.5	58.62%	15	35.22%
25	57.51%	14.5	34.11%
24.5	56.4%	14	32.99%
24	55.3%	13.5	31.9%
23.5	54.2%	13	30.76%
23	53.05%	12.5	29.65%
22.5	51.94%	12	28.53%
22	50.82%	11.5	27.42%
21.5	49.71%	11	26.31%
21	48.6%	10.5	25.2%
20.5	47.5%	10	24.1%
20	46.4%		

The formula used was the following:

Predicted Racquetball Winning Percentage = 1.789 (B value intercept) + 2.2287 (B value for wall-volley) x wall-volley (average of two trials)

Relationship of Racquetball Ability to Electronic Tennis Ability

As presented earlier in Chapter I, a sub-problem of this study was to determine the relationship of ability in racquetball to skill in playing electronic tennis.

Complete round-robin tournaments were played in racquetball and in electronic tennis and two essential scores were recorded: 1) winning percentage of each subject in both tournaments and 2) differential score which was calculated by subtracting points given up from points scored. A total of 2,211 matches were played in both racquetball and electronic tennis.

Intercorrelations of Racquetball and Electronic Tennis

Intercorrelations were carried out by use of the SAS computer program. Correlation coefficients that were obtained were extremely low, which led the researcher to the conclusion that electronic tennis and racquetball are not significantly related. The highest coefficient was an $\bar{r}$ of .21 when electronic tennis differential rank was correlated with racquetball differential score. Results are shown in Table IX.

TABLE IX

CORRELATION COEFFICIENTS OF RACQUETBALL/ELECTRONIC TENNIS

	Racquetball % Win.	Racquetball Differential Score	Racquetball Differential Rank
Electronic Tennis %	.05	.21	.18
Electronic Tennis Differential Score	.06	.20	.18
Electronic Tennis Differential Rank	.11	.21	.17

Summary

An analysis of the data presented in this section shows a multiple correlation of .56 on the wall-volley skill test and racquetball winning percentage. Another coefficient recorded was a .53 on the wall-volley and racquetball differential score. After viewing the results it is evident that there is a low relationship between the wall-volley and racquetball winning percentage.

The intercorrelations comparing racquetball ability and electronic tennis ability indicate a low level of similarity in performance level. The highest coefficient produced was an $\bar{r}$ of .21 when correlating electronic tennis percent won and racquetball differential score.

When administering skill tests it should be pointed out that they can only measure certain aspects of a specific sport. There are many factors such as environmental conditions, emotional pressure, and daily

variations in performance that greatly influence one's score.[3] These variables should be kept in mind when constructing skill tests in order to facilitate the individual's best effort while testing.

There are many sports that do not possess sound skill tests at the present time. Racquetball is one of these sports that has borrowed tests from similar sports such as tennis, and adapted it for use, but does not have its own valid test. The researcher attempted to consider tests on the basis of their practicality in terms of time required to administer, equipment needed, ease of scoring, and their ability to measure specific aspects of performance in racquetball.

It appears that the utilization of such non-court tests as reaction time, movement time, and Electronic Tennis can offer very little in the way of improving in court (wall-volley) tests for predicting racquetball playing ability. Since the wall-volley gives a validity coefficient of .56 there is little point in adding a reaction time or movement time test to the battery to raise the validity to a .57.

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[3]Johnson, Barry C. and Jack K. Nelson. Practical Measurements for Evaluation in Physical Education, 2nd Ed. Minneapolis: Burgess Publishing Co., 1974, p. 231.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The explosion of racquetball onto the American sports scene has created a need for improvement in equipment, facilities, and most of all procedures for evaluation and classification. There are few skill tests in racquetball; only partial tests that have been adapted from tennis, squash, badminton, and handball.

Authorities are highly critical of the manner in which racquetball players are judged, purely subjectively. But with the growth of racquetball today there is a need for objective judgement on behalf of physical educators and players alike. No battery of tests make use of statistical data in order to predict playing ability. Racquetball has become popular only in the last ten years and has created a void in the assessment of playing ability by means of skill tests.

Private as well as public facilities for racquetball are being constructed at a record pace which makes it imperative that an evaluative instrument or battery be developed to predict or determine playing ability of racquetball. There is a need for a battery especially for beginning players because of the popularity racquetball now enjoys.

Problem

The purpose of this study was to construct a battery of reaction time tests together with the wall-volley skill test to predict and

evaluate playing ability in racquetball among college men. Specifically, it was the intent of the investigator to determine if ability could be predicted by proficiency in one or more of the reaction time tests. The essential skills of eyesight, hearing and movement were considered most important when constructing the test battery as those were termed strong necessities for successful performance in racquetball.

A subproblem of the study was to determine the relationship of ability in racquetball to skill in playing electronic tennis.

Procedure

The subjects for this study were sixty-seven male undergraduate students enrolled in eight beginning racquetball/tennis classes at Oklahoma State University during the Fall semester of 1976. For the first six weeks of class, the subjects received identical instruction in the basic skills and rules of racquetball. During the last two weeks of the racquetball section, a complete round-robin singles tournament was conducted outside of class time, mostly at night. Reaction time and movement time tests were administered on Saturday mornings in the Oklahoma State University Physiology of exercise lab, located in Colvin Center. Wall-volley skill tests were completed during actual class time.

Skills Test Selection

It was imperative that the selection of tests considered for the battery be ones that had some practical use in the sport of racquetball. The vertical jump was selected because of the necessity to jump for numerous balls hit above a person's extended reach. The multiple choice reaction test was chosen because there was a need for the players to

follow the flight of the ball to determine which direction the ball would go. This was exemplified by the subject following the changing light sequence during testing conditions. Finally, the movement time test imitates the forehand swing used in racquetball, beginning in a stationary position and striding to contact an incoming ball in flight. The wall-volley test was also used as a test of reaction, which was explained in Chapter III.

Round-Robin Tournament

The criterion selected for the study was a complete round-robin racquetball tournament with matches lasting eight minutes. The sixty-seven subjects played each other and attempted to score as many points as possible during the allotted time of a match. As the study involved sixty-seven subjects, a total of 2,211 matches were played during the tournament in order to collect the data. Total number of points scored by a subject for all the matches were compared to the total number of points scored by the opponents of each subject. The difference in the two totals represented the differential score. Also, winning percentages were calculated from all the matches played by each subject.

Treatment of Data

The SAS computer program was utilized to analyze the data statistically in this study. The program was designed to interpret the following: 1) the validity of each individual test item with the criterions; 2) intercorrelations of the independent variables; 3) descriptive statistics including means, standard deviations possible scores, and highs and lows achieved for each test; 4) multiple

correlations; and 5) a regression equation to predict percent winning and differential score.

Conclusions

After analyzing the data found within the study, the following conclusions were formulated:

(1) A .55 multiple correlation was recorded for the wall-volley and movement time in predicting racquetball skill. Therefore, these two items are the most valid measures of racquetball ability for beginning players. Due to the fact no valid or reliable skill tests for the sport of racquetball exist utilizing reaction time tests, the proposed two-item battery including movement time and wall-volley warrants consideration as a start in this direction.

(2) A significantly high correlation between the dependent variables, the differential score and winning percentage revealed a .90 coefficient. It is assumed that these two items are measuring the same variable; racquetball playing ability.

(3) Test-retest correlations revealed satisfactory reliabilities for the vertical jump, multiple choice, movement time, and wall-volley as high for the group used in this study. The range of reliability for the four items was from .78 to .99.

(4) The correlations of individual test items with the racquetball differential score revealed that wall-volley had the highest correlation ($\bar{r}$ = .53). Therefore, the best test utilizing differential score was the wall-volley to predict racquetball ability.

(5) The correlations of individual test items with the racquetball winning percentage as the criterion resulted in the wall-volley having the highest correlation ($\bar{r}$ = .56). Therefore, to predict racquetball winning percentage the wall-volley appears to be the best choice from the study.

(6) It is possible to divide students into categories of beginners, intermediate, and advanced players after administering two 30-second wall-volley trials, and averaging their total scores.

(7) The results of the wall-volley test from this study only reinforce the findings of previous research that the wall-volley is a valid predictor of playing ability in a racquet sport.

(8) The following correlation coefficients were indicated when correlating electronic tennis with racquetball: electronic tennis winning percent and racquetball winning percent at .05, with racquetball differential score a .21 and with racquetball differential rank a .18. Electronic tennis differential score and racquetball winning percent revealed a .06, with racquetball differential score a .20, and with racquetball differential rank a .18. Electronic tennis differential rank with racquetball winning percentage a .11, with racquetball differential score a .21, and with racquetball differential rank a .17. These low correlation coefficients clearly indicate that these two test items had no positive measurable relationship.

Recommendations

The following recommendations for further study are:

(1) Other possible reaction time tests, strength tests and agility tests should be given consideration about addition to the test battery.

(2) To increase the number of trials given to each subject during test administration, and to increase the wall-volley test from a 30-second volley to a 60-second volley.

(3) A similar study utilizing female subjects.

(4) To control the amount of practice of each subject playing racquetball during out-of-class time.

(5) Restrict the racquetball matches to games of eleven points rather than a time limit of eight minutes. This would be done to equal the electronic tennis matches, which were played to eleven points to determine a winner.

(6) To administer a wall-volley test utilizing only backhand volleys and another test utilizing forehand volleys only.

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APPENDIX A

INTRODUCTORY LETTER TO SUBJECTS

INTRODUCTORY LETTER TO RACQUETBALL PLAYERS

PARTICIPATING IN THE REACTION TIME STUDY

This class, along with the other HPER 2282 Tennis and Racquetball classes at Oklahoma State University during the fall semester 1976, has been selected to be a part of a dissertation study involving your instructor. The researcher for this project is Mr. Bob Klass.

The purpose of this study is to investigate the area of reaction time and determine its relation to racquetball playing ability. Also, to see if reaction time could be used as a predictor for racquetball playing ability.

During the first eight weeks of the semester, all subjects will take part in five reaction time tests in the Physiology Lab and during the last eight weeks, participate against the other subjects in a round-robin racquetball tournament. All matches will be eight minutes in length, with the main objective TO SCORE AS MANY POINTS AS POSSIBLE. The instructor will record the number of points scored in each match.

International Racquetball Association rules will prevail and questionable calls will be replayed.

It is very important for each and every subject to be present during the days of testing. The study will be both interesting and informative to you all and should be FUN.

THANK YOU ALL FOR YOUR COOPERATION AND PARTICIPATING IN THIS STUDY.

APPENDIX B

ROUND-ROBIN RACQUETBALL TOURNAMENT RESULT SHEET

SCORE SHEET FOR ROUND-ROBIN

RACQUETBALL TOURNAMENT

DATE: _____

HOME COURT PLAYER: _____

COURT NUMBER: _____

	Score
1) Home Court Player vs Opponent's Name	Score Score
2)	
3)	
4)	
5)	

APPENDIX C

ROUND-ROBIN ELECTRONIC TENNIS TOURNAMENT

RESULT SHEET

SCORE SHEET FOR ELECTRONIC

TENNIS TOURNAMENT

DATE: _____

NAMES / SCORES	
PLAYER	POINTS
vs	vs
PLAYER	POINTS
PLAYER	POINTS
vs	vs
PLAYER	POINTS
PLAYER	POINTS
vs	vs
PLAYER	POINTS

NAMES / SCORES	
PLAYER	POINTS
vs	vs
PLAYER	POINTS
PLAYER	POINTS
vs	vs
PLAYER	POINTS
PLAYER	POINTS
vs	vs
PLAYER	POINTS

APPENDIX D

SCORESHEET FOR REACTION TIME TEST RESULTS

REACTION TIME SKILLS SCORECARD

NAME: _____ AGE: _____

SECTION: _____

TEST #1 - VERTICAL JUMP REACTION TIME

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

Average _____ seconds.

TEST #2 - FOUR CHOICE/MULTIPLE CHOICE REACTION TIME

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

Average _____ seconds.

TEST #3 - FOREHAND MOVEMENT TIME

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

Average _____ seconds.

TEST #4 - 30-SECOND WALL-VOLLEY

# 1	# 2	Total of # 1 & 2

APPENDIX E

RAW SCORES OF RACQUETBALL ROUND-ROBIN TOURNAMENT

PRE-TEST AND POST-TEST

PRE-TEST RACQUETBALL TOURNAMENT

Name		1	2	3	4	5	6	7	8	9	10	
W. Richards	1		18/11	9/6	6/8	7/7	4/10	1/19	5/22	13/13	3/8	= 66/104-Won 2-Lost 5-Tied 2
B. Traverse	2	11/18		9/6	15/7	15/6	5/5	18/13	3/6	13/4	13/8	=102/ 73-Won 6-Lost 2-Tied 1
R. Seim	3	6/9	6/9		15/15	16/6	16/1	9/9	10/3	15/1	15/2	=108/ 55-Won 5-Lost 2-Tied 2
K. Stephenson	4	8/6	7/15	15/15		16/3	7/14	6/8	9/8	10/2	3/1	= 81/ 72-Won 5-Lost 3-Tied 1
M. Hollman	5	7/7	6/15	6/16	3/16		7/5	4/8	3/12	7/16	11/3	= 54/ 98-Won 2-Lost 6-Tied 1
F. Cunningham	6	10/4	5/5	1/16	14/7	5/7		1/20	4/21	5/19	2/15	= 47/114-Won 2-Lost 6-Tied 1
B. Zellus	7	19/1	13/8	9/9	8/6	8/4	20/1		7/21	10/9	17/11	=111/ 80-Won 6-Lost 2-Tied 1
K. Johnson	8	22/5	6/3	3/10	8/9	12/3	21/4	21/7		18/0	9/9	=120/ 50-Won 6-Lost 2-Tied 1
T. Voth	9	13/13	4/13	1/15	2/10	16/7	19/5	9/10	0/18		10/3	= 74/ 94-Won 3-Lost 5-Tied 1
K. Black	10	8/3	8/13	2/15	1/3	3/11	15/2	11/17	9/9	3/10		= 60/ 83-Won 2-Lost 6-Tied 1

Name		1	2	3	4	5	6	7	8	9	10	
W. Richards	1		10/9	2/14	1/8	2/9	11/6	5/8	1/15	6/6	9/13	=47/88-Won 2-Lost 6-Tied 1
B. Traverse	2	9/10		8/6	3/6	3/5	14/5	6/11	7/7	4/10	5/5	=59/65-Won 2-Lost 5-Tied 2
R. Seim	3	14/2	6/8		9/6	11/6	13/9	8/5	7/11	10/4	14/1	=92/52-Won 7-Lost 2-Tied 0
K. Stephenson	4	8/1	6/3	6/9		8/4	5/9	6/10	11/5	6/6	13/2	=69/49-Won 5-Lost 3-Tied 1
M. Hollman	5	9/2	5/3	6/11	4/8		14/3	9/9	5/11	6/1	4/5	=62/53-Won 4-Lost 4-Tied 1
F. Cunningham	6	6/11	5/14	9/13	8/8	10/6		8/10	11/4	9/6	3/11	=69/83-Won 3-Lost 5-Tied 1
B. Zellus	7	8/5	11/6	5/8	6/10	9/13	10/8		4/10	3/6	8/8	=64/74-Won 3-Lost 5-Tied 1
K. Johnson	8	15/1	7/7	11/7	5/11	11/5	4/11	10/4		19/3	6/6	=88/52-Won 5-Lost 2-Tied 2
T. Voth	9	6/6	10/4	4/10	6/6	1/6	6/9	6/3	3/19		5/10	=47/73-Won 2-Lost 5-Tied 2
K. Black	10	13/9	5/5	1/14	2/13	5/4	11/3	8/8	6/6	10/5		=61/67-Won 4-Lost 2-Tied 3
Percentage Won:		22.2	22.2	77.8	55.6	44.4	33.3	33.3	55.6	22.2	44.4	

APPENDIX F

RAW SCORES FOR TEST-RETEST RELIABILITY AND COMPUTATIONS

RETESTING

Subject	Vertical Jump	Mult. Choice	Movement Time	Wall Volley
Wayne Richards	.252	.361	.187	14
Barry Traverse	.260	.298	.249	24.5
Ron Seim	.245	.429	.200	17
Kent Stephenson	.245	.447	.231	15.5
Mark Holman	.291	.621	.392	19.5
Frank Cunningham	.251	.462	.264	20
Bill Zellers	.264	.423	.216	18
Kelly Johnson	.279	.401	.250	15
Tom Voth	.275	.359	.195	18.5
Klu Black	.256	.355	.244	18
	Σ=2.618	Σ=4.157	Σ=2.428	Σ=180
	$\bar{X}$= .2618	X= .4157	$\bar{X}$= .2428	$\bar{X}$= 18

PRETEST

Subject	Vertical Jump	Mult. Choice	Movement Time	Wall Volley
Wayne Richards	.229	.370	.299	14.5
Barry Traverse	.195	.307	.175	24
Ron Seim	.245	.425	.224	20.5
Kent Stephenson	.150	.409	.378	20
Mark Holman	.228	.284	.299	13.5
Frank Cunningham	.242	.406	.269	16
Bill Zellers	.269	.399	.220	24.5
Kelly Johnson	.283	.354	.229	22.5

Tom Voth	.277	.396	.362	18
Klu Black	.237	.350	.326	17
	Σ=2.355	Σ=3.700	Σ=2.781	Σ=190.5
	$\overline{X}$= .2355	$\overline{X}$= .3700	$\overline{X}$= .2781	$\overline{X}$= 19.05

TEST AND RE-TEST VERTICAL JUMP

Pre-Test		Post-Test		
X	X^2	y	y^2	Xy
.229	.052	.252	.064	.058
.195	.038	.260	.068	.051
.245	.060	.245	.060	.060
.150	.023	.245	.060	.037
.228	.052	.291	.085	.067
.242	.059	.251	.063	.061
.269	.072	.264	.070	.071
.283	.080	.279	.078	.079
.277	.077	.275	.076	.076
.237	.056	.256	.066	.061
Σ=2.355	Σ=.569	Σ=2.618	Σ=.690	Σ=.621
$\bar{X}$= .2355	$\bar{X}$=.057	$\bar{X}$= .2618	$\bar{X}$=.069	$\bar{X}$=.0621

VERTICAL JUMP

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$r = \frac{.621}{\sqrt{.569 \times .690}}$$

$$r = \frac{.621}{\sqrt{.393}} = \frac{.621}{.627} = r = .99$$

MULTIPLE CHOICE REACTION

Pre-Test		Post-Test		
X	X^2	y	y^2	Xy
.370	.137	.361	.130	.134
.307	.094	.298	.099	.092
.425	.181	.429	.184	.182
.409	.167	.447	.200	.183
.284	.081	.621	.386	.176
.406	.165	.463	.214	.188
.399	.159	.423	.179	.169
.354	.125	.401	.161	.142
.396	.157	.359	.129	.142
.350	.123	.355	.126	.124
Σ=3.700	Σ=1.389	Σ=4.157	Σ=1.808	Σ=1.532
$\overline{X}$= .3700	$\overline{X}$= .1389	$\overline{X}$= .4157	$\overline{X}$= .1808	$\overline{X}$= .1532

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$r = \frac{1.532}{\sqrt{1.389 \times 1.808}}$$

$$r = \frac{1.532}{\sqrt{2.511}} = \frac{1.532}{1.585} = .97$$

MOVEMENT TIME

Pre-Test		Post-Test		
X	X^2	y	y^2	Xy
.299	.089	.187	.035	.056
.175	.031	.249	.062	.046
.224	.050	.200	.040	.045
.378	.143	.231	.053	.087
.299	.089	.392	.154	.120
.269	.072	.264	.070	.071
.220	.048	.216	.047	.047
.229	.052	.250	.062	.057
.362	.131	.195	.038	.071
.326	.106	.244	.059	.079
Σ=2.781	Σ=1.213	Σ=2.428	Σ=.620	Σ=.679
$\overline{X}$= .2781	$\overline{X}$= .1213	$\overline{X}$= .2428	$\overline{X}$=.062	$\overline{X}$=.0679

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$r = \frac{.679}{\sqrt{1.213 \times .620}} = \frac{.679}{\sqrt{.752}} = \frac{.679}{.867} = .78$$

WALL-VOLLEY

Pre-Test		Post-Test		
X	X^2	y	y^2	Xy
14.5	210.25	14	196	203
24	576	24.5	600.25	588
20.5	420.25	17	289	348.5
20	400	15.5	240.25	340
13.5	182.25	19.5	380.25	263.25
16	256	20	400	320
24.5	600.25	18	324	441
27.5	506.25	15	225	337.5
18	324	18.5	342.25	333
17	289	18	324	306
Σ=190.5	Σ=3764.25	Σ=180	Σ=3321	Σ=3480.25
$\bar{X}$= 19.05	$\bar{X}$= 376.425	$\bar{X}$= 18.0	$\bar{X}$=332.1	$\bar{X}$= 348.025

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$r = \frac{3480.25}{\sqrt{3764.25 \times 3321}}$$

$$r = \frac{3480.25}{\sqrt{12501074}}$$

$$r = \frac{3480.25}{3535.68} = .98$$

APPENDIX G

COMPUTER DATA AND RESULTS OF THE COMPLETE ROUND-ROBIN TOURNAMENTS

ELECTRONIC TENNIS RACQUETBALL

	Vertical Jump	Multiple Choice	Movement Time	Wall-Volley	Won-Lost o/o	Differential Score	Differential Rank	Won-Lost o/o	Differential Score	Differential Rank
1	.210	.367	.223	22	38.2	205	54	30.3	221	51
2	.246	.395	.210	19	57.3	345	23	33	206	54
3	.259	.412	.340	17	55.9	319	30	34.8	260	45.5
4	.266	.462	.198	17	48.5	291	39	28.8	171	58
5	.182	.316	.129	19	61.8	387	13	48.5	344	31.5
6	.256	.376	.310	18.5	55.9	314	32.5	45.9	379	23
7	.217	.342	.282	14	48.5	249	46	42.5	366	26
8	.199	.329	.336	19	41.2	198	57	56.1	436	15
9	.256	.393	.287	19	70.6	588	2	24.2	200	56
10	.297	.411	.282	16	41.2	199	56	45.5	382	22
11	.217	.400	.233	24	82.3	636	1	43.9	429	18
12	.184	.315	.302	21.5	50	316	31	43.9	38	65
13	.226	.357	.185	19	57.3	402	12	43.9	336	36
14	.277	.396	.362	18	35.3	166	61	45.5	260	45.5
15	.195	.307	.175	24	51.7	346	21.5	71.2	563	7
16	.231	.465	.285	10.5	35.3	193	58	28.8	119	60
17	.222	.401	.274	19	50	332	25	56.1	452	11
18	.201	.367	.221	21.5	33.8	143	63	56.1	373	25
19	.247	.400	.224	19.5	29.4	101	64	39.4	225	50
20	.295	.368	.277	15.5	67.6	473	6	39.4	491	10
21	.247	.397	.196	17.5	35.3	200	55	59.1	433	17
22	.251	.459	.198	16.5	39.7	186	60	43.9	344	31.5
23	.256	.377	.203	19	52.9	359	16	34.8	207	53

24	.207	.418	.178	24.5	57.3	417	10	100	999	1
25	.229	.370	.299	14.5	48.5	298	37	31.8	205	55
26	.242	.406	.269	16	45.6	275	41	24.2	75	63
27	.283	.354	.229	22.5	60.3	365	15	71.2	783	3
28	.345	.525	.354	12.5	20.6	1	67	25.8	1	67
29	.334	.438	.249	21	41.2	296	38	42.4	352	27
30	.150	.409	.378	20	60.3	414	11	51.5	414	20
31	.203	.389	.213	14.5	48.5	512	4	43.9	374	24
32	.260	.338	.284	19	58.8	368	14	39.4	254	47
33	.254	.390	.252	23	51.7	349	20	31.8	196	57
34	.210	.355	.337	17.5	64.7	420	9	40.9	426	19
35	.245	.367	.177	24	39.7	225	52	69.7	850	2
36	.256	.316	.235	24.5	54.4	354	18	54.5	440	13
37	.207	.292	.178	18.5	64.7	526	3	22.7	61	64
38	.228	.377	.242	17.5	33.8	155	62	27.3	94	61
39	.305	.538	.342	13	55.9	346	21.5	39.4	332	37
40	.273	.420	.221	24.5	45.6	256	45	56.1	501	9
41	.240	.402	.218	24.5	51.7	441	8	42.4	410	21
42	.261	.384	.437	23	36.8	188	59	53	437	14
43	.237	.350	.326	17	50	308	36	45.5	347	30
44	.361	.341	.223	20.5	26.5	89	66	43.9	319	38
45	.269	.399	.220	24.5	48.5	248	47	59.1	684	5
46	.213	.363	.164	17.5	57.3	351	19	72.7	690	4
47	.215	.380	.357	16	41.2	246	48	46.9	348	29
48	.259	.42-	.214	15.5	55.9	310	35	34.8	245	48
49	.287	.343	.150	22	70.6	478	5	54.5	631	6
50	.235	.417	.232	17.5	51.7	325	28	37.9	339	33.5
51	.292	.541	.286	19.5	45.6	312	34	56.1	435	16
52	.245	.425	.224	20.5	45.6	234	50	51.5	536	8
53	.294	.405	.248	13	41.2	222	53	22.7	135	59
54	.279	.433	.285	11	54.4	244	49	18.2	7	66
55	.240	.316	.182	20.5	63.2	452	7	39.4	338	35
56	.231	.315	.184	19.5	48.5	314	32.5	36.4	349	28
57	.330	.514	.275	18	47.1	281	40	50	442	12
58	.273	.409	.287	20	54.4	358	17	42.4	276	44
59	.325	.484	.447	22	54.4	351	19	36.4	212	52

60	.294	.376	.200	17	41.2	265	43	42.4	299	41
61	.198	.421	.208	18.5	50	340	24	36.4	303	39.5
62	.228	.284	.299	13.5	48.5	269	42	25.8	76	62
63	.192	.589	.192	23.5	44.1	258	44	43.9	303	39.5
64	.247	.481	.299	21.5	52.9	328	27	56.1	339	33.5
65	.229	.408	.220	21.5	54.4	324	29	39.4	297	42
66	.282	.410	.394	15	44.1	231	51	36.4	238	49
67	.219	.371	.209	15.5	55.9	331	26	37.9	290	43

APPENDIX H

CORRESPONDENCE WITH RACQUETBALL MANUFACTURERS

84

September 8, 1976

Mr. Bob Klass
Oklahoma State University
Colvin Physical Education Center
School of Health, Physical Education & Leisure Services
Stillwater, Oklahoma 74074

Dear Bob:

I spoke with Richard Smith today, AMF Voit's Director of Public Relations, and he is very happy that the company is still able to support your project.

You will receive 36 packets, 72 Roll Out balls, in just a few days.

We would appreciate you keeping us informed as to the progress of your experiments, and once again wish you the best of luck.

Sincerely,

COMMUNICATION RESOURCES, INC.

Michael A. Nash

MAN/sy

cc: Richard Smith

COMMUNICATION
RESOURCES
INCORPORATED

3007 ENTERPRISE STREET
COSTA MESA, CALIFORNIA 92626

(714) 546-5243

1567 FORREST AVENUE • LA GRANGE, GEORGIA 30240
TELEPHONE (404) 882-8151

85

SEAMCO

SEAMCO SPORTING GOODS
A DIVISION OF DART INDUSTRIES INC

August 16, 1976

Mr. Bob Kalss
School of Health, Phys. Ed. and Leisure Services
Colvin Physical Education Center
Stillwater, Oklahoma 74074

Dear Mr. Kalss:

This is to confirm our conversation of today, concerning your racquetball dissertation.

You will be receiving two (2) dozen #58-5580 Black Racquetballs and two (2) dozen #58-5590 Green Racquetballs, via UPS from our Georgia facility within two weeks. I have enclosed a specification sheet and Racquetball Rulebooks, which I hope will be of help in your evaluation and instruction.

I hope you will use the Seamco Drawsheets in your tournament tests, for greater exposure to this rapidly growing sport.

If I can be of any further assistance, please call me toll free at 800-241-8111. Good luck!

Sincerely,

Scott Hamilton
Customer Services

Note: The two control areas we briefly touched on that should be considered, color of the ball and the type of racquet, might be incorporated in the results.

SH/pk

APPENDIX I

ONE-ITEM TEST BATTERY WITH RACQUETBALL

DIFFERENTIAL SCORE CRITERION

WALL-VOLLEY TEST BATTERY WITH

CRITERION AND RESIDUAL

(DIFFERENTIAL SCORE)

Subject	Criterion	Predicted Criterion	Residual	Wall Volley
01	221	408	-187	22
02	206	393	-187	19
03	260	285	- 25	17
04	171	330	-159	17
05	344	420	- 76	19
06	379	336	43	18.5
07	366	204	161	14
08	436	287	149	19
09	200	347	-147	19
10	382	258	124	16
11	429	538	-109	24
12	38	371	-333	21.5
13	336	379	- 43	19
14	260	250	10	18
15	563	496	67	24
16	119	79	40	10.5
17	452	329	123	19
18	373	392	- 19	21.5
19	225	341	-116	19.5
20	491	285	206	15.5
21	433	298	135	17.5
22	344	303	41	16.5
23	207	371	-164	19
24	999	526	473	24.5
25	205	199	6	14.5

26	75	252	-177	16
27	783	486	297	22.5
28	1	115	-114	12.5
29	352	385	- 33	21
30	414	320	94	20
31	374	172	202	14.5
32	254	356	-102	19
33	196	453	-257	23
34	426	297	129	17.5
35	850	489	361	24
36	440	504	- 64	24.5
37	61	357	-296	18.5
38	94	279	-185	17.5
39	332	192	140	13
40	501	511	- 10	24.5
41	410	478	- 68	24.5
42	437	344	93	23
43	347	256	91	17
44	319	372	- 53	20.5
45	684	525	159	24.5
46	690	364	326	17.5
47	348	192	156	16
48	245	308	- 63	15.5
49	631	524	107	22
50	339	323	16	17.5
51	435	348	87	19.5
52	536	406	130	20.5
53	135	187	- 52	13
54	7	173	-166	11
55	338	432	- 94	20.5
56	349	375	- 26	19.5
57	442	318	124	18
58	276	376	-100	20
59	212	433	-221	22
60	299	290	9	17
61	303	333	- 30	18.5

62	76	190	-114	13.5
63	303	476	-173	23.5
64	339	419	- 80	21.5
65	297	419	-122	21.5
66	238	233	5	15
67	290	247	43	15.5

APPENDIX J

RESULTS OF THE ROUND-ROBIN RACQUETBALL TOURNAMENT

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

RACQUETBALL ROUND ROBIN

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1		7/7		6/10		9/11	11/4	5/8	3/12	7/8	14/7	8/8	10/10	6/13	9/15
2	7/7			8/6		8/10	10/4	2/13	4/13	6/12	7/7	5/4	7/10	9/13	12/5
3															
4	10/6	6/8				7/7	6/9	4/9	13/8	7/7	10/10	4/6	11/13	14/9	3/13
5															
6	11/9	10/8		7/7			4/4	9/10	6/8	6/2	11/5	12/12	10/8	9/9	9/14
7	4/11	4/10		9/6		4/4		10/7	5/6	12/7	3/19	11/1	10/2	9/9	11/11
8	8/5	13/2		9/4		10/9	7/10		10/8	8/11	10/10	5/5	6/6	14/7	9/14
9	12/3	13/4		8/13		8/6	6/5	8/10		9/6	3/7	9/15	7/6	12/3	7/9
10	8/7	12/6		7/7		2/6	7/12	11/8	6/9		9/6	4/10	5/7	5/8	2/6
11	7/14	7/7		10/10		5/11	19/3	10/10	7/3	6/9		12/4	9/18	10/8	24/16
12	8/8	4/5		6/4		12/12	1/11	5/5	15/9	10/4	4/12		8/4	7/10	10/4
13	10/10	10/7		13/11		8/10	2/10	6/6	6/7	7/5	18/9	4/8		7/12	9/3
14	13/6	13/9		9/14		9/9	9/9	7/14	3/12	8/5	8/10	10/7	12/7		8/10
15	15/9	5/12		13/3		14/9	11/11	14/9	9/7	6/2	16/24	4/10	3/9	10/8	

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1	7/3	3/6	4/10	5/11	4/20	5/9	8/7	3/18	6/13	10/10	11/5	6/7	3/14	9/5	9/6
2	8/6	8/10	2/13	4/7	9/3	5/5	6/11	3/9	4/4	11/6	5/5	4/4	6/11	5/10	0/8
3															
4	6/2	7/9	7/10	1/10	6/8	8/6	16/3	4/14	3/14	8/5	7/3	8/3	1/9	6/2	4/11
5															
6	19/17	7/5	6/12	5/5	4/9	10/10	10/8	7/5	21/19	8/4	3/9	10/3	7/11	15/5	6/8
7	10/10	5/5	4/8	10/2	10/5	3/7	3/7	7/2	13/8	6/3	15/1	8/3	6/4	10/8	1/3
8	8/11	19/11	6/9	7/10	13/8	10/12	9/1	10/10	8/4	7/12	8/14	10/6	14/7	6/8	7/9
9	7/1	7/6	15/5	10/4	3/12	7/3	2/7	2/11	6/9	15/5	11/1	13/5	7/1	1/12	3/9
10	6/12	6/6	5/12	8/13	7/7	6/10	7/13	7/15	19/12	7/12	10/10	5/11	5/11	0/12	14/13
11	4/8	11/4	3/9	5/9	11/6	13/9	7/7	1/14	8/11	9/7	11/3	8/10	7/10	5/5	9/4
12	4/14	3/12	4/14	4/6	7/7	11/11	6/8	14/14	3/13	16/3	15/3	10/1	3/13	6/6	1/10
13	11/4	5/7	4/9	18/14	15/15	9/13	19/7	13/8	19/10	6/9	10/3	7/7	3/11	14/11	3/1
14	20/7	6/6	8/6	5/13	12/6	15/15	13/9	13/13	14/5	10/15	12/4	7/19	12/4	23/6	12/9
15	3/15	2/10	5/19	14/14	11/11	9/4	2/10	6/5	2/14	7/2	1/9	9/8	6/11	3/14	13/10

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1	8/10	3/11	7/5	8/6	4/10	6/11	14/9	9/9	6/4	2/10	3/7	21/6	16/6	8/11	10/6
2	7/5	4/2	2/12	9/5	4/7	10/3	8/12	14/3	3/22	0/13	0/11	6/5	0/11	9/5	3/13
3															
4	11/16	3/9	1/16	10/5	11/16	10/4	6/11	1/9	5/8	0/22	6/9	20/5	4/14	6/4	5/6
5															
6	6/13	2/5	15/6	7/6	4/5	8/3	5/3	14/12	3/17	8/7	9/6	3/3	9/4	11/9	5/8
7	6/8	9/4	3/7	15/10	13/8	3/13	5/11	8/6	11/6	2/6	1/5	10/10	8/8	9/7	6/11
8	14/12	10/10	4/4	16/18	22/16	15/10	6/10	9/7	10/10	6/8	9/7	14/12	10/8	8/8	10/3
9	8/3	11/6	0/14	11/6	10/1	7/2	4/6	1/10	2/7	3/12	7/3	8/3	7/9	7/0	4/9
10	7/9	5/7	9/9	22/15	8/15	7/7	10/7	4/9	8/13	6/11	14/9	13/4	15/6	10/11	10/15
11	8/10	11/6	0/14	12/5	22/9	13/6	8/14	15/10	8/15	9/10	12/4	8/8	16/12	14/9	8/12
12	9/8	7/11	3/15	14/0	10/10	15/1	16/10	14/13	4/7	3/4	24/0	6/6	12/3	7/5	6/5
13	5/4	2/8	12/12	13/9	5/26	7/14	12/5	15/7	6/8	6/13	11/6	4/6	5/11	10/3	5/7
14	7/11	10/10	9/14	6/18	20/19	8/3	5/16	7/11	14/23	13/13	9/1	11/5	4/1	5/9	3/19
15	10/3	6/13	19/10	7/11	4/22	10/10	10/5	3/13	9/9	1/15	12/15	12/3	13/6	9/8	8/10

	61	62	63	64	65	66	67	68	69	70
1	5/9	14/23	20/9	16/11	14/3	11/3	0/16	3/14	4/19	10/9
2	10/8	9/11	8/13	2/2	9/5	14/14	9/14	5/8	6/0	6/4
3										
4	2/7	13/10	5/6	6/12	3/8	1/12	8/4	7/10	3/6	2/19
5										
6	4/15	7/5	4/12	10/5	7/13	5/11	7/5	1/14	9/3	8/2
7	6/6	12/12	6/4	5/6	4/6	9/9	5/7	9/14	6/4	7/7
8	9/10	11/13	14/9	11/6	3/3	14/13	12/15	8/8	5/7	8/6
9	13/2	13/8	10/1	6/8	11/6	17/10	4/6	7/2	9/9	11/4
10	4/5	10/10	11/13	3/5	10/6	10/6	13/18	12/15	10/7	5/7
11	13/12	11/14	21/20	5/7	4/6	8/12	16/7	8/3	4/8	9/7
12	6/11	4/6	11/5	11/8	4/6	6/8	19/11	12/2	6/10	8/5
13	9/11	4/20	3/18	26/5	9/2	10/10	17/15	13/2	13/13	7/5
14	23/8	14/7	7/8	9/9	11/5	10/7	8/14	9/14	16/15	13/21
15	3/12	8/3	6/6	7/12	16/7	13/8	14/7	8/7	6/2	8/6

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

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

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
16	9/14	15/17	6/9	8/6	6/15	14/10	16/6	6/15	9/3	10/10	18/1	6/11	11/3	11/8	11/10
17	6/13	9/3	3/14	6/12	15/6	9/9	2/23	6/19	3/8	10/5	5/6	6/29	1/8	0/30	2/12
18	2/6	5/7	1/8	6/5	15/4	7/2	16/5	2/10	5/6	15/2	16/2	1/8	6/8	10/5	5/10
19	10/9	5/12	7/4	8/6	19/11	6/15	5/12	5/15	6/10	3/10	11/2	15/8	3/13	3/11	4/10
20	3/10	4/9	1/18	12/12	20/14	6/6	2/8	2/13	4/14	10/3	7/11	14/12	13/17	8/6	8/13
21	12/18	9/9	2/25	9/6	7/7	10/3	6/6	11/18	2/10	9/0	7/6	4/7	1/9	10/6	1/14
22	2/8	7/11	6/11	10/3	6/3	8/4	14/7	5/13	3/9	14/3	11/9	6/13	11/3	10/4	6/9
23	9/28	2/13	6/6	10/1	4/7	9/2	12/8	7/11	14/14	16/3	10/6	15/9	4/12	1/16	15/12
24	15/6	4/9	3/13	13/4	12/12	15/3	5/11	6/17	14/12	18/1	13/1	7/10	4/7	6/3	6/9
25	16/5	14/3	13/3	19/0	15/4	20/10	16/3	11/4	6/5	21/0	15/0	22/0	10/4	25/6	14/1
26															
27	10/6	6/8	3/7	6/10	19/12	15/15	4/11	11/11	3/9	7/7	9/3	6/13	4/29	14/3	3/12
28	9/19	14/7	2/12	6/9	4/8	0/15	19/9	0/22	8/5	4/9	2/9	7/2	3/18	6/18	5/9
29	16/8	8/9	5/12	16/0	25/2	5/12	11/6	6/8	11/3	21/1	18/2	14/1	3/6	8/8	4/6
30	8/16	1/10	14/6	0/15	7/6	10/10	6/14	3/17	8/14	4/7	14/3	4/7	17/15	11/11	2/7

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
16	13/8	14/7	18/13	15/10	2/12	16/10	4/14	10/8	4/13	9/6	17/4	17/0	7/5	9/10	13/7
17	3/10	13/6	4/21	9/3	6/10	11/8	0/28	9/19	12/14	4/12	2/10	2/5	22/10	6/8	5/10
18	5/5	7/9	2/10	7/1	10/4	15/6	3/14	16/8	2/20	4/11	10/3	11/2	9/4	13/3	10/9
19	7/5	2/6	4/14	6/5	10/2	10/4	1/15	9/4	2/6	6/11	13/3	10/4	5/10	2/12	1/19
20	5/8	4/7	5/9	15/2	5/7	4/11	10/10	10/19	7/8	1/19	6/5	9/3	8/8	5/16	7/1
21	10/3	4/6	2/13	12/6	3/9	6/2	1/31	10/5	11/6	4/11	6/4	6/5	6/13	14/14	1/12
22	7/12	1/12	14/2	10/4	11/8	16/7	2/27	11/8	14/10	3/13	13/10	17/1	13/17	13/13	10/9
23	9/8	6/7	4/12	5/5	2/1	9/10	4/2	3/7	8/8	2/11	9/6	15/19	22/6	13/17	7/5
24	8/7	10/10	4/15	7/12	15/9	12/11	8/8	3/7	2/8	5/1	11/4	9/8	5/8	6/6	4/7
25	16/1	15/0	19/7	17/2	19/1	24/4	10/5	19/6	18/1	20/5	11/3	32/1	15/0	17/3	24/1
26															
27	3/8	5/4	1/19	5/6	8/8	8/4	10/19	5/7	5/6	9/6	8/7	8/3	10/7	5/3	4/10
28	2/15	1/12	1/20	3/14	7/8	9/11	6/6	9/9	4/12	1/16	8/6	16/3	10/10	4/19	5/16
29	9/9	13/6	21/7	25/6	11/4	18/13	3/11	13/7	5/8	3/10	23/3	20/1	9/3	11/6	9/5
30	3/12	10/6	0/17	1/17	9/14	5/6	12/4	2/23	12/7	14/7	21/7	0/27	2/11	4/13	6/7

	61	62	63	64	65	66	67	68	69	70
16	14/3	11/5	10/3	7/5	15/6	6/17	7/5	15/2	14/6	15/1
17	4/9	5/7	6/9	10/7	7/10	7/9	8/8	5/8	6/2	9/6
18	10/2	8/5	5/10	4/2	14/4	10/6	8/8	13/3	6/12	11/3
19	6/1	8/8	5/2	9/4	9/3	10/10	11/6	2/8	5/4	4/5
20	8/13	9/4	5/11	16/8	16/3	9/14	11/2	4/5	8/3	5/3
21	6/12	10/10	3/6	4/11	6/5	15/9	4/12	4/5	8/8	8/6
22	6/4	9/9	16/12	8/8	13/1	11/11	5/3	6/4	14/1	1/9
23	12/4	3/6	6/17	16/12	10/10	18/9	6/12	10/10	4/6	9/3
24	19/11	6/23	7/7	19/10	8/7	11/14	13/13	9/9	6/7	8/5
25	19/1	19/1	19/3	18/0	20/1	15/4	14/1	16/2	28/1	20/3
26										
27	7/15	9/4	5/5	12/12	7/7	4/8	6/9	6/5	4/2	8/5
28	9/14	6/10	2/5	8/13	5/7	4/10	1/9	2/11	9/2	8/4
29	19/2	10/2	4/15	9/8	12/3	5/11	15/6	14/12	19/2	22/0
30	4/18	10/10	6/8	5/1	19/5	0/10	7/9	4/18	3/17	0/13

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
31	3/7	6/8		2/6		17/19	10/10	11/8	1/7	12/6	8/4	14/4	4/11	7/20	15/3
32	6/3	10/8		9/7		5/7	5/5	11/19	6/7	6/6	4/11	12/3	7/5	6/6	10/2
33	10/4	13/2		10/7		12/6	8/4	9/6	5/15	12/5	9/3	14/4	9/4	6/8	19/5
34	11/5	7/4		10/1		5/5	2/10	10/7	4/10	13/8	9/5	6/4	14/18	13/5	14/14
35	20/4	3/9		8/6		9/4	5/10	8/13	12/8	7/7	6/11	7/7	15/15	6/12	11/11
36	9/5	5/5		6/8		10/10	7/3	12/10	3/7	10/6	9/13	11/11	13/9	15/15	4/9
37	7/8	11/6		3/16		8/10	7/3	1/9	7/2	13/7	7/7	8/6	7/19	9/13	10/2
38	18/3	9/3		14/4		5/7	2/7	10/10	11/2	15/7	14/1	14/14	8/13	13/13	5/6
39	13/6	4/4		14/3		19/21	8/13	4/8	9/6	12/19	11/8	13/3	10/19	5/14	14/2
40	10/10	6/11		5/8		4/8	3/6	12/7	5/15	12/7	7/9	3/16	9/6	15/10	2/7
41	5/11	5/5		3/7		9/3	1/15	14/8	1/11	10/10	3/11	3/15	3/10	4/12	9/1
42	7/6	4/4		3/8		3/10	3/8	6/10	5/13	11/5	10/8	1/10	7/7	19/7	8/9
43	14/3	11/6		9/1		11/7	4/6	7/14	1/7	11/5	10/7	13/3	11/3	4/12	11/6
44	5/9	10/5		2/6		5/15	8/10	8/6	12/1	12/0	5/5	6/6	11/14	6/23	14/3
45	6/9	8/0		11/4		8/6	3/1	9/7	9/3	13/14	4/9	10/1	1/3	9/12	10/13

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	14/9	13/6	6/2	9/10	10/3	18/12	8/2	28/9	6/15	5/16		6/10	19/9	8/16	16/8
32	7/15	3/9	7/5	12/5	9/4	9/9	11/7	13/2	9/4	3/14		8/6	7/14	9/8	10/1
33	9/6	14/3	8/1	4/7	18/1	25/2	11/6	6/6	13/3	3/13		7/3	12/2	12/5	6/14
34	6/8	12/6	5/6	6/8	12/12	6/9	3/10	1/10	4/13	0/19		10/6	9/6	0/16	15/0
35	15/6	6/15	4/15	11/19	14/20	7/7	3/6	7/4	12/12	4/15		12/19	8/4	2/25	6/7
36	10/14	9/9	2/7	15/6	6/6	3/10	4/8	2/9	3/15	10/20		15/15	15/0	12/5	10/10
37	6/16	23/2	5/16	12/5	8/2	6/6	7/14	8/12	11/5	3/16		11/4	9/19	6/11	14/6
38	15/6	19/6	10/2	15/5	13/2	18/11	13/5	11/7	17/6	4/11		11/11	22/0	8/6	17/3
39	3/9	8/3	6/5	10/6	14/4	10/2	9/3	14/14	12/14	5/6		9/3	5/8	3/11	14/8
40	10/10	5/10	2/15	10/3	3/10	0/9	3/14	13/16	1/18	0/21		7/7	9/4	1/21	7/4
41	1/18	6/5	2/16	2/11	11/7	6/7	9/11	6/10	1/13	0/15		3/9	9/2	2/18	3/14
42	11/6	29/6	8/1	8/15	12/14	7/4	13/6	9/15	10/7	0/22		13/6	2/7	1/14	7/4
43	3/11	8/1	8/6	13/3	17/13	9/1	3/11	12/4	7/4	4/10		29/4	18/3	6/3	15/17
44	8/11	30/0	5/10	11/3	6/8	6/10	4/10	16/1	3/6	6/25		3/14	18/6	8/8	11/11
45	10/11	12/2	10/5	10/4	13/8	14/1	9/6	12/15	9/6	1/14		7/10	12/3	9/5	6/4

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
31		9/10	0/9	9/3	6/12	14/13	8/8	6/25	8/10	9/11	1/7	14/26	11/19	21/12	2/7
32	10/9		6/8	11/2	8/15	5/16	13/6	4/10	7/9	10/10	15/10	14/14	7/4	18/5	9/10
33	9/0	8/6		11/3	9/7	9/8	13/2	2/11	15/15	13/1	12/2	6/7	10/0	14/3	9/6
34	3/9	2/11	3/11		13/6	12/12	13/9	3/14	2/7	28/2	9/2	9/11	7/14	5/7	9/1
35	12/6	15/8	7/9	6/13		12/7	7/10	1/6	11/4	13/6	9/5	23/5	9/6	3/10	14/7
36	13/14	16/5	8/8	12/12	7/12		16/6	3/11	10/10	9/14	11/3	13/13	3/15	6/9	4/11
37	8/8	6/13	2/13	9/13	10/7	6/16		9/14	9/6	11/3	11/4	6/6	8/10	9/9	10/12
38	25/6	10/4	11/2	14/3	6/1	11/3	14/9		4/7	12/6	11/4	18/7	8/5	10/3	4/9
39	10/8	9/7	15/15	7/2	4/11	10/10	6/9	7/4		13/3	9/4	20/19	1/7	2/9	10/5
40	11/9	10/10	1/13	2/28	6/13	14/9	3/11	6/12	3/13		5/14	10/10	4/14	6/9	4/15
41	7/1	10/15	2/12	2/9	5/9	3/11	4/11	4/11	4/9	14/5		9/4	4/12	1/23	3/12
42	26/14	14/14	7/6	11/9	5/23	13/13	6/6	7/18	19/20	10/10	4/9		10/6	16/3	4/10
43	19/11	4/7	0/10	14/7	6/9	15/3	10/8	5/8	7/1	14/4	12/4	6/10		23/2	5/7
44	12/21	5/18	3/14	7/6	10/3	9/6	9/9	3/10	9/2	9/6	23/1	3/16	2/23		5/4
45	7/2	10/9	6/9	1/9	7/14	11/4	12/10	9/4	5/10	15/4	12/3	10/4	7/5	4/5	

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31	9/3	14/10	11/11	2/23	13/13	9/10	33/20	9/13	15/3	10/10	21/10	15/4	4/16	14/9	8/14
32	3/1	11/9	6/8	11/4	6/8	17/17	3/17	16/2	9/8	15/15	11/4	6/7	7/9	14/11	4/7
33	11/11	13/3	7/6	4/1	7/3	8/0	5/6	11/1	10/3	8/8	16/2	17/1	15/6	10/8	13/6
34	10/0	14/7	4/15	3/8	4/6	9/13	9/3	14/6	6/13	16/3	7/7	5/8	14/3	5/5	10/4
35	23/16	9/16	6/12	19/4	13/4	13/13	9/9	8/10	10/9	11/7	10/10	8/4	6/12	15/14	10/6
36	3/14	11/5	8/6	13/6	9/2	13/1	4/10	6/6	9/12	13/13	3/15	6/6	13/19	20/20	3/14
37	15/6	7/7	3/14	10/4	3/11	14/9	16/6	7/10	4/11	13/9	8/6	15/0	2/13	6/13	8/8
38	8/8	14/6	7/7	3/5	3/7	25/2	36/12	14/1	6/7	6/8	11/6	13/5	14/6	12/7	7/8
39	11/18	7/7	9/13	9/0	7/3	0/8	9/6	2/11	6/3	5/1	15/0	9/9	6/13	4/19	13/3
40	13/6	2/11	9/9	7/10	4/12	6/22	0/29	9/3	7/9	8/8	11/13	10/4	6/9	10/14	1/16
41	5/16	4/8	14/8	3/4	5/10	3/12	7/9	8/6	4/6	2/17	6/12	8/1	14/3	2/20	19/1
42	8/9	7/6	9/13	5/6	10/16	7/7	11/11	18/6	6/3	3/14	10/5	3/4	10/10	14/2	11/13
43	14/18	12/12	9/6	7/10	8/13	6/9	6/3	4/3	5/2	8/2	3/13	10/2	4/14	11/3	6/9
44	6/10	14/3	9/1	16/1	8/13	23/30	14/6	9/9	10/14	3/8	11/2	5/5	4/2	6/10	19/3
45	9/5	6/7	9/9	15/3	14/6	8/25	0/22	12/12	6/7	5/12	12/4	11/2	11/13	2/22	9/18

	61	62	63	64	65	66	67	68	69	70
31	13/9	10/12	9/9	4/8	15/4	7/6	6/9	7/13	7/7	10/9
32	10/7	6/3	24/11	9/21	16/3	6/8	10/11	15/1	14/3	8/11
33	7/7	6/9	23/9	11/7	6/6	8/9	7/10	10/6	13/6	19/0
34	6/10	23/14	2/2	8/8	6/3	10/3	0/10	2/6	11/7	9/6
35	8/15	10/10	19/7	12/14	3/9	6/9	7/10	11/7	3/8	4/7
36	12/1	10/9	9/11	8/8	3/8	16/12	3/9	10/4	4/9	6/5
37	9/3	12/6	2/8	10/10	11/11	4/14	9/3	8/5	5/5	7/8
38	19/5	14/4	10/4	11/6	18/3	14/15	6/9	9/3	12/0	15/4
39	15/2	9/2	25/3	16/4	11/3	5/11	6/12	10/16	9/7	5/7
40	3/14	22/8	7/9	12/12	8/6	7/7	2/24	9/19	11/6	7/9
41	6/3	4/16	2/4	10/10	7/3	9/10	4/9	5/8	6/6	6/3
42	6/19	12/9	13/8	6/11	17/8	9/10	13/6	13/13	17/16	10/19
43	10/10	13/6	4/6	3/11	12/5	8/8	7/9	13/2	10/11	8/8
44	7/13	8/4	9/1	15/15	12/3	16/16	3/11	20/1	6/8	9/3
45	18/7	11/11	6/8	4/3	15/1	5/7	13/2	15/11	4/8	9/7

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
46	10/8	5/7		16/11		13/6	8/6	12/14	3/8	9/7	10/8	8/9	4/5	11/7	3/10
47	11/3	2/4		9/3		5/2	4/9	10/10	6/11	7/5	6/11	11/7	8/2	10/10	13/6
48	5/7	12/2		16/1		6/15	7/3	4/4	14/0	9/9	14/0	15/3	12/12	14/9	10/9
49	6/8	5/9		5/10		6/7	10/15	18/16	6/11	15/22	5/12	0/14	9/13	18/6	11/7
50	10/4	7/4		16/11		5/4	8/13	16/22	1/10	15/8	9/22	10/10	26/5	19/20	22/4
51	11/6	3/10		4/10		3/8	13/3	10/15	2/7	7/7	6/13	1/15	14/7	3/8	10/10
52	9/14	12/8		11/6		3/5	11/5	10/6	6/4	7/10	14/8	10/16	5/12	16/5	5/10
53	9/1	3/14		9/1		12/14	6/8	7/9	10/1	9/4	10/15	13/14	7/15	11/7	12/3
54	4/6	22/3		8/5		17/3	6/11	10/10	7/2	13/8	15/8	7/4	8/6	23/14	9/9
55	10/2	13/0		22/0		7/8	6/2	8/6	12/3	11/6	10/9	4/3	13/6	13/13	15/1
56	7/3	11/0		9/6		6/9	5/1	7/9	3/7	9/14	4/12	0/24	6/11	1/9	15/12
57	6/21	5/6		5/20		3/3	10/10	12/14	3/8	4/13	8/8	6/6	6/4	5/11	3/12
58	6/16	11/0		14/4		4/9	8/8	8/10	9/7	6/15	12/16	3/12	11/5	1/4	6/13
59	11/8	5/9		4/6		9/11	7/9	8/8	0/7	11/10	9/14	5/7	3/10	9/5	8/9
60	6/10	13/3		6/5		8/5	11/6	3/10	9/4	15/10	12/8	5/6	7/5	19/3	10/8

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
46	8/13	10/3	5/5	5/7	8/5	10/3	12/7	8/9	7/8	1/16		8/3	15/2	9/9	12/3
47	7/14	6/13	9/7	6/2	7/4	6/4	12/1	7/6	10/10	0/15		4/5	12/1	6/13	15/10
48	13/18	21/4	10/2	14/4	9/5	13/2	2/14	12/4	15/4	7/19		19/1	20/1	7/21	17/0
49	10/15	3/9	1/7	5/6	2/15	6/12	4/10	5/5	12/7	2/17		6/5	14/3	6/25	17/1
50	12/2	10/6	4/10	2/10	7/5	9/3	8/11	1/2	9/15	1/19		8/8	8/7	4/11	14/9
51	10/16	8/11	6/15	4/10	11/4	2/6	7/16	10/9	11/12	4/24		4/8	11/9	13/18	6/5
52	14/4	28/0	14/3	15/1	10/10	31/1	27/2	2/4	8/8	5/10		19/10	6/6	11/3	4/12
53	8/10	19/9	8/16	4/9	19/10	5/10	8/11	7/3	7/3	6/19		7/5	9/9	7/13	23/2
54	13/4	14/12	20/2	6/2	8/7	6/11	10/14	8/8	8/2	1/18		6/5	12/4	8/5	7/12
55	6/9	12/4	11/4	11/6	19/1	11/4	13/3	11/2	5/5	5/20		6/9	16/1	10/3	7/14
56	4/17	10/2	3/10	3/13	5/6	4/6	10/13	6/9	4/11	3/11		7/8	6/8	3/23	7/21
57	0/17	5/2	2/11	4/10	3/9	5/6	1/17	19/15	8/9	1/32		3/8	3/16	1/20	27/0
58	5/7	10/22	4/0	10/5	8/8	13/6	17/13	6/22	8/5	0/15		7/10	10/10	3/9	11/2
59	10/9	8/6	3/13	12/2	16/5	14/14	13/13	17/13	6/6	3/17		3/5	19/4	6/11	13/4
60	7/13	10/5	9/10	19/1	1/7	12/1	9/10	5/7	7/4	1/24		10/4	16/5	5/9	7/6

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	3/9	1/3	11/11	0/10	16/23	14/3	6/15	8/8	18/11	6/13	16/5	9/8	18/14	10/6	5/9
47	10/14	9/11	2/13	7/14	16/9	5/11	7/7	6/14	7/7	11/2	8/4	6/7	12/12	3/14	7/6
48	11/11	8/6	6/7	15/4	12/6	6/8	14/3	7/7	13/9	9/9	8/14	13/9	6/9	1/9	9/9
49	23/2	4/11	1/4	8/3	4/19	6/13	4/10	5/3	0/9	10/7	4/3	6/5	10/7	11/16	3/15
50	13/13	8/6	3/7	6/4	4/13	2/9	11/3	7/3	3/7	12/4	10/5	16/10	13/8	13/8	6/14
51	10/9	17/17	0/8	13/9	13/13	1/13	9/14	2/25	8/0	22/6	12/3	7/7	9/6	30/23	25/8
52	20/33	17/3	6/5	3/9	9/9	10/4	6/16	12/26	6/9	29/0	9/7	11/11	3/6	6/14	22/0
53	13/9	2/16	1/11	6/14	10/8	6/6	10/7	1/14	11/2	3/9	6/8	6/18	3/4	9/9	12/12
54	3/15	8/9	3/10	13/6	9/10	12/9	11/4	7/6	3/6	9/7	6/4	3/6	2/5	14/10	21/16
55	10/10	15/15	8/8	3/16	7/11	13/13	9/13	8/6	9/7	8/8	17/2	14/3	2/8	8/3	8/3
56	10/21	4/11	2/16	7/7	10/10	15/3	6/8	6/11	0/15	13/11	12/6	5/10	13/3	2/11	1/9
57	4/15	7/6	1/17	8/5	4/8	6/6	0/15	5/13	9/9	4/10	1/8	4/3	2/10	5/5	9/7
58	16/4	9/7	6/15	3/14	12/6	19/13	13/2	6/14	13/6	9/6	3/14	10/10	14/4	2/4	15/2
59	9/14	11/14	8/10	5/5	14/15	20/20	13/6	7/12	19/4	14/10	20/2	2/14	3/11	10/16	7/14
60	14/8	7/4	6/13	4/10	6/10	14/3	8/8	8/7	3/13	16/1	19/1	13/11	9/6	3/19	1/9

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
46		14/9	11/17	2/10	12/12	16/21	3/8	9/1	7/9	2/15	14/7	9/1	10/0	8/11	6/5
47	9/14		0/14	9/9	6/13	4/3	9/9	12/21	8/12	9/8	5/5	15/1	7/12	13/2	9/6
48	17/11	14/0		14/16	31/5	10/18	16/4	14/15	15/2	9/9	17/3	31/0	8/14	13/9	14/3
49	10/2	9/9	16/14		8/3	9/21	7/9	10/10	5/6	4/7	7/6	25/2	8/7	6/8	4/3
50	12/12	13/6	5/31	3/8		7/12	14/9	8/32	6/13	5/5	10/6	6/5	7/7	9/3	6/15
51	21/16	3/4	18/10	21/9	12/7		9/16	14/14	11/19	28/15	15/15	6/3	6/24	10/10	14/9
52	8/3	9/9	4/16	9/7	9/14	16/9		13/3	25/10	19/1	3/5	7/7	6/0	25/15	8/7
53	1/9	21/12	15/14	10/10	32/8	14/14	3/13		13/3	9/9	15/10	11/8	6/13	10/11	11/11
54	9/7	12/8	2/15	6/5	13/6	19/11	10/25	3/13		4/4	7/5	5/5	9/10	13/10	6/6
55	15/2	8/9	9/9	7/4	5/5	15/28	1/19	9/9	4/4		15/2	18/4	9/3	10/14	8/8
56	7/14	5/5	3/17	6/7	6/10	15/15	5/3	10/15	5/7	2/15		5/13	6/13	5/5	11/11
57	1/9	1/15	0/31	2/25	5/6	3/6	7/7	8/11	5/5	4/18	13/5		9/6	8/5	3/12
58	0/10	12/7	14/8	7/8	7/7	24/6	0/6	13/6	10/9	3/9	13/6	6/9		9/13	10/10
59	11/8	2/13	9/13	8/6	3/9	10/10	15/25	11/10	10/13	14/10	5/5	5/8	13/9		5/5
60	5/6	6/9	3/14	3/4	15/6	9/14	7/8	11/11	6/6	8/8	11/11	12/3	10/10	5/5	

	61	62	63	64	65	66	67	68	69	70
46	7/7	9/4	10/19	20/20	3/11	6/1	11/17	7/4	15/10	8/9
47	6/4	6/3	5/19	8/3	7/5	20/19	6/13	8/8	9/7	4/9
48	6/8	16/9	26/14	14/14	8/4	10/10	8/3	16/12	9/11	28/1
49	2/8	3/7	8/4	5/0	5/7	6/6	6/7	3/4	10/0	12/12
50	18/11	12/12	9/14	8/8	9/10	16/19	20/7	4/5	17/10	14/1
51	8/13	10/13	7/7	7/19	7/14	8/8	0/14	1/9	16/13	11/18
52	9/10	13/13	19/8	35/10	32/2	6/11	15/4	17/6	15/6	9/3
53	14/8	7/15	25/21	6/12	11/5	9/9	7/8	12/12	11/6	2/11
54	8/7	9/6	3/3	6/8	4/6	15/7	9/4	11/5	6/7	8/9
55	16/19	20/20	7/13	9/6	16/6	13/13	11/5	10/4	11/14	8/8
56	19/8	7/15	5/8	7/8	10/4	6/7	7/5	9/3	6/7	2/8
57	7/10	13/11	14/10	14/14	7/10	6/7	1/16	4/5	4/7	6/7
58	15/11	6/9	8/14	19/13	6/9	11/11	25/21	9/9	9/12	6/6
59	17/12	9/12	10/10	14/17	10/3	19/19	6/11	6/4	10/8	7/11
60	6/7	9/3	15/2	8/16	13/6	20/19	17/22	5/6	8/8	10/6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
61	9/5	8/10		7/2		15/4	6/6	10/9	2/13	5/4	12/13	11/6	11/9	8/23	12/3
62	23/14	11/9		10/13		5/7	12/12	13/11	8/13	10/10	14/11	6/4	20/4	7/14	3/8
63	9/20	13/8		6/5		12/4	4/6	9/14	1/10	13/11	20/21	5/11	18/3	8/7	6/6
64	11/16	2/2		12/6		5/10	6/5	6/11	8/6	5/3	7/5	8/11	5/26	9/9	12/7
65	3/14	5/9		8/3		13/7	6/4	3/3	6/11	6/10	6/4	6/4	2/9	5/11	7/16
66	3/11	14/14		12/1		11/5	9/9	13/14	10/17	6/10	12/8	8/6	10/10	7/10	8/13
67	16/0	14/9		4/8		5/7	7/5	15/12	6/4	18/13	7/16	11/19	15/17	14/8	7/14
68	14/3	8/5		10/7		14/1	14/9	8/8	2/7	15/12	3/8	2/12	2/13	14/9	7/8
69	19/4	0/6		6/3		3/9	4/6	7/5	9/9	7/10	8/4	10/6	13/13	15/16	2/6
70	9/10	4/6		19/2		2/8	7/7	6/8	4/11	7/5	7/9	5/8	5/7	21/13	6/8

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
61	3/14	9/14	2/10	1/6	13/8	12/6	4/6	4/12	11/19	1/18		15/7	14/9	2/19	18/4
62	5/11	7/5	5/8	8/8	4/9	10/10	9/9	6/3	23/6	1/19		4/9	10/6	2/10	10/10
63	3/10	9/6	10/5	2/5	11/5	6/3	12/16	17/6	7/7	3/19		5/5	5/2	15/4	8/6
64	5/7	7/10	2/4	4/9	8/16	11/4	8/8	12/16	10/19	0/18		12/12	13/8	8/9	1/5
65	6/15	10/7	4/14	3/9	3/16	5/6	1/13	10/10	7/8	1/20		7/7	7/5	3/12	5/19
66	17/6	9/7	6/10	10/10	14/9	9/15	11/11	9/18	14/11	4/15		8/4	10/4	11/5	10/0
67	5/7	8/8	8/8	6/1	2/11	12/4	3/5	12/6	13/13	1/14		9/6	9/1	6/15	9/7
68	2/15	8/5	3/13	8/2	5/4	5/4	4/6	10/10	9/9	2/16		5/6	11/2	12/14	18/4
69	6/14	2/6	12/6	4/5	3/8	8/8	1/14	6/4	7/6	1/28		2/4	2/9	2/19	17/3
70	1/15	6/9	3/11	5/4	3/5	6/8	9/1	3/9	5/8	13/20		5/8	4/8	0/22	13/0

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
61	9/13	7/10	7/7	10/6	15/8	1/12	3/9	5/19	2/15	14/3	3/6	19/6	10/10	13/7	7/18
62	12/10	3/6	9/6	14/23	10/10	9/10	6/12	4/14	2/9	8/22	16/4	9/12	6/13	4/8	11/11
63	9/9	11/24	9/23	2/2	7/19	11/9	8/2	4/10	3/25	9/7	4/2	8/13	6/4	1/9	8/6
64	8/4	21/9	7/11	8/8	14/12	8/8	10/10	6/11	4/16	12/12	10/10	11/6	11/3	15/15	3/4
65	4/15	3/16	6/6	3/6	9/3	8/3	11/11	3/18	3/11	6/8	3/7	8/17	5/12	3/12	1/15
66	6/7	8/6	9/8	3/10	9/6	12/16	14/4	15/14	11/5	7/7	10/9	10/9	8/8	16/16	7/5
67	9/6	11/10	10/7	10/0	10/7	9/3	3/9	9/6	12/6	24/2	9/4	6/13	9/7	11/3	2/13
68	13/17	1/15	6/10	6/2	7/11	4/10	5/8	3/9	16/10	19/9	8/5	13/13	2/13	1/20	11/15
69	7/7	13/14	6/13	7/11	8/3	9/4	5/5	0/12	7/9	6/11	6/6	16/17	11/1	8/6	8/4
70	9/10	11/8	0/19	6/9	7/4	5/6	8/7	4/15	7/5	9/7	3/6	19/10	8/8	3/9	7/9

	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	7/7	4/6	8/6	8/2	11/18	13/8	10/9	8/14	7/8	19/16	8/19	10/7	11/15	12/17	7/6
62	4/9	3/6	9/16	7/3	12/12	13/10	13/13	15/7	6/9	20/20	15/7	11/13	9/6	12/9	3/9
63	19/10	19/5	14/26	4/8	14/9	7/7	8/19	21/25	3/3	13/7	8/5	10/14	14/8	10/10	2/15
64	20/20	3/8	14/14	0/5	8/8	19/7	10/35	12/6	8/6	6/9	8/7	14/14	13/19	17/14	16/8
65	11/3	5/7	4/8	7/5	10/9	14/7	2/32	5/11	6/4	6/16	4/10	10/7	9/6	3/10	6/13
66	1/6	19/20	10/10	6/6	19/16	8/8	11/6	9/9	7/15	13/13	7/6	7/6	11/11	19/19	19/20
67	17/11	13/6	3/8	7/6	7/20	14/0	4/15	8/7	4/9	5/11	5/7	16/1	21/25	11/6	22/17
68	4/7	8/8	12/16	4/3	5/4	9/1	6/17	12/12	5/11	4/10	3/9	5/4	9/9	4/6	6/5
69	10/15	7/9	11/9	0/10	10/17	13/16	6/15	6/11	7/6	14/11	7/6	7/4	12/9	8/10	8/8
70	9/8	9/4	1/29	12/12	1/14	18/11	3/9	11/2	9/8	8/8	8/2	7/6	6/6	11/7	6/10

	61	62	63	64	65	66	67	68	69	70
61		4/8	4/5	7/14	10/4	9/18	13/6	5/12	10/10	13/11
62	8/4		5/5	10/4	7/2	6/11	12/12	9/7	13/8	5/11
63	5/4	5/5		7/9	9/4	7/7	2/6	2/6	12/3	8/9
64	14/7	4/10	9/7		11/5	6/4	8/12	11/6	7/13	10/10
65	4/10	2/7	4/9	5/11		4/17	1/14	7/6	1/20	2/9
66	18/9	11/6	7/7	4/6	17/4		5/5	18/5	4/12	8/11
67	6/13	12/12	6/2	12/8	14/1	5/5		6/15	22/0	6/6
68	12/5	7/9	6/2	6/11	6/7	5/18	15/6		19/7	12/13
69	10/10	8/13	3/12	13/7	20/1	12/4	0/22	7/19		7/6
70	11/13	11/5	9/8	10/10	9/2	11/8	6/6	13/12	6/7	

VITA[2]

Robert Alan Klass

Candidate for the Degree of

Doctor of Education

Thesis: THE VALIDATION OF A BATTERY OF REACTION TIME TESTS TO PREDICT RACQUETBALL ABILITY FOR COLLEGE MEN

Major Field: Higher Education

Minor Field: Health, Physical Education, and Recreation

Biographical:

Personal Data: Born in Little Neck, New York, the son of Mr. and Mrs. Jack Klass. Married to LaDonna Jo Klass.

Education: Graduated from Martin Van Buren High School, Queens Village, New York, in June, 1964; received the Bachelor of Science degree in Health, Physical Education, and Recreation from Indiana State University in 1969; received the Master of Science in Health, Physical Education, and Recreation from Indiana State University in 1970; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1977.

Professional Experience: Instructor, Indiana State University, Fall Semester, 1969; teacher of Health, Physical Education, and driver education, coach of basketball, baseball, track and field, Rosedale High School, 1970-71; teacher of Physical Education and coach of basketball and track and field, Fort Wayne Public Schools, 1971-73; Sales Manager, Commercial Corrugated Container Corporation, 1973-75; graduate teaching assistant, Department of Health, Physical Education, and Recreation, Oklahoma State University, 1975-76; Member of the American Association of Health, Physical Education, and Recreation; Member of the Oklahoma Association of Health, Physical Education, and Recreation; Member of the Indiana Association of Health, Physical Education, and Recreation.