

AN INVESTIGATION OF THE EFFECTIVENESS OF
FOUR PRACTICE SCHEDULES ON LEARNING
THE SERVE IN TENNIS

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A Thesis

Submitted to the Graduate Faculty of Appalachian
State University in Partial Fulfillment of the
Requirement for the Degree Master

of Art

in

The Department of Health, Physical Education, and Recreation

by

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Appalachian State University

June, 1975

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ACKNOWLEDGEMENTS

The writer expresses appreciation to Dr. Vaughn K. Christian for helpful suggestions and professional guidance as the advisor for this research project. The writer gratefully acknowledges the help of the thesis committee: Dr. Judy Clarke, Dr. Wayne Edwards, and Dr. Ole Larson. Thanks, also, go to the author's wife, Pat, for help in editing and typing the preliminary copies of the paper. Finally, special thanks to Dr. Pat Gaynor for analyzing the data at the Computer Center at Appalachian State University.

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ABSTRACT

The purpose of the study was to investigate four practice schedules on acquiring ability to serve in tennis. A secondary purpose was to investigate the validity and reliability of a modification of Hewitt's Tennis Achievement Test used in the beginning tennis classes at Bob Jones University. The subjects were sixty-three freshmen and sophomore male students voluntarily enrolled in beginning tennis classes at Bob Jones University, Greenville, South Carolina, during the fall term of 1974. The subjects from the class list were divided into four groups by randomly assigning each one to a group prior to the pretest. The four groups under study were classified into different practice conditions. The study was restricted to measures of ability to serve in tennis.

Each of the four experimental groups followed a different practice schedule for a period of ten weeks. Group A practiced one day per week, taking thirty serves with no rest between trials. Group B practiced two days per week, taking fifteen serves each day with no rest periods between trials. Group C practiced one day per week, taking thirty serves with a four-minute rest interval between each ten trials. Group D practiced two days per week, taking fifteen serves each day with a four-minute rest interval between each five trials.

Each of the two classes taking part in the study met for thirty-five minutes on Tuesdays and Thursdays. Thus, groups A and C practiced on Tuesdays only while groups B and D practiced on Tuesdays and Thursdays. Only bending and stretching exercises were used for warming up prior to

each practice session. The warm-up period began when all subjects were present and lasted for five to six minutes. Each group of four subjects, practicing according to the same schedule, was assigned to a court. Each individual within the group practiced according to schedule, with court partners retrieving balls. On test days the individual's court partners not only retrieved balls but also scored the test and recorded the score.

After five weeks of practice the serving test was administered again to check the progress of subjects. Two days later the test was administered to test the reliability of the serving test itself. The test was administered at the conclusion of the ten-week study, at which time the final test scores were measured against scores on the Scott-French Revision of the Dyer Backboard Test to make a validity check on the serving test.

The first analysis of data utilized the four experimental groups to denote the degree of differences for the following comparisons: the means of each group, the degree of variance among the scores of each group, and the differences in standard deviations for each group. The design utilized was analysis of variance.

The second analysis of data used test and retest to establish the relationship that exists between the two sets of scores. The design was comparison of means utilizing a student t .

The Pearson Product Moment method of correlation was utilized to compute reliability and validity coefficients.

The findings of this study were as follows:

1. There was no significant difference among the four experimental groups' ability to serve the tennis balls.

2. There were significant gains in each of the experimental groups from pretest to post-test scores.

3. The reliability coefficient for the test used was found to be .608 for the combined groups. The reliability coefficient for the individual groups was as follows: Group A - .678; Group B - .45499; Group C - .92065; Group D - .460.

4. The validity coefficient for the test was found to be .4708 when the subjects' average scores were correlated with the scores made on the Scott-French Revision of the Dyer Backboard Test.

The following conclusions were drawn from the study:

1. The ability to learn the tennis serve does not depend on a particular practice schedule.

2. The nature of individual differences in subjects offset the effects of a specific practice schedule.

CHAPTER I

INTRODUCTION

The major objective of practical research is to find a basis of improvement in methods of teaching. Teachers have traditionally been quite subjective in determining the frequency and length of practices in teaching motor skills or other school subjects.

The old adage "practice makes perfect" implies that the more one practices the more one learns. However, efficiency in teaching and learning demands intelligent scheduling of work periods. It has long been acknowledged by authorities that individuals do not learn effectively simply because of practice. Thorndike, as well as other authorities, emphasized that exercise and study must be under favorable conditions for effective learning to take place. Oxendine states, "the important problem is the determination of the optimum amount of practice and the most ideal spacing of practice periods for maximum learning of different types of skills at different points on the learning curve. Many questions still exist regarding the most efficient means of scheduling practices for different types of learning."¹

Many variations in research designs have been used while attempting to solve particular learning problems. Also, a wide variety of tasks have been used to try to establish better methods of teaching motor skills.

¹Joseph B. Oxendine, Psychology of Motor Learning (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1968), p. 207.

Much of the research has involved novel tasks, because of the distinct experimental control advantages. However, several researchers have used meaningful motor tasks in trying to find information regarding the optimal distribution of practice. The advantage of research with meaningful tasks is that it relates more closely to other gross motor skills taught in the school program. There are certain disadvantages, however, in exercising experimental control.²

The manner in which learning takes place has been of interest to researchers and educators for a number of years. One of these questions relates to the amount of time between practice sessions and the distribution of time within the practice sessions that are required in order to learn some act, either mental or physical. Apart from the practical value that is to be gained by determining the most effective means of practice to the teaching of physical activities, it also may give basic data on the method by which people learn motor acts. The data available divides into two functions of massed and distributed practice. Although these are relative terms and must be defined for each experimental situation, the main question is whether or not individuals learn more effectively with intertrial rest intervals, brief intertrial rest intervals, or when the trials are spaced by varying periods of time.

To use class time to its fullest advantage led to this study of the distribution of practice time in the learning of a new motor skill. It was believed that the results of this study would be of professional

²Ibid., p. 212.

³David H. Clarke and H. Harrison Clarke, Research Processes in Physical Education, Recreation, and Health (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970), p. 317.

value to those who were interested in the merits of massed and distributed practice schedules on the learning of motor skills.

STATEMENT OF THE PROBLEM

Since the analysis of massed and distributed practice schedules resists conclusive clarity, it was deemed worthwhile to investigate the effectiveness of four practice schedules on acquiring ability to serve in tennis.

PURPOSE OF THE STUDY

The primary purpose was to investigate four practice schedules on acquiring ability to serve in tennis. A secondary purpose was to investigate the validity and reliability of a modification of Hewitt's Tennis Achievement Test used in the beginning tennis classes at Bob Jones University.

DEFINITIONS OF TERMS

Massed Practice - A concentrated practice schedule which had little or no rest, or other activity, between the start and the finish of the practice session.

Distributed Practice - A practice schedule in which the sessions were spread over a period of time or separated by rest intervals or activities which were different from the one being practiced.

Natural or Acquired Ability - Subjects that scored 40 points, or more, on the pretest.

DELIMITATIONS

The subjects were sixty-three freshmen and sophomore male students voluntarily enrolled in beginning tennis classes at Bob Jones University, Greenville, South Carolina, during the fall term of 1974. The four groups under study were classified into different practice conditions. The study was restricted to measures of ability to serve in tennis.

LIMITATIONS

The study was designed to include seventy-two subjects but due to absenteeism nine subjects were dropped. Although the subjects were asked to conform to a definite practice schedule, motivational levels may have affected the subjects' performances.

CHAPTER II

REVIEW OF RELATED LITERATURE

INTRODUCTION

Many studies have been completed in psychology regarding varied time elements and the distribution of practice effects on learning. The first experimental work, reported by Ebbinghaus in 1885, dealt with practice and learning of meaningful poetry and nonsense syllables. The researcher and subject were one and the same. Although no statistical analysis had been available the investigator concluded that a given unit of information could have been learned in less time and remembered longer when rest intervals occurred between the study sessions. This effort to experiment with time relationships and their effect on learning served as a beginning for experimental work in various aspects of learning. Ebbinghaus' work stimulated others to test his findings through investigative study in this area. Thorndike (1914), Pyle (1919), Reed (1924), and Lyon (1931) investigated practice distributions as they related to learning verbal materials.

Experimental research related to the learning of motor skills began about 1900 when several researchers, working independently of one another, used mazes of various types in learning studies. Later, mazes, mirror tracing, and the pursuit rotor (developed by Koerth in 1922) were used for the purpose of conducting research in learning.

STUDIES RELATED TO MASSED AND DISTRIBUTED PRACTICE SCHEDULES

Snoddy developed a mirror-tracing instrument which was used in several early studies of practice and rest distribution. In one study (1935) five groups of university students learned the mirror tracing skill, each on a different practice schedule. Based on the author's findings, it was suggested that there were two processes in mental growth, and further, that these processes were directly opposed to each other. These two opposed growth processes were referred to as primary and secondary. Primary growth occurred early and was stable; it was the foundation for secondary growth. Secondary growth came later and was less stable. The stability of secondary growth was greatly dependent upon the adequacy of primary growth. Snoddy further stated that early growth was enhanced by distributed practices while later growth occurred best when practices were massed. Snoddy's theory advocated spaced practices in the early stages of learning and massed practices later in the learning process.¹

Loge (1930) taught college students mirror tracing skills as well as verbal tasks involving nonsense syllables, code work, and mirror reading. It was found that for each type of task, a twenty-four hour rest period between practice trials was more effective than was a continuous schedule or one with a one-minute rest period between trials.²

¹Joseph B. Oxendine, Psychology of Motor Learning (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968), p. 209.

²Ibid., p. 212.

In a study conducted by Cozens in 1931, evidence of greater improvement in performance of certain types of track and field events of male college freshmen was shown when practice for a specific event was spread over a longer period of time than when practice was concentrated. Further, for track athletes, it might be concluded that three one-hour practice periods per week, spread over the entire year, was a better schedule than practice periods of one hour per day six days per week for one semester.³

The results of a study conducted by Travis in 1937 suggested an optimal spacing or distribution of trials while learning a motor skill. There was found a significantly greater amount of progress on the part of subjects that had a twenty-minute rest period between each of six five-minute sessions over subjects who had rest periods of five minutes, forty-eight hours, seventy-two hours or one hundred twenty hours when using a specifically designed pursuit oscillator.⁴

Ammons compared two groups of ten college students, using the pursuit rotor. One group had a five-minute rest interval between each of thirty-six trials while the other group took the trials in immediate succession. There was a significant difference in the performance of the groups in favor of the group having had the rest intervals.⁵

³Frederick W. Cozens, "A Comparative Study of Two Methods of Teaching Class Work in Track and Field Events," Research Quarterly, 2:75-79, December, 1931.

⁴Roland C. Travis, "The Effect of the Length of the Rest Period on Motor Learning," Journal of Psychology, 3:189-94, 1937.

⁵Robert B. Ammons, "Effect of Distribution of Practice on Rotary Pursuit 'Hits'," Journal of Experimental Psychology, 41:17-22, January, 1951.

In 1952 Kimble reported using rest intervals of ten seconds and seventy seconds between trials for two groups using the pursuit rotor over a period of ten days. The more spaced group, seventy-second interval, showed significant improvement in performance.⁶

Using the pursuit rotor, Adams in 1954 concluded that a longer rest period between trials or a more distributed practice session would produce a significantly higher level of performance. Adams used varying time lengths while working with five groups. Rest intervals varied as follows: zero, three, ten, twenty, and thirty seconds for one hundred fifty trials. The thirty-second rest interval group improved significantly in performance over the other groups. No recommendation was made concerning an optimal length of rest period.⁷

In 1950 Knapp and Dixon had two groups of thirty-five subjects, each learning a ball juggling task. It was reported that the group practicing five minutes per day learned the task more rapidly than the group practicing fifteen minutes every other day. There was a significant difference between the two means.⁸

Riopelle investigated the psychomotor learning of two groups of college male sophomores in terms of performance on the Vector Complex Reaction Time Test under the conditions of massed (N = 20) and distributed

⁶Gregory A. Kimble and Robert B. Shatel, "The Relationship Between Two Kinds of Inhibition and the Amount of Practice," Journal of Experimental Psychology, 44:355-59, November, 1952.

⁷Jack A. Adams, "Psychomotor Performance as a Function of Inter-trial Rest Intervals," Journal of Experimental Psychology, 48:131-33, August, 1954.

⁸Clyde G. Knapp and W. Robert Dixon, "Learning to Juggle: I. A Study to Determine the Effect of Two Different Distributions of Practice on Learning Efficiency," Research Quarterly, 21:331-36, October, 1950.

practice (N = 23). The massed group received forty trials in one day while the distributed practice group received four trials per day for ten days. The level of performance of the distributed practice group was consistently and significantly higher than that of the massed practice group, and the difference between the two groups increased as learning progressed.⁹

In 1964 Singer used forty subjects for practicing the novel skill of bouncing a basketball off the floor and into the basket under massed and distributed practice conditions. One group continuously attempted eighty shots at the basket while a second group paused five minutes and a third group rested twenty-four hours between each of four twenty-attempt trials. Subjects were tested immediately at the conclusion of practice, one day after, the following week, and one month later. Immediate acquisition of the skill was statistically significant (.01 level) under distributed practice (the twenty-four hour-rest group), and no significant differences between groups were found the next day and the following week. Ultimate retention of the skill, as measured by a test one month later, demonstrated the massed and relatively massed practice groups to be statistically more effective (.05 level) than the distributed practice group.¹⁰

Oxendine in 1964 had fifty-three college students practice the skill of mirror tracing on three different schedules in Group I each

⁹Arthur J. Riopelle, "Psychomotor Performance and Distribution of Practice," Journal of Experimental Psychology, 40:390-95, June, 1950.

¹⁰Robert N. Singer, "Massed and Distributed Practice Effects on the Acquisition and Retention of a Novel Basketball Skill," Research Quarterly, 36:68-77, March, 1965.

succeeding practice period increased in length. Group II practiced on a schedule in which each succeeding practice period became shorter. Group III used constant units of practice throughout the learning period. During the experimental period all groups completed the same amount of practice. At the end of the learning period, the group using constant practice units performed significantly better than the other two groups, followed in order by the increasing practice group and by the decreasing practice group. It was concluded that constant units of practice from day to day throughout the training period were superior to either the progressively increasing or progressively decreasing schedules used in this study.¹¹

In The Psychology of Learning, Garry states that the practice period should be short when new motor skills are being introduced for the first time and that the more complex the skill to be learned the more liberal should be the distribution of practice. The author further stated that massed practice was desirable when peak performance of a well-established skill was required.¹²

Cook reported in 1944 that massed practices were markedly superior to distributed practices throughout the investigation of subjects learning a series of mazes.¹³

¹¹Joseph B. Oxendine, "Effect of Progressively Changing Practice Schedules on the Learning of a Motor Skill," Research Quarterly, 36:307-15, October, 1965.

¹²Ralph Garry, The Psychology of Learning (Washington, D.C.: The Center for Applied Research in Education, Inc., 1963), p. 58.

¹³T. W. Cook, "Factors in Massed and Distributed Practice," Journal of Experimental Psychology, 34:325-33, September, 1944.

Hilgard and Smith had three groups of subjects, each practicing four daily twenty-five minute sessions on the Koerth pursuit rotor that were differentiated by the number of one-minute trials within each session. Scores at the end of each of the four daily sessions were very much alike in spite of the differences in amount of time spent in practice. The group with the most practice (massed) made the poorest score on the first day, though not significantly lower statistically. This would indicate an advantage to early distributed practice in learning a new motor skill and suggests a 'typical' course of improvement with time, achieved within wide variations in practice.¹⁴

Morris concluded that there were no significant differences among three patterns of distributed practice on skill achievement in the underhand volleyball serve. Retention tests also showed no significant differences among the groups.¹⁵

Stelmach examined the efficiency of two practice schedules on two large muscle motor tasks--the stabilometer and ladder climb. There were four groups of subjects (N = 160); each individual in a group performed on one of the two motor tasks under one of the two conditions. Distributed practice consisted of alternating thirty-second trials of practice and rest; massed practice was continuous for eight minutes. Comparisons made during the last minute of practice prior to the rest pause revealed that the massed groups had significant decrements in performance level. In

¹⁴E. R. Hilgard and M. B. Smith, "Distributed Practice in Motor Learning: Score Changes Within and Between Daily Sessions," Journal of Experimental Psychology, 30:136-46, February, 1942.

¹⁵Nancy Jane Morris, "Effectiveness of Distributed Practice on Underhand Volleyball Serve Skill Achievement and Retention," Unpublished Master's Thesis, 1967.

contrast, after the rest period when both groups were on a distributed schedule, no significant difference was found in the amount of learning. Learning was found to be a function of the number of trials and independent of the conditions of practice. With respect to efficiency, the basic consideration was that the two types of practice had exactly the same net time in actual physical performance on the task.¹⁶

SYNTHESIS OF RESEARCH ON PRACTICE DISTRIBUTION

Oxendine, in Psychology of Motor Learning, gave a synthesis of research on practice distribution stating the following generalizations:

1. Distributed practices are generally more efficient for learning and performance than are massed ones.
2. Relatively short practices (in time or in number of repetitions) make for more efficient learning than do longer practices.
3. Progressively decreasing the concentration of practice periods during the learning period seems advantageous.
4. Progressively decreasing the length of practice periods during the learning period appears to make learning more effective.
5. Proficiency which has been gained over a long period of time is retained better than that which is developed within a short period.
6. A high level of motivation enables one to benefit from longer and more concentrated practices than would be possible with a lesser degree of motivation.
7. Individuals or groups who are more competent in a particular activity can effectively practice that activity for longer periods than can persons or groups who are less competent. Similarly, older children are able to practice longer than younger ones.

¹⁶George E. Stelmach, "Efficiency of Motor Learning as a Function of Intertrial Rest," Research Quarterly, 40:198-202, March, 1969.

8. In physical education or sports activities, the number of repetitions or trials (shots, throws, dives, etc.) should be considered as the unit of practice rather than the time spent at the work session.
9. Some group activities can be practiced for a longer period than individual tasks because of the fewer trials that the person may have; i.e., he often has a rest period between his turns in a group activity.¹⁷

However, in reviewing literature Carron writes that for a number of reasons it was difficult to generalize from the results of the studies reported. First, a great majority of the studies concerned with these problems have used motor tasks which were continuous in nature (largely the pursuit rotor or similar tracking tasks). While a number of physical education tasks could be referred to as continuous, it would seem that in a great many 'real life' (nonlaboratory) tasks, the response consisted of a single discrete movement or a series of discrete movements. Before generalizing from the theoretical model to a practical situation, an investigator must determine whether these phenomena occur in tasks which were basically different from the pursuit tasks mentioned above. Even if all nonlaboratory motor skills were continuous in nature, generalization from the laboratory to the nonlaboratory situation would have been hazardous. The bulk of the experimental evidence leading to the development of the present theoretical model has, as stated above, been obtained almost exclusively from one motor task--the pursuit rotor.¹⁸

Stelmach writes that it was generally thought that distributive practice was more advantageous than massed practice. A review of the

¹⁷Oxendine, loc. cit.

¹⁸Albert V. Carron, "Performance and Learning in a Discrete Motor Task Under Massed and Distributed Practice," Research Quarterly, 40:481-89, October, 1969.

relevant literature reveals that there were several studies which suggest the opposite; namely, the possibility of massed practice being more effective for learning than distributed practice. In the past, several psychologists have investigated various work-rest practice schedules with a view to defining optimal conditions for motor learning. Unfortunately, most of the data had been obtained on the pursuit rotor, which is a highly specialized motor task and one thought to be very sensitive to work-rest ratios.¹⁹

LIMITING FACTORS RELATED TO GENERALIZATIONS BASED ON RESEARCH FINDINGS

The nature and complexity of the skill to be learned would make it difficult to apply generalizations to practical instructional situations. Although distributed practice schedules may be generally accepted as most desirable, the question of the length of the intervals between trials has not been determined. Another factor would be the nature of the individual involved since a specific practice schedule may not prove to be most efficient for a particular individual.

Richardson in 1971 made an analysis of psychomotor studies related to massed and distributed practice schedules and warned educators "against using current generalizations in educational textbooks to support the generic belief that distributed practice is superior to massed practice."²⁰

¹⁹Stelmach, loc. cit.

²⁰Peggy Ann Richardson, "An Analysis of Psychomotor Studies Related to Massed and Distributed Practice Schedules in Physical Education, Psychology, Business Education, and Music Education," Unpublished Doctoral Dissertation, 1971.

Richardson's statement would certainly indicate that much more research is needed in this area.

SUMMARY OF RELATED LITERATURE

The review of literature indicated that distributed practice schedules were best for learning motor skills.^{21, 22, 23, 24, 25, 26} One suggested an optimal spacing of practice schedules.²⁷ Three studies suggested that a distributed schedule was best during the early stages of learning a motor skill and that massed practices were preferred later.^{28, 29, 30}

One study indicated that distributed practice was preferred for learning, whereas retention was favored when the practices were massed.³¹ Another study suggested that constant practice scheduling was preferred over increasing and decreasing the spacing of the rest intervals during

²¹Cozens, loc. cit.

²²Travis, loc. cit.

²³Ammons, loc. cit.

²⁴Kimble and Shatel, loc. cit.

²⁵Knapp and Dixon, loc. cit.

²⁶Riopelle, loc. cit.

²⁷Travis, loc. cit.

²⁸Oxendine, loc. cit.

²⁹Garry, loc. cit.

³⁰Stelmach, loc. cit.

³¹Singer, loc. cit.

the practice sessions.³² A third study indicated that massed practice conditions were best,³³ while studies that combined massed and distributed and had different distributed schedules respectively showed no difference in the overall effect of the different time elements on the practice schedule.^{34, 35}

Oxendine offered several generalizations based on research that indicated distributed practice schedules were preferable.³⁶ Carron stated that it was very difficult to generalize because most research have been accomplished working with motor tasks that were continuous in nature.³⁷ Stelmach stated that it has generally been accepted that distributed practice has been more beneficial than massed practice. However, a review of literature reveals several studies which suggest the converse; namely, the possibility of massed practice being more effective than distributed practice.³⁸

Richardson warned educators against using the current generalizations to support the generic belief that distributed practice was superior to massed practice. This warning was based on an analysis of studies

³²Oxendine, loc. cit.

³³Cook, loc. cit.

³⁴Morris, loc. cit.

³⁵Stelmach, loc. cit.

³⁶Oxendine, loc. cit.

³⁷Carron, loc. cit.

³⁸Stelmach, loc. cit.

related to massed and distributed practice schedules in the fields of physical education, psychology, business education, and music education.³⁹

³⁹Richardson, loc. cit.

CHAPTER III

PROCEDURE

OVERVIEW

The purpose of the study was to investigate four practice schedules on acquiring ability in the tennis serve. A secondary purpose was to test the validity and reliability of a modification of Hewitt's Tennis Achievement Test used in the beginning tennis classes at Bob Jones University. The data was collected by testing sixty-three subjects' on four occasions over a ten week period of time. The pretest was given on the first day the subjects' had class. The mid-test and retest were given in consecutive class sessions during the fifth week. The post-test was given at the end of the tenth week, with the French-Scott Revision of the Dyer Backboard Test given the following class session. After the pretest, each group of subjects was taught the tennis serve in the same manner.

SELECTION OF SUBJECTS

The subjects were sixty-three freshmen and sophomore male students voluntarily enrolled in beginning tennis classes at Bob Jones University, Greenville, South Carolina, during the fall term of 1974. The subjects were divided into four groups by randomly assigning each one to a group, from the class list, prior to the pretest.

At the start of the study a pretest was given to the subjects to determine skill levels in serving. Those demonstrating a natural or acquired ability to serve on the pretest were not included in the study.

Each of the four experimental groups followed a different practice schedule for a period of ten weeks. Group A practiced one day per week, taking thirty serves with no rest between trials. Group B practiced two days per week, taking fifteen serves each day with no rest periods between trials. Group C practiced one day per week, taking thirty serves with a four-minute rest interval between each ten trials. Group D practiced two days per week, taking fifteen serves each day with a four-minute rest interval between each five trials.

TESTING EQUIPMENT

Dunlop Tennis Balls - Special balls that were pretested were used for each practice and testing session. Each ball that was utilized would bounce within three inches of the height of a new ball when dropped from a height of five feet onto a concrete floor.

Tennis Courts - The same regulation tennis courts were used throughout the study, with the markings for scoring the test permanently marked on each court. The court layout is shown in Figure 1.

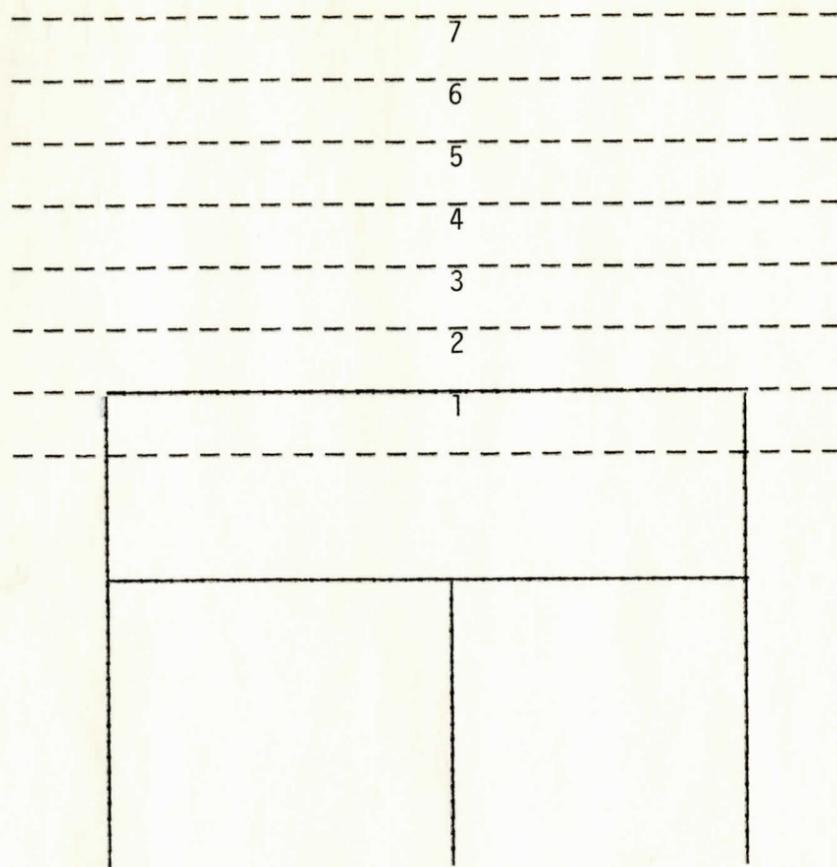


FIGURE I

COURT LAYOUT

Tennis Racket - Tennis rackets were provided by each subject.

Serving Test - The test used was the Bob Jones University modification of the serving part of Hewitt's Tennis Achievement Test.

PROCEDURE FOR TESTING SERVING ABILITY

Students taking part in the study were told not to practice the serve at all, except according to the schedule assigned. Thus, the students warmed-up on test days by bending and stretching exercises

for approximately 5 - 6 minutes. Just prior to the start of the test the subject went through the motions of serving.

Instructions to the subjects:

1. The subject must start behind the baseline.
2. The serve must be a proper serve from the correct court to the correct court as defined by the rules.
3. The subject will have 5 practice attempts. The subject may use these practice attempts in any combination desired for serves to the right service court and the left service court.
4. The subject will serve 20 balls for a score: 5 to the right, 5 to the left, 5 to the right, and 5 to the left.
5. Let serves will be repeated.

PROCEDURE FOR PRACTICE SESSIONS

Each of the two classes taking part in the study met for thirty-five minutes on Tuesdays and Thursdays. Thus, Groups A and C practiced only on Tuesdays while Groups B and D practiced on Tuesdays and Thursdays. Only bending and stretching exercises were used for warming up prior to each practice session. The warm-up period began when all subjects were present and lasted for 5 - 6 minutes. Each group of four subjects, practicing according to the same schedule, was assigned to a court. Each individual within the group practiced according to schedule, with court partners retrieving balls for him. On test days the individual's court partners not only retrieved balls but also scored the test and recorded the score.

After five weeks of practice the serving test was administered again to check the progress of subjects. Two days later the test was administered to test the reliability of the serving test itself. The test was administered at the conclusion of the ten-week study, at which time the final test scores were measured against scores on the French-Scott Revision of the Dyer Backboard Test to make a validity check on the serving test.

STATISTICAL ANALYSIS

The data collected was analyzed by use of the analysis of variance for repeated measures. The second analysis of data used a test and retest to establish the relationship that existed between the two sets of scores. The design was comparison of means utilizing a student t . Pearson Product Moment method of correlation was utilized to compute reliability and validity coefficients. The null hypothesis was tested at both the .05 and .01 level of significance.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

The first analysis of data utilized the four experimental groups to denote the degree of differences for the following comparisons: the means of each group; the degree of variance among the scores of each group; and the differences in standard deviations for each group. The design utilized was an analysis of variance for repeated measures.

The second analysis of data used test retest data to establish the difference that existed between the pretest and post-test scores. The design was comparison of means utilizing student t . The Pearson Product Moment method of correlation was utilized to compute reliability and validity coefficients for the tests utilized.

ANALYSIS OF DATA FOR THE COMPARISON OF THE TEST SCORES FOR THE FOUR EXPERIMENTAL GROUPS

The analysis of data indicated that there was not a significant difference among the four experimental groups. Table I reveals an F-ratio of .580 with 3 and 59 degrees of freedom.

TABLE I

ANALYSIS OF VARIANCE OF TENNIS SERVES OF 63 MALE STUDENTS IN FOUR EXPERIMENTAL GROUPS UTILIZING MASSED AND DISTRIBUTED PRACTICE SCHEDULES

Source	SS	df	MS	F	P
Treatment	173.869	3	57.956		
Within Conditions	5891.543	59	99.857	0.580	n.s.*
Total		62			

*An F ratio of 4.14 required for significance at .01 level of confidence.

ANALYSIS OF DATA FOR DIFFERENCE BETWEEN PRETEST AND POSTTEST SCORES FOR 63 MALE STUDENTS IN FOUR EXPERIMENTAL GROUPS

As shown in Table II, the difference between initial performance and final performance was significant for each group.

TABLE II

ANALYSIS OF DATA FOR COMPARISON BETWEEN PRETEST AND POSTTEST SCORES FOR 63 MALE STUDENTS IN FOUR EXPERIMENTAL GROUPS

Source	Means	DF	t-Ratio	P
Group A	13.8667	14	3.6933	.05*
Group B	15.6875	15	4.1120	.05**
Group C	13.5000	15	4.8257	.05**
Group D	11.8125	15	2.6167	.05**

*A T ratio of 2.16 required for significance at .05 level of confidence.

**A T ratio of 2.14 required for significance at .05 level of confidence.

CORRELATION BETWEEN INITIAL TEST AND RETEST SCORES FOR COMBINED EXPERIMENTAL GROUPS

The correlation coefficient for reliability between the initial test and retest scores was 0.60864 for the combined groups. Table III shows the significant correlation.

TABLE III

ESTIMATES OF RELIABILITY FOR BOB JONES UNIVERSITY
MODIFICATION OF HEWITT'S SERVING TEST FOR THE
COMBINED EXPERIMENTAL GROUPS

Variable		Correlation Coefficient	P
Initial Test	N 63 Mean 12.0476 S.D. 6.4669	0.608	.01*
Retest	N 63 Mean 13.2381 S.D. 5.7997		

*An F ratio of .325 required for significance at .01 level of confidence.

CORRELATION BETWEEN INITIAL TEST AND RETEST
SCORES FOR INDIVIDUAL EXPERIMENTAL GROUPS

The correlation coefficients for reliability between the initial test and retest scores for the individual groups can be found in Table IV. The correlations ranged from .920 to .454.

TABLE IV

ESTIMATES OF RELIABILITY FOR BOB JONES UNIVERSITY
MODIFICATION OF HEWITT'S SERVING TEST FOR THE
INDIVIDUAL EXPERIMENTAL GROUPS

Group	Variable	Initial Test	Retest	Correlation Coefficient	P
A	N	15	15	0.678	.01*
	M	12.8667	16.0667		
	SD	7.0495	6.9020		
B	N	16	16	0.454	.01*
	M	12.1875	12.0625		
	SD	5.6240	3.3560		
C	N	16	16	0.920	.01*
	M	10.0625	11.7500		
	SD	4.9728	6.6583		
D	N	16	16	0.460	.01*
	M	13.1250	13.2500		
	SD	7.9990	5.2090		

*An F ratio of .623 required for significance at .01 level of confidence.

** .497 at .05 level.

CORRELATION BETWEEN SUBJECTS' SCORES MADE ON BOB JONES UNIVERSITY'S
MODIFICATION OF HEWITT'S SERVING TEST AND SCORES MADE ON SCOTT-
FRENCH REVISION OF THE DYER BACKBOARD TEST

The validity coefficient for the relationship of the test used in this study and the French-Scott Test was found to be .4708, which was significant at the .01 level of confidence. Statistical information is given in Table V.

TABLE V

ANALYSIS OF DATA SHOWING CORRELATION BETWEEN SUBJECTS' SCORES MADE ON BOB JONES UNIVERSITY'S MODIFICATION OF HEWITT'S SERVING TEST AND SCORES MADE ON SCOTT-FRENCH REVISION OF THE DYER BACKBOARD TEST

Source		Source		P
Bob Jones University's Modification of Hewitt's Serving Test		French-Scott Test Scores		
N	63	N	63	
Mean	15.326	Mean	32.349	
SD	5.069	SD	7.382	
Correlation Coefficient = .4708				.01*

*For 61 df .4708 is significant at the .01 level of confidence (0.2948 was necessary for significance at the .05 level). The null hypothesis was tested at both the .05 and .01 level of significance.

CHAPTER V

SUMMARY, FINDINGS, DISCUSSION OF THE FINDINGS,
CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The primary purpose of the study was to make a comparison of the effectiveness of four practice schedules on learning the serve in tennis. A secondary purpose was to analyze the validity and reliability of the Bob Jones University modification of Hewitt's Tennis Serving Test used in beginning tennis classes at Bob Jones University. The subjects practiced according to four different time schedules as follows: Group A practiced one day per week, taking thirty serves with no rest between trials; Group B practiced two days per week, taking fifteen serves each day with no rest between trials; Group C practiced one day per week, taking thirty serves with a four-minute rest interval between each ten trials; Group D practiced two days per week, taking fifteen serves each day with a four-minute rest interval between each five trials.

The subjects were sixty-three freshmen and sophomore male students, voluntarily enrolled in beginning tennis classes at Bob Jones University, Greenville, South Carolina during the fall term of 1974. There were fifteen subjects in Group A and sixteen subjects in each of Groups B, C, and D.

The data collected were analyzed by use of the analysis of variance technique for repeated measures. The second analysis of data used test retest to establish the relationship that exists between two sets

of scores. The design was comparison of means utilizing a student t . Pearson Product Moment method of correlation was utilized to compute reliability and validity coefficients.

FINDINGS

The findings of this study were as follows:

1. There was no significant difference among the four experimental groups ability to learn the tennis serve.
2. There were significant gains in each of the experimental groups from pretest to post-test scores.
3. The reliability coefficient for the test used was found to be .608 for the combined groups. The reliability coefficient for the individual groups were as follows: Group A - .678; Group B - .45499; Group C - .92065; Group D - .460.
4. The validity coefficient for the test was found to be .4708 when the subjects' average scores were correlated with the scores made on the Scott-French Revision of the Dyer Backboard Test.

DISCUSSION OF THE FINDINGS

The findings related to the primary purpose of the study indicates that the researcher failed to reject the null hypothesis. There was found no statistically significant difference among these experimental groups following specific massed and distributed practice schedules. The preceding statement was made to emphasize this researcher's concern that all of the studies relating to massed and distributed practice schedules reviewed are to be viewed in a relatively narrow context. This was true because of differences in research designs, sampling

methods and numbers, work-rest ratios, purposes, and the continuous nature of the tasks often used in the studies. It appeared that the generalizations made by some researchers were based on conclusions drawn from studies that were relatively narrow in scope. The events related to this study would lead this researcher to believe that it was difficult to generalize from the results of studies reported and that though it is generally thought that distributed practice schedules are more efficient for learning, the converse was suggested by some studies. The events referred to involved the nature, motivation, cooperation, and personal schedules of the subjects.

Considering the nature of the subjects, Hull's theory of learning was pertinent. Hull stated that reactive inhibition was characterized by the inclination to avoid repeating a response which has just been performed, and the greater the amount of effort in the performance or the more often the performance, the greater was the hesitancy to repeat the act. This inhibition declined with the passage of time. Learning, therefore, was not a function of a given amount of practice but depended instead upon reinforcement (drive reduction). To be effective, practice must be under circumstances in which the learner had a physiological or psychological need.¹ Since this reactive inhibition was a 'tendency', then certainly it would not be present in the same degree with all the subjects in a study. Motivation and desire would also differ from subject to subject which would affect the seriousness with which the subject undertook the task at hand and the cooperation which would be given to

¹Joseph B. Oxendine, Psychology of Motor Learning (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968), p. 32.

the researcher. Finally, the schedules of the subjects participating in the study definitely affected the results. Among the limitations for this study was listed the fact that the researcher could not control the schedules of the subjects. Involvement in the learning of a motor skill would certainly be affected by differing work, study, rest, eating, and sleeping habits of the subjects.

The significant gains for each experimental group from pretest to post-test was expected. This indicated that instruction and practice, for beginning tennis students, brought about improvement and progress as one would seek to improve the performance of a particular motor skill. The degree of motivation undoubtedly varied greatly among the subjects but the incentive of a passing grade and earned quality points on the subject's scholastic record was common to all and would direct the subjects toward the greatest improvement. The subject's desire to learn the particular skill as a part of the development of skill for the game of tennis also might have provided incentive.

The test-retest method used to determine the reliability of the Bob Jones University Modification of Hewitt's Test produced a significant correlation coefficient for the combined groups. The coefficients for Groups A, B, and D were relatively low, the reason possibly could be attributed to those with a lower degree of motor ability being grouped together by chance. The practice schedule may have been a factor in these findings, or the variability could have been the result of inconsistent performance on the part of the subjects. Group C had a coefficient that was extremely high. There are three possible reasons for the reliability coefficient of Group C being much higher than the remaining groups: the relative massing of practice, i.e. thirty serves with a four-minute

rest interval between each ten serves, could produce a more efficient learning situation; the method of grouping subjects possibly combined subjects with a higher degree of general motor ability in the same group; the skill of serving in tennis, even among highly skilled players, innately produces variability in performance at different times. It was felt that the second and third reasons could account for the varying r with Group C. Those subjects grouped together in Group C possibly had a higher degree of general motor ability initially and perhaps could have had more consistent performance. General motor ability has been used to describe an individual's proficiency in a wide variety of fundamental skills and fitness activities. Clarke (1959), Fleishman (1964) and other authors have described the components of motor ability. It is these general traits that enable some individuals to acquire consistency in movements with relative effortlessness.

The validity coefficient for the comparison of the test used in this study with the Scott-French Revision of the Dyer Backboard Test was found to be .470 which was significant at the .01 level of confidence. The validity coefficient for the Scott-French test was .61 with a criterion of subjective ratings. Thus, the correlation of the average scores on the Bob Jones University Modification of Hewitt's Test with the Scott-French test indicated that these two tests measure the subjects' ability to serve and stroke the ball off a wall to the same degree. Research indicated a validity coefficient of .59 be attained for a test to be recommended for use in skill testing.²

²Harold M. Barrow and Rosemary McGee, A Practical Approach to Measurement in Physical Education (Philadelphia: Lea & Febiger, 1968), p. 42.

The findings of Morris and Stelmach were basically in agreement with the findings of this study which indicated no significant difference among four experimental groups using different practice schedules.^{3, 4} The other studies referred to indicated that either massed or distributed practice schedules produced superior performance. The explanation for the varied findings can be found in the nature of the task, the design of the study, and the experimental controls. The writer agreed with Stelmach, learning was related to the number of trials and was independent of practice conditions. Also, this researcher believed that the general motor abilities of an individual, incentives, and motivation were important factors in determining the effectiveness of an instructional program apart from all other considerations.

CONCLUSIONS

The following conclusions were drawn from the study:

1. The ability to learn the tennis serve does not depend on a particular practice schedule.
2. The nature of individual differences in subjects offset the effects of a specific practice schedule.

³Nancy Jane Morris, "Effectiveness of Distributed Practice on Underhand Volleyball Serve Skill Achievement and Retention," Unpublished Master's Thesis, 1967.

⁴George E. Stelmach, "Efficiency of Motor Learning as a Function of Intertrial Rest," Research Quarterly, 40:198-202, March, 1969.

RECOMMENDATIONS

The following recommendations have been proposed:

1. To conduct further research in the area of discrete movement, and a series of discrete movements.
2. To conduct studies that involve using actual sports skills for the purpose of providing practical and useful information.
3. To conduct studies that extend the research and limited findings of some researchers by involving larger numbers of subjects to determine if the results would be the same.

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APPENDICES

APPENDIX A

RAW SCORES FROM TESTS

Group A	Bob Jones University's Pretest	Modification of Mid-Test	Hewitt's Test Retest	Post-Test	Scott-French Backboard Test
S ₁	11	10	13	31	35
S ₂	6	6	16	13	35
S ₃	19	12	18	26	38
S ₄	9	6	10	18	31
S ₅	19	15	12	18	40
S ₆	11	13	25	30	30
S ₇	17	15	18	20	35
S ₈	23	26	27	35	39
S ₉	4	3	5	19	25
S ₁₀	5	24	25	38	33
S ₁₁	14	6	12	39	41
S ₁₂	9	21	9	33	21
S ₁₃	12	19	26	18	37
S ₁₄	24	8	11	33	22
S ₁₅	6	9	14	30	36

APPENDIX A (CONTINUED)

Group B	Pretest	Mid-Test	Retest	Post-Test	Backboard Test
S ₁	12	11	11	29	39
S ₂	6	10	12	33	34
S ₃	25	15	17	30	36
S ₄	4	3	7	29	38
S ₅	10	4	9	34	39
S ₆	12	15	12	39	32
S ₇	10	15	15	37	28
S ₈	5	10	16	30	27
S ₉	8	13	17	40	40
S ₁₀	13	28	14	22	32
S ₁₁	6	14	16	15	27
S ₁₂	4	14	9	35	37
S ₁₃	9	12	7	31	28
S ₁₄	5	11	10	10	15
S ₁₅	21	15	13	35	31
S ₁₆	4	10	16	24	34

APPENDIX A (CONTINUED)

Group C	Pretest	Mid-Test	Retest	Post-Test	Backboard Test
S ₁	20	11	13	35	42
S ₂	5	7	6	17	20
S ₃	8	5	3	19	30
S ₄	8	13	14	23	31
S ₅	8	17	19	31	31
S ₆	6	8	11	28	23
S ₇	24	19	21	11	39
S ₈	2	2	4	7	26
S ₉	16	12	14	39	37
S ₁₀	14	11	16	29	30
S ₁₁	7	10	7	30	32
S ₁₂	8	17	21	21	36
S ₁₃	5	5	12	12	6
S ₁₄	17	17	22	32	29
S ₁₅	5	5	7	9	20
S ₁₆	16	6	11	25	26

APPENDIX E

MEANS AND STANDARD DEVIATIONS FOR THE PRETEST AND POSTTEST

Source		Pre-Test	Variable	Post-Test
Group A	M	12.600		26.733
	SD	6.501		8.396
Group B	M	9.688		27.875
	SD	6.074		8.253
Group C	M	10.563		23.563
	SD	6.366		10.494
Group D	M	10.000		24.938
	SD	8.157		12.195

VITA

Ronald F. Felts was born September 13, 1936, East Portsmouth, Ohio. The author received the Bachelor of Religious Education degree from Piedmont Bible College, Winston-Salem, North Carolina, in 1960.

As a minister the writer established the Pequannock Valley Baptist Church in Pompton Plains, New Jersey, in 1961 and was its pastor for four and one-half years. The writer was pastor of the Montvale Baptist Church, Montvale, Virginia, during 1965 and 1966 before going to Bob Jones University as a Bible teacher.

While teaching at Bob Jones University, Greenville, South Carolina, the author was given an opportunity to teach physical education part-time. This teaching sparked an interest that led into a professional training program in physical education. Most of the author's undergraduate training was at Bob Jones University, but the final six courses were taken at Appalachian State University in the summer of 1972.

Mr. Felts has taught for nine years at Bob Jones University, the last five of which were full-time in the field of physical education. The writer is a member of the National Intercollegiate Soccer Officials Association, a member and officer of the South Carolina Intercollegiate Soccer Officials Association, the South Carolina Soccer Coaches Association, and the International Federation of Amateur Softball Association Umpires and has a background of officiating soccer, basketball, and softball.

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