THE EFFECT OF TWO SPECIFIC PRACTICE ENVIRONMENTS ON THE FOREHAND AND BACKHAND BALL PLACEMENT ABILITY OF BEGINNING TENNIS PLAYERS

by

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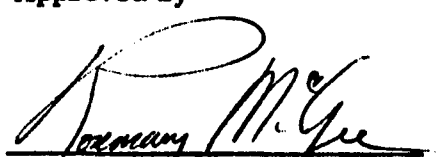
A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Greensboro
1975

Approved by



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October 9, 1975
Date of Acceptance by Committee

ROBERTS, BETTY RUTH. The Effects of Two Specific Practice Environments on the Forehand and Backhand Ball Placement Ability of Beginning Tennis Players. (1975) Directed by: Dr. Rosemary McGee. Pp. 89.

It was the purpose of this study to determine the effects of two practice environments on the forehand and backhand ball placement ability of beginning tennis players. The subjects were 32 female students enrolled at Stonewall Jackson High School. They were divided into two groups.

During the first 3 days of the study three tennis skills tests were administered: the Shepard Modification of the Broer-Miller Tennis Drive Skills Test, the Hewitt Revision of the Dyer Backboard Test and a Stationary Test which was a modification of the Broer-Miller Tennis Drive Skills Test. The subjects then received 2 days of instruction on the forehand and backhand strokes. Following the instruction, Group I practiced 12 days in a stable environment; Group II practiced 12 days in an unstable practice environment. Ball-Boy machines were used in both environments. The same three skills tests were then re-administered.

The null hypothesis of the study stated that there will be no significant differences in the final forehand and backhand ball placement ability of beginning tennis players who experience an unstable practice environment in which balls vary in trajectory, speed and direction and those who experience a more stable practice environment in which balls are more consistent in trajectory, speed and direction. Analysis of variance techniques were used to examine the posttest scores on each skills test. No significant differences were disclosed between the two groups on any of the tests, thus the null hypothesis was accepted.

Three sub-questions were also investigated in the study. Sub-question one attempted to determine whether either environment tended to develop more skill in the forehand than the backhand or vice versa. An analysis of variance design was used to analyze the data on the Stationary and Shepard Tests. The findings disclosed that neither practice environment developed more skill in the forehand than the backhand or vice versa.

Sub-question two attempted to identify the ball placement ability of players experiencing the unstable environment. A t test for significance of the difference between two means for related samples was computed on each skills test, utilizing pre- and posttest total scores. Significant improvement occurred on the Shepard Test.

In order to determine in which of the four scoring areas of the Shepard Test the improvement had occurred, a t test for significance of the difference between pre- and posttest scores was calculated for each area. Significant improvements occurred in areas two and four.

Sub-question three attempted to identify the ball placement ability of players experiencing the stable environment. A t test for significance of the difference between two means for related samples was computed on each skills test, utilizing pre- and posttest total scores. Significant t ratios were discovered on the Stationary and Shepard Tests.

In order to determine in which of the four scoring areas of the Shepard and Stationary Tests the improvement had taken place, a t test for significance of the difference between pre- and posttest scores was calculated for each scoring

area in each test. A significant difference occurred in area six on the Shepard Test; no significant differences were found on the Stationary Test.

Within the limitations of the study, it was concluded that there were no significant differences in ball placement ability of players experiencing the unstable environment and those experiencing the more stable environment. Neither environment developed more skill in the forehand than the backhand or vice versa. Players in the unstable practice environment made significant improvement on the Shepard Test; players in the stable practice environment made significant improvement on the Shepard and Stationary Tests.

Dedicated to

Mom, Dad, Lois, Suzanne and Curly

ACKNOWLEDGEMENTS

The writer wishes to express her sincere appreciation to Dr. Rosemary McGee for her guidance, patience and understanding throughout this study.

Appreciation is also extended to Miss Beverley Conklin for her interest and invaluable assistance.

To the students at Stonewall Jackson High School who so eagerly participated in the study, the writer wishes to express her gratitude.

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CHAPTER I

INTRODUCTION

Physical educators have been interested for some time in how individuals learn the movements required in various sports and dance. One primary aim of the physical educator is to help the individual move effectively and efficiently in order to accomplish certain tasks.

Gentile (1972) suggested two important tasks a teacher must perform when teaching the early stages of a motor skill. These were to (1) create a specific environmental problem and (2) establish an adequate motivational level. She further stated that there seems to be no exact teacher-specification of how an individual is made aware of the specific movements he must acquire in order to match the environmental demands of the sport he is attempting to learn. The decision about whether the learner's structured environmental conditions should be simplified or whether the stimuli should be exaggerated presently rests with the teacher as the sole judge. Some conditions may be advantageous to the learner, while other conditions may hamper the individual if he is then placed in another environment which varies slightly from the regulatory learning environment.

Many movement tasks have been taught to individuals through an inductive process. This process consists of isolating particular skills from the sport and then requiring students to practice these movements, under certain environmental conditions, until they have been mastered to some extent. An instructor

who advocates this procedure of teaching motor skills will place the student in the constantly changing environmental condition of the sport very late in the instructional process.

More recently, however, physical educators are beginning to question the value of this process. Robb (1972) has suggested that the learning condition in which stereotyped movements are isolated and repeated over and over again could possibly produce a rather fixed movement pattern which could hinder the player once he confronts the actual environment of the sport. Perhaps the learning environment should be a simulation or microcosm of the game itself, providing the beginner with an opportunity to anticipate, adjust and adapt his body movements in much the same way he will as he enters the playing environment of the sport.

It seems, therefore, that the question of how a person learns the movements effectively and efficiently for sports participation remains unanswered. Gentile (1972) suggests the need for research which would attempt to identify the structure the learning environment should possess in order to best benefit the individual involved in the motor learning process.

This study attempted to examine the forehand and backhand ball placement ability of beginning tennis players who experienced different practice environments. It further endeavored to determine whether either environment was more advantageous than the other in achieving accuracy in the two ground strokes.

Statement of the Problem

The purpose of this study was to determine the effects of two practice environments on the forehand and backhand ball placement ability of beginning tennis players.

More specifically, the investigation attempted to answer the following questions:

1. Does either practice environment tend to develop more skill in the forehand than the backhand or vice versa?
2. What is the forehand and backhand ball placement ability of beginning players who experience a practice environment of constantly changing conditions, consisting primarily of stroking oncoming tennis balls of irregular speed, distance, trajectory and direction, as provided by two Ball-Boy teaching machines?
3. What is the forehand and backhand ball placement ability of beginning players who experience a practice environment of somewhat stable conditions, consisting primarily of stroking oncoming tennis balls of constant speed, trajectory, distance and direction, as provided by the Ball-Boy teaching machine?

Hypothesis for the Study

This study tested the null hypothesis that there will be no significant differences in the final forehand and backhand ball placement ability of beginning tennis players who experience an unstable practice environment in which balls vary in trajectory, speed and direction and those who experience a

more stable practice environment in which balls are more consistent in trajectory, speed and direction.

Definitions of Terms

The following definitions were used for this study:

Ball-Boy Machine. An electric machine, utilized as a teaching device, that automatically projects a tennis ball at a pre-determined force and trajectory every 5 seconds.

Ball Placement Ability. The ability of the player to hit the forehand and backhand strokes across the center net and within the doubles boundary lines of the opposing court.

Base or Ready Position. A position directly behind the center mark on the tennis court and within one foot to either the right, left, or back of it.

Beginning Tennis Player. A person who had not had previous playing experience nor formal instruction in the game.

Closed Skill. A movement skill in which the performer builds and executes a pattern of movement under relatively fixed environmental conditions and continues to practice it until it virtually becomes a habit (Poulton 1957; Singer 1968; Gentile 1972).

Open Skill. A movement skill performed under conditions where the relevant stimulus events are changing and the environmental events are somewhat unpredictable (Poulton 1957; Singer 1968; Gentile 1972).

Stable Practice Environment. A practice environment in which the subject was limited to approximately one step during the stroking of a tennis ball. The balls in this practice environment were constant in speed, distance, trajectory and direction, as projected from a single Ball-Boy machine.

Unstable Practice Environment. A practice environment in which the subject was free to move as many steps in any direction as needed during the stroking of a tennis ball. The balls in this practice environment were constantly changing speed, direction, trajectory and direction, as projected from either of two Ball-Boy machines.

Scope of the Study

The subjects for this study were limited to 32 high school female volunteers, enrolled in physical education classes at Stonewall Jackson High School, Charleston, West Virginia, during the 1973-74 academic year. The study was limited to subjects who had neither played tennis nor received formal instruction in the game.

The subjects received only two periods of mass tennis instruction. Following the mass instruction, each subject had 12 practice sessions on the tennis courts. The subjects hit 24 balls from the Ball-Boy machine(s) on each of the 12 days. No verbal feedback as to the success or failure of the subject's

stroking ability was given by the class instructor during the practice sessions or any time thereafter.

The measurement of the player's ball placement ability was limited to the administration of the Shepard (1972) Modification of the Broer-Miller (1950) Tennis Drive Skills Test, the Hewitt (1968) Revision of the Dyer (1938) Backboard Test and a Stationary Tennis Test which was a slight modification of the Broer-Miller (1950) Tennis Drive Skills Test.

Significance of the Study

The research studies on tennis skill acquisition disclose various views concerning the structure of the practice environment and steps of progression for the beginning player. The studies reveal that opinions differ in regard to whether tennis skills should be considered "closed" skills or "open" skills. It seems appropriate at this point, with the availability of Ball-Boy machines, to study how practice environments can best be structured in order to produce a beginning tennis player with as much accuracy as possible in forehand and backhand ball placement ability.

Singer (1972) indicated that the use of mechanical teaching aids during practice sessions, in an effort to promote better sports skill performance, has not been thoroughly investigated at the present time. There is lack of evidence as to whether these aids are beneficial in developing skills more quickly than the traditional methods of practice.

One of the main values of this study was to provide information about two specifically structured practice environments and to determine the value

each may have in developing a beginning tennis player with as much accuracy as possible in the forehand and backhand strokes.

Assumptions

1. If the subject indicated that she had not had previous tennis experience or instruction, she truly had not.
2. If the subject was asked not to practice or play tennis outside of the practice session, she did not.
3. The Ball-Boy machine produced a steady stream of precisely duplicated balls with proper settings on the machine.

CHAPTER II

REVIEW OF LITERATURE

Researchers have dealt with motor skill acquisition in a wide variety of tasks and under a number of varying conditions. Pertinent to this study are four areas of the literature: gross motor skills, gross motor skills and environmental structure, the learning of tennis skills and practice conditions.

Gross Motor Skills

The dimensions of motor skill acquisition were merely being defined and explored between 1890 and 1927. A survey of the early literature on motor skill acquisition discloses that the majority of the research dealt primarily with laboratory tasks. The rotary pursuit apparatus was quite popular, along with mirror tracers and stabilometers. Motor tasks, whereby one movement was superimposed upon another were so complex that few studies dealt with such dynamic situations as found in the pools, gymnasiums, or on the playing fields (Sage, 1971).

Several theoretical formulations about how motor skills were acquired began to appear between 1927 and 1945. At the same time, the experimental work being conducted in the area was gaining in sophistication. Seashore (1942) was among the first to distinguish between the meaning of gross and fine motor skills. He defined a gross skill as "neuromuscular coordinations which involve vigorous contractions of large muscles and usually movement of the whole body (p. 259)."

This definition was somewhat different from the one used to describe the fine motor skill. The fine skill had been referred to, many times in the past, as eye-hand coordination. It involved neuromuscular coordinations, but the skill was usually precision-oriented with certain segments of the body being moved within a limited area in order to accomplish the designed task (Singer, 1968).

One of the first widely recognized studies dealing with the acquisition of fine and gross motor skills was conducted by Poulton in 1957. He produced a new classification of skills which was based primarily upon the environmental conditions surrounding the performer as he attempts to accomplish a particular movement task. One group of skills he classified as "open" skills, while the second group was termed "closed" skills. Open skills, according to Poulton, demand a great deal of anticipation and require the individual to adjust his movements according to the unpredictable events which are occurring within the time and space of his environment. Closed skills, on the other hand, require a somewhat stereotyped movement pattern, for they are generally performed in an environment which is relatively stable.

The skill classification by Poulton prompted considerable interest among physical educators who were trying to decide which sports should be included in each of the two skill categories. Just recently Robb (1972) identified tennis, basketball, softball and volleyball as examples of sports requiring the use of open skills, while gymnastics, diving, free-throw shooting and golf were examples of sports requiring the closed skills.

Other authors studied Poulton's work and presented additional information related to environmental conditions and how these could influence the sports skill classification. Gentile (1972), Burke (1972), Lawther (1972) and Spaeth (1972) concluded that in open skills the movement is regulated primarily by the external situations within the environment and that these skills will never be repeated in exactly the same manner as the performer executed them in previous events. The stereotyped movement pattern, however, is essential in sports utilizing the closed skills because in these skills the performer attempts to "groove" a movement pattern which can later be repeated over and over again within a limited environmental setting.

Higgins and Spaeth (1974), using a dart-throwing task, evaluated the diversity and consistency of individual movement patterns during both a stationary and moving target condition. They found that open skill performers moved with a diversity of movement patterns in accordance with the environmental condition. The closed skill performers, however, used consistency throughout their patterns of movement, regardless of the environmental condition. This substantiated an earlier study by Bartlett (1948) in which he found the open skill performer formed judgments, made decisions and responded in a variety of ways in terms of his environment as contrasted to the closed skill performer.

Knapp (1963) concluded that the two categories of skills, as developed by Poulton, were far too restrictive. As a result, she developed a continuum of motor skills. She proposed that some sports contain both open and closed skills and that the skill requirements of a particular sport must be examined in order

to develop the most effective teaching strategies for that sport. If it is necessary for the performer to monitor information from the environment for the purposes of triggering off a movement, she considered the skill an open one. She classified the movement itself, however, a closed skill (Whiting, 1972).

Fitts (1964) disclosed further information which he felt had direct implications for the teaching of motor skills. He identified three complexity levels of skill through which a learner usually proceeds when accomplishing a motor task. The three phases were: (1) the cognitive phase, defined as the learner's awareness of the goals to be achieved in the task; (2) the associative phase, concerned with the elimination of extraneous movements by the learner while he becomes efficient in the overall integration of the skill; and (3) the autonomous phase, whereby the learner begins to direct his attention to strategy, for he no longer has to think about the component processes of the skill itself.

Further work by Fitts (1965) produced a taxonomy of motor skills, based on the degree of difficulty involved in a specific movement task. He proposed three levels of motor skill difficulty. In a Level I motor task, he stated that both the performer and the object involved in the skill are stationary prior to the movement. A Level II task was described as one in which either the performer or the object is moving during the task. In the Level III task, movement occurs by both the performer and the object. The taxonomy was centered around the degree of body involvement and the extent of the external influences during the task. Many questions about the various levels and tasks were never answered due to the inability of Fitts to complete the taxonomy. The influence of the angle

of the moving object, its speed, its spin and flight, were among the factors yet to be disclosed.

Researchers later began to investigate whether the open type skills, such as found in tennis or badminton, should be taught first as closed skills and then as open skills or whether they should be taught as open skills right from the beginning. Whiting (1969) questioned the value of specific procedures being employed during sports instruction, such as the practice of a tennis stroke against a backboard. He suggested that possibly such practices are useful in "grooving" the stroke, but it became questionable whether the ball coming off the backboard gives similar information to the one which would be encountered in the game of tennis. In such practices, Whiting suggested that players may be learning inappropriate response patterns for use in game play. He stated that a decision must be made as to why such practices are being employed by the instructor.

Spaeth (1972) supported the views of Whiting stating, "If a field hockey player demonstrates "ideal form" in regard to stickwork and cannot react successfully to both teammates and opposition during the game, he is not a successful player in terms of the goal of the game (p. 339)."

Higgins (1972) and Del Rey (1972) agreed that if open skill performance requires diversified movements, then traditional attempts to consistently exhibit a single ideal movement are not only erroneous, but could be detrimental to open skill performance. If an open skill were to be taught as a closed skill first, the instructor's aim would be to groove the strokes involved in the game, keep the environmental stimuli as constant as possible and then hope these skills

would transfer to the open skill situation (Marteniuk, 1972).

Locke (1972) concluded that the issue of correct form may be a "straw man" since there is lack of evidence to indicate that teachers require students to practice open skills under closed skill conditions. According to Locke, there is no evidence that controlling environmental sources of uncertainty will affect the amount of learning during the initial stages of learning a motor skill. He stated that there has only been speculation in terms of the value of environmental control.

Gross Motor Skills and Environmental Structure

An attempt was made to explore the research disclosing how an environment could be structured for the learner to acquire a repertoire of motor patterns matching the total number of possible stimulus subsets found within the environment of a particular sport. Few studies were found which disclosed this information either directly or indirectly.

Turvey (1964) created two room environments and studied their effect on warmup performances on a stabilometer task. His pauperized room consisted of bare walls plus the apparatus for testing. He then created a room displaying bright pictures, colored paper and numerous objects. He theorized that visual receptors would fail to adequately receive and adjust to the environmental change and a decrement would occur in the warm-up scores following a change in practice rooms. The observed differences in the scores following a room change did not prove to be significant.

Harris (1966) investigated the performance of college women using a novel ball-catching skill against two different backgrounds. One background was solid in color; the other was filled with images similar in size to the ball involved. She found no significant difference in the learning speed under the two conditions but there was a significant difference in the catching performance when the skill was executed in front of the solid background.

Mott (1969) studied the effects of four environmental conditions on the throwing performance of college women. The investigation was concerned with the influence of the amount of enclosure surrounding a target and the individual's ability to achieve accuracy and distance. The study disclosed no significant differences in the accuracy performance scores under four conditions. On the distance factor, however, longer throws were made at those targets having backs to them.

In the few studies found, closed type skills were utilized more than the open type skills. As Spaeth (1972) indicated, "relatively little investigation has been done in the area of open skills and the challenge of developing appropriate instruction, methodology and laboratory tasks remains (p. 358)."

The Learning of Tennis Skills

An investigation of the literature dealing specifically with the sport of tennis reflects controversial views as to whether the skills used in the sport should be classified and taught as open skills or closed skills. Driver (1956) defined accommodation as "certain adjustments in stroking, which are contrary to orthodox form, but are necessitated by the emergency of the player's

situation" (p. 36.)" Driver did not encourage accommodation by the beginning player due to its necessity for peculiar methods of stroking which are far from the prescribed form she suggests. Accommodation, according to Driver, should be reserved for advanced players who know when and where to use it.

Barta (1964) suggested that beginners be given instruction in a confined area and that basic strokes be developed before going to the tennis court situation. She advocated the use of technological devices which will produce precise, duplicated balls which will quickly develop the student's hitting skill. Later Barta (1972) stated that basic skills must be perfected before one can apply them in a game situation.

Kraft (1963) advocated "grooving" the strokes, but goes so far as to indicate that during practice the balls should land specifically to the front and side of the player, without too much spin. According to Kraft, the balls should be received in such a manner that the individual will meet success during the practice session. Xanthos (1968) further supported this view by stating that the individual should be free from the problem of timing his moves as he practices certain strokes.

In contrast to these tennis specialists, some motor learning authors have taken opposing views about how one best obtains a motor skill. Lawther (1968), supporting the views of Wolfle (1951), proposed that a performer needs practice in a variety of situations in order to generalize a skill so that an automatic performance results, in spite of varying environmental cues. Lawther stated that the real test of a skill came when the individual uses what has been

learned, when it is needed, and in the appropriate situation. "The importance of early experiencing of the motor act in the game for which it was developed is apparent (p. 97)."

Cratty (1973), although referring to skilled athletes rather than beginning players, stated that drills in a sport should contain, if possible, the exact components of the event or skills to be improved. The drills, according to Cratty, should include those things the athlete sees and hears in the competitive situation, as well as the duplication of the movements involved in the competition.

Bach (1958) and Howell (1958) expressed similar views in regard to basketball skills in particular. Gagne and Foster (1949) stated that the learning of motor tasks is largely a matter of learning perceptual relationships, perceiving appropriate cues and responding to those cues with increasing speed and accuracy.

Loree (1965) emphasized that initial instruction and practice is particularly important because auditory and visual cues guide the responses during the early stages of learning. Crow (1969), however, disclosed the results of his study which were opposite to the view of Loree. Crow used beginning, intermediate and advanced tennis players to determine the relationship between skill and the ability to spatially orient oneself to a moving object. Subjects were asked to judge the flight of a ball and to move to a position where they expected the ball to bounce. The study showed no significant differences among the three skill levels in their ability to judge the moving object.

Solley (1952) noted that often in physical education there tends to be instruction whereby speed of a skill is retarded until a reasonable degree of accuracy has been obtained. He reported that subjects learning a skill in which initial speed and accuracy were stressed, transferred these skills more readily into the final performance environment than did those subjects who had practiced with one of the two variables controlled. Those subjects who practiced with speed controlled had far more problems in the transition of the skills into the final performance environment than did the remaining subjects.

Woods (1967) investigated the effects of teaching tennis with instructional emphasis either on speed followed by accuracy, accuracy followed by speed, or equal emphasis on both speed and accuracy. The most desirable results were obtained by those receiving equal and simultaneous emphasis on both velocity and accuracy. The least desirable results were obtained by those subjects receiving initial emphasis on accuracy followed by velocity. Singer (1972) compiled the research efforts over the years on the topic and concluded that skills should be initially practiced at regular speed, without regard for accuracy. The research evidence suggested that accuracy will eventually become part of the pattern of execution.

Fulton (1942, 1945) stated that movements such as hammer throws, golf strokes and tennis strokes, where the accumulation of momentum was essential for an effective performance, would be adversely affected by an early emphasis on accuracy. These research studies and others indicate that views vary on how one should initially practice sport skills and other motor tasks.

Practice Conditions

Since practice is so important to the learning of motor skills, a survey was made of the literature to examine the different types of practice that have been utilized in learning physical education activities. The survey disclosed that the majority of the research has dealt with two main areas: (1) the effects of mental practice and (2) the effects of massed versus distributed practice schedules. As this study was not concerned with either of those two factors, attention was directed only to those studies in which the effects of different practice conditions were examined.

Maaske (1960), Sell (1963), Minahan (1963), Kite (1964) and Fisk (1967) studied the success of learning basketball skills through practice conditions in which the rim size of the basketball goal varied somewhat. Maaske disclosed that those subjects who practiced at goals smaller than the regulation size were successful, during game competition, on 43.4% of their field goal attempts. Those who had practiced at the official size goals were successful on only 31.3% of their field goal attempts. Similar results were reported by Sells who stated that subjects utilizing the official size goal hit 32.3% of their shots as opposed to a 36.4% success by those subjects practicing at the smaller rim. Minahan, Fisk and Kite discovered no significant differences among subjects practicing with varying goal sizes.

Gephart (1954) and Barrette (1969) studied the effects of practice conditions in which the subjects were either blindfolded or sighted. The skill used in these studies was the basketball free-throw. Gephart found, after 6 weeks of

practice, that the blindfolded group had improved significantly more than the sighted group. Barrette found no significant differences between the sighted and non-sighted groups. Griffith (1931) studied the effects of practicing the golf swing while blindfolded as opposed to sighted practice. He found that the blindfolded group improved more than the group with sighted practice.

Chui (1965) investigated the effects of two practice conditions when learning the game of golf. One group of subjects practiced on a simulated golf course, called Golf-O-Tron, in which regulation golf balls and clubs were used. The other group of subjects practiced the conventional way, hitting whiffle balls, practicing particular shots, etc. The performance scores of the two groups indicated very little difference as a result of the varying practice conditions.

Solley and Borders (1965) examined two practice conditions used to develop the forehand stroke in tennis. One practice condition consisted of practicing by the traditional method, which was merely going to the court to practice after the instructor had analyzed and demonstrated the stroke. The second group of subjects followed the same practice procedure for the first few class meetings but then switched to the Ball-Boy machine for all practice sessions the remainder of the instructional period. The subjects in group two hit 20 balls per class period. The results of the study indicated a significant difference between the two groups. The scores for the subjects utilizing the Ball-Boy machine were significantly higher than the scores received by the subjects in the traditional group. The consensus was that the Ball-Boy machine was a valuable aid to the teaching of the forehand stroke.

Brose (1964) investigated three methods of practice to develop skill in baseball-throwing. Subjects were involved with one of the following practice conditions: (1) practicing with leaded baseballs, (2) practicing with regular baseballs, or (3) practicing on a wall pulley with 10 pounds of resistance daily. The three groups showed no significant differences in baseball-throwing ability as a result of the three practice conditions.

Roberts (1966) studied the effects of a particular practice technique on the golf swing. One group of subjects practiced with regular golf balls. The second group of subjects practiced with large, white sponge balls the first six class periods and then switched to practice with the regular golf balls. Although the large balls seemed more advantageous for the wood shots, the groups were not significantly different at the conclusion of the study.

Many experimental studies have been conducted regarding practice conditions. These studies, however, have dealt with practice utilizing different types of equipment, practice whereby the order of skills varied, or practice where distances have varied as in archery practice. The writer found no studies dealing specifically with the structuring of the environment for the practice of skills.

CHAPTER III

PROCEDURES

It was the purpose of this study to determine the effects of two practice environments on the forehand and backhand ball placement ability of beginning tennis players. The procedures for collecting data involved the following steps: (1) selection of subjects; (2) selection of tests; (3) description of tests; (4) administration of tests; (5) instructional program; (6) practice sessions and (7) treatment of data.

Selection of Subjects

Thirty-two female students were randomly selected from four physical education classes at Stonewall Jackson High School, Charleston, West Virginia, during the spring of 1974. These subjects had no previous formal instruction or experience in the game of tennis. Students who volunteered as subjects for the study were asked to sign a paper which was circulated within each class. The writer found that only a limited number of those who volunteered could be used in the study due to the amount of class time and the mechanical set-up required for the Ball-Boy machines. The investigator, therefore, selected the first nine names from each of the circulated papers and these individuals became subjects for the study. Four subjects were eventually dropped from the study for various personal reasons; 32 subjects completed the study.

Any attempt to assign randomly the subjects to the experimental groups was unsuccessful because they could not change physical education periods. Randomization within a class was impossible; the two experimental conditions could not be applied within one class period time due to the time factor and the mechanical set-up of the equipment.

Subjects selected from the 9:00 to 9:50 a.m. class and those from the 10:00 to 10:50 a.m. class formed Group I for the study. Those selected from the 1:00 to 1:50 p.m. class and the 2:00 to 2:50 p.m. class formed Group II. Subjects included both right and left-handed players.

Selection of Tests

A review of the tennis literature disclosed several tests for evaluating the beginner's tennis skill. Several factors were considered in the selection of the tests to be used. These factors included the specific objectives of the study, the validity and reliability of the tests, as well as the availability of facilities and equipment for administering the tests.

The Hewitt (1968) Revision of the Dyer (1938) Backboard Tennis Test was chosen for the study because of its quick evaluation of the player's general tennis ability. The validity of the test was determined by comparing the rank order of playing ability, as a result of a round robin tournament, with the scores on the skill test. The validity coefficients for the test were .68 through .73 for the beginning players. The reliability of the test was computed by the test-retest method and the results disclosed a coefficient of .82 for beginning players.

The Shepard (1972) Modification of the Broer-Miller (1950) Tennis Drive Skills Test was selected because it was one of the few skills test designed to evaluate a player's ability to stroke an oncoming tennis ball. Since the strokes during a game are made in regard to an approaching ball, this test seemed most appropriate for the study. Shepard disclosed discriminatory validity of this test as a result of differentiation between beginners, intermediates and advanced skill level groups beyond the .001 level of confidence. The reliability for the total test was reported to be .91 and the correlation coefficient for the sums of the odd and even-numbered trials was .84.

Secondary to the two standard skills tests, a modification of the Broer-Miller (1950) Tennis Drive Skills Test was used to gain further information about the beginning players in this study. No reliability or validity coefficients were established for the test. It was designed to provide information regarding the player's ability to remain in a stationary position and stroke an oncoming tennis ball. The writer felt this information possibly could provide additional insight to the problem being investigated.

Description of Tests

Hewitt Revision of the Dyer Backboard Tennis Test

A wooden gymnasium divider served as a backboard for the administration of this test. One inch masking tape was used to designate an area on the wall 20 feet wide and 20 feet high. On the gymnasium floor, 20 feet from the wall, a restraining line of 20 feet was marked. The divider was equipped with a

painted line 3 feet above the floor, the same height as a regulation tennis net at the center. Figure 1 illustrates the testing area.

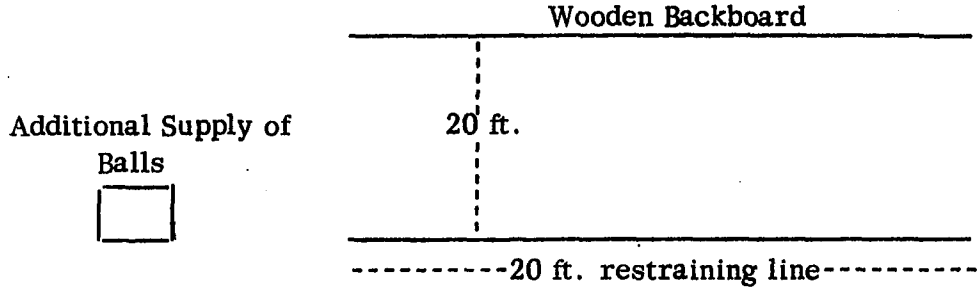

Figure 1. Testing Area for the Hewitt Revision of the Dyer Backboard Test

To begin the test, the subject stood behind the restraining line with a racket and two balls. The object of the test was to serve one of the two balls, using any type of serve and rally the ball against the wall as many times as possible within a 30-second time period. The time for a specific trial began when the first ball contacted the wall above the 3-foot mark. Any type of stroke could be used in order to score the most hits possible. To score a legal hit, the ball had to land on or above the 3-foot mark on the wall. A ball hit below the 3-foot mark, or one hit from a position nearer the wall than the restraining line, did not count as a legal hit. This could, however, assist the subject in keeping the rally going.

Any time the subject lost control of the ball, another ball could be started from back of the restraining line. An additional supply of balls was available to the subject to be used any time throughout the trial. Figure 1 shows the location of these balls. No scoring penalty resulted when these balls were used, only time was lost while the subject was obtaining them. Subjects were

given three 30-second trials and these were administered on a rotational basis within the class period.

The final score for a subject was the average of the three test trials. Subjects were allowed a 2-minute warm-up period prior to taking the first trial. A copy of the scorecard appears in Appendix A.

Shepard Modification of the Broer-Miller Tennis Drive Skills Test

The Shepard (1972) Test was administered in accordance with the directions given by its author, with the following modifications:

1. The original test called for an individual to toss the balls in an underhand manner into specific target circles located on the court. The subject taking the test was to move to the target circle area and stroke the ball into the opposite court. Since Ball-Boy machines were available, they were used to project the balls rather than an individual. The machine projecting the balls into a specific target circle was located directly across the net on the opposite service line. It was the opinion of the writer that the Ball-Boy machine, set on slow speed, would be as consistent or possibly more consistent than a tosser. The location of the machines and the target circles are presented in Figure 2.
2. The original test called for target circles 22 inches in diameter. In order for the machines to consistently project the balls within the target circles, it was necessary to increase the diameter of the

------- Rope located 4'4" above the net.

▲ Subject in the base position for taking the test. This position was 12 inches within an area to the front, sides, or back of the center mark.

[1] Target circle which received balls projected from machine A.

[2] Targetcircle which received balls projected from machine B.

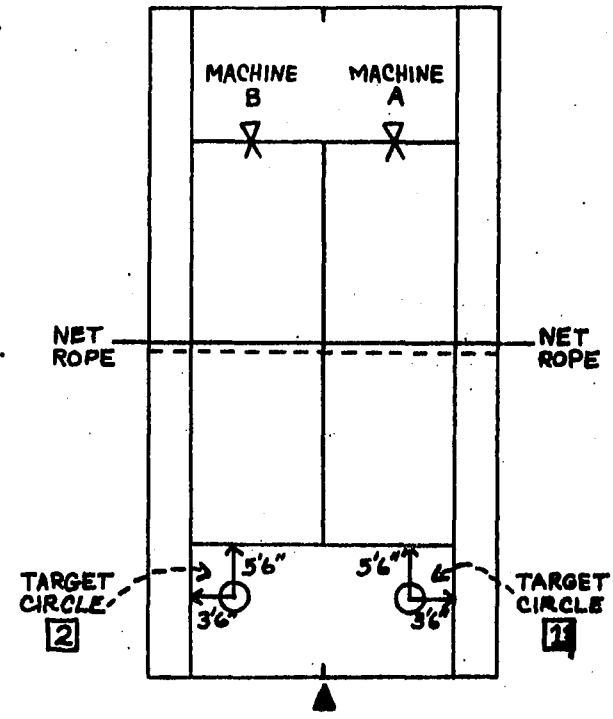

Figure 2. Location of Ball-Boy Machines for Shepard Test

circles from 22 inches to 30 inches.

3. The original test called for three scoring areas back of the tennis court baseline. Since this study was concerned only with the subject's ability to stroke the ball within the doubles court boundaries, these scoring areas outside the court were eliminated from the test. Only those areas located within the doubles court boundaries were used for scoring the subject's performance.

A regulation tennis court was used. A nylon rope was stretched 4 feet, 4 inches directly above the net and parallel to it. The target area for scoring the test was developed by drawing two lines parallel to the net. One line was drawn 10 feet nearer the net than the service line; the second line was drawn 10 feet behind the service line. These lines were drawn from doubles side line to doubles

side line. The service line was also extended to the doubles side line. These lines divided the target area for scoring into four specific sections. These areas had point values, moving from the net to the baseline, of two, four, six and eight. Figure 3 illustrates the scoring areas.

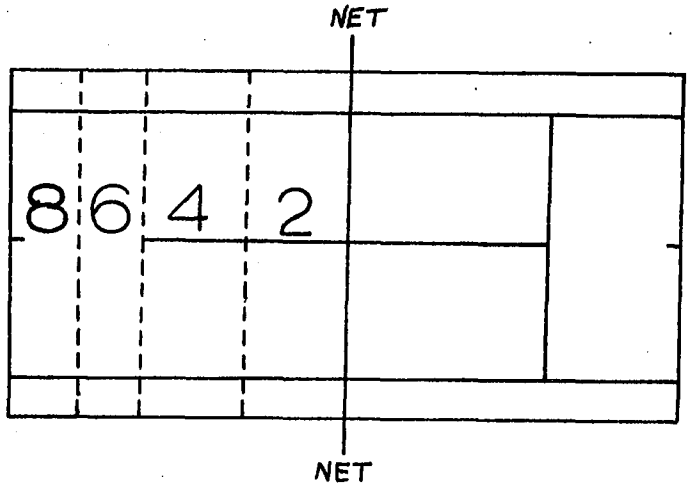

Figure 3. Target Area for Scoring the Shepard and Stationary Tests

The player taking the test initially stood near the center mark, in an area known as a base position. When the Ball-Boy machine projected the ball into the target circle, the subject attempted to move into position to hit the ball so that it travelled under the rope and deep into the target area on the opposite side of the court. The hitter was instructed not to hit a ball if it did not land within the target circle, or if at any time a ball was projected when she was not ready. Two assistants, each one located near one of the target circles, were used to note verbally to the subject any ball which failed to land within the target circle. This prevented the subject from having to judge the position on the ground where the ball was making contact. Subjects were allowed a sufficient amount of time

to return within the base position following each toss. The position of the assistants, scorer and test administrator is shown in Figure 4.

------- Rope above net.

TA Test Administrator; position was dependent upon which machine was in use.

S Scorer.

A_2 Assistant who noted balls which did not fall within target # 2.

A_1 Assistant who noted balls which did not fall within target # 1.

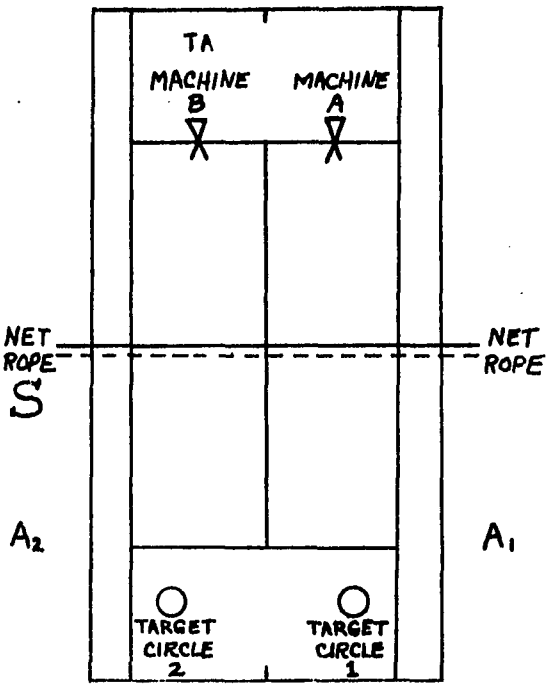

Figure 4. Position of Assistants, Test Administrator, and Scorer for Administration of the Shepard Test

The player was to score as many points per hit as possible. Each subject received 14 consecutive forehand shots and 14 consecutive backhand shots. If a player swung and missed the ball, it counted as one of the 14 trials.

In order to score the values as illustrated in Figure 3, the subject had to hit the ball between the rope and the net. If the player hit the ball into the target area, but over the rope, she received one-half the value of the area for that particular hit. Any time a ball contacted a line between two values, the subject was given the score of the higher value. A ball hit into the net or out of

bounds did not score points but constituted one of the 14 trials for that particular stroke.

The scorekeeper placed the number value of each area on the scorecard for each trial. If the ball travelled over the rope, the number was circled. In the tabulation of the scores, the circled numbers received one-half credit for that area. An example of the scorecard can be found in Appendix B.

Stationary Skills Test

Since this study was concerned with the effects of two practice environments on the forehand and backhand ball placement ability of beginning tennis players, the writer felt it was pertinent to evaluate the subject's ability to remain in a stationary position and hit an oncoming tennis ball using forehand and backhand strokes. A review of the tennis literature did not disclose a specific test of this nature. The Broer-Miller (1950) Tennis Drive Skills Test did, however, evaluate the subject's ability to drop and hit a ball from a position back of the baseline into the opposite court using the forehand and backhand strokes. A copy of the original test may be found in Appendix C. Because the strokes were evaluated from a stationary position, the test appeared to be somewhat relevant to the study. The scoring procedures for the test were also favorable as they were identical to those utilized in the administration of the Shepard (1972) Test. Thus, this test was chosen as the skills test for evaluating the subject's ability to stroke a ball from a stationary position. The test, however, was modified in the following ways:

1. The original test called for the subject to drop and hit 14 forehand shots and 14 backhand shots from a position back of the baseline. The subject was attempting to stroke the ball between the net and a rope located 4 feet, 4 inches directly above the net and into an area deep on the opposite side of the court. The test was modified in order for the subject to stroke balls provided by a Ball-Boy machine, rather than to stroke the balls following a self drop of the ball. The machine was stationed at the intersection of the service line and center service line on the opposite side of the court. The speed of the projected ball was slow. Figure 5 gives the position of the Ball-Boy machine.

TA Test administrator

------ Rope above net

X Ball-Boy machine

▲ Base position of subject taking the test

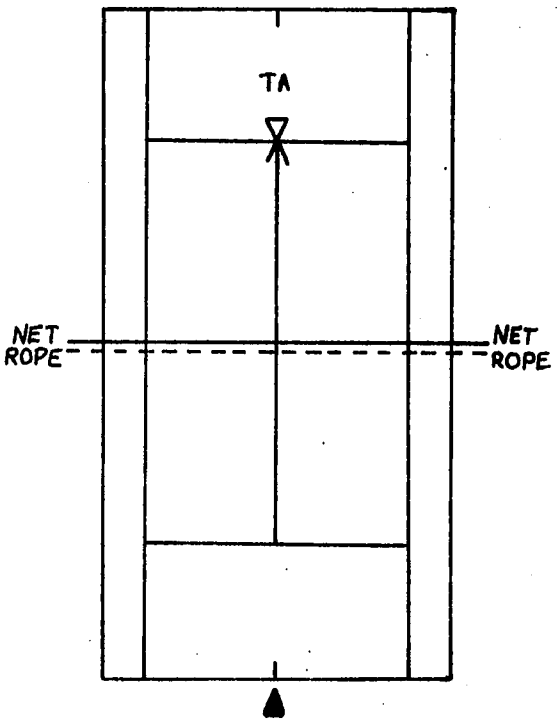

Figure 5. Base Position of Subject Taking the Stationary Skills Test

2. In the original test, the subject could take her initial position for the test anywhere back of the baseline. The test was modified to purposely limit the movement of the subject in stroking the oncoming ball. The base position was designated near the center mark of the court and the subject was required to initially stand within the base area. The area for the base position was 12 inches to the back, right or left sides of the center mark. The base position is shown in Figure 5.
3. In the original test, the scoring areas were located from the net to an area beyond the baseline. As this study was concerned only with the subject's ability to place the balls within the doubles court boundaries, the scoring areas for the test were modified to be the same as in the Shepard (1972) Test. The scoring areas are illustrated in Figure 3.

The player taking the test was supplied balls within her range of reach as she stood at the base position on the court. In order to determine the range of reach, the subject assumed her stroking position, at which time the machine was adjusted and set in order to project balls to the area of the extended racket. When this was accomplished, the machine was then anchored by means of rubber door stops to prevent any movement during the test.

The player received 14 consecutive balls on the forehand side and 14 consecutive balls on the backhand side. If a player swung at the ball and missed, it counted as a trial. The player was allowed sufficient time to return both feet to

within the base position following each projected ball.

The object of the test was to hit the oncoming ball between the net and the rope and into the highest scoring area on the opposite side of the court. If the player hit the ball between the rope and net, she scored those values indicated in Figure 3. If the player hit the ball over the rope, and into a specific target area, she scored one-half the value of the area for that particular hit. A ball landing on a line between two values received the higher of the two values. A ball hit into the net or out of bounds did not score points but counted as one of the 14 trials on that particular stroke.

The scorekeeper placed the number value of each area on the scorecard for each trial. If the ball travelled over the rope, the number was circled. In the tabulation of the scores, the circled numbers received half-credit for that area. The scores for the test were the total of the 14 trials on the forehand and the total of the 14 trials on the backhand. An example of the scorecard can be found in Appendix B.

Administration of Tests

The initial skills tests were administered to the subjects the first 3 days of the study and the final skills tests were administered the last 3 days of the study. One test was given each day in the following order: (1) Hewitt (1968) Revision of the Dyer (1938) Backboard Test; (2) Stationary Modification of the Broer-Miller (1950) Tennis Drive Skills Test and (3) Shepard (1972) Modification of the Broer-Miller (1950) Tennis Drive Skills Test.

The facilities and equipment were prepared for the testing program in compliance with the specifications as established by the tests unless modifications warranted different requirements. All balls used in the testing situation were new optic yellow Wilson championship balls. This type ball was chosen because of its availability to the writer. The tennis projecting machine used in the two outdoor tests was the Ball-Boy machine. Other equipment necessary for the administration of the tests included ropes, ball basket, tape for marking the floor and wall limits, a stopwatch, clipboards, pencils, scorecards and plywood numbers for identifying the score values on the gray asphalt court.

The writer served as the test administrator and was assisted by a group of students from the four physical education classes. Prior to the actual testing periods, the procedures were carefully explained to the assistants and several practice sessions were conducted in order for the assistants to have full command of their responsibilities during the tests. The student assistants were used at the same testing stations during the final tests as in the initial tests. The investigator provided the subjects with an explanation and demonstration of each skill test on the day a particular test was to be administered and answered those questions the subjects had in reference to the test.

Instructional Program

The subjects in this study were given 2 days of formal instruction. The investigator presented the forehand stroke the first day and the backhand stroke on the second day of the instructional program. The teaching methods for the

two strokes were designed to be as consistent as possible for all classes. Classes met for a 50-minute period each day.

Prior to the initiation of the study, permission was granted from the Athletic Institute (1970) for the use of published material (see Appendix D) on the techniques of the forehand and backhand strokes in tennis. This material was mimeographed and given to the subjects during the 2 days of instruction. A copy of the material is included in Appendix E.

At the beginning of each of the two instructional periods, the subjects were asked to read the sheet which had been distributed to them on that particular day. At the completion of this task the subjects viewed the tennis loop film (Athletic Institute, 1970) which described and demonstrated the specific stroke being taught. The investigator then answered questions the subjects had regarding the loop film.

The loop film was then shown to the class a second time. As the subjects viewed the loop film, the investigator read specific techniques from the mimeographed sheet as they appeared in the demonstration on the screen. The loop film projector was regulated in such a manner to allow each subject sufficient time to think about the technique as it was viewed on the screen.

Immediately following the second viewing of the loop film, the subjects were divided into squads and given 15 minutes to practice the stroke. The practice period consisted of hitting balls against a backboard located in the gymnasium. At the completion of the practice period the subjects viewed the loop film for a third time, again with the investigator stressing the techniques

involved in making a successful stroke.

At the close of the 2 days of instruction, the subjects were told they would receive no further instruction or verbal feedback from the investigator, regardless of whether the strokes they made in the practice sessions to follow were successful or unsuccessful. Subjects were taught how to use the loop film projector and told that the projector would be set up daily for their viewing purposes. The investigator encouraged the subjects to view the films often and to read the mimeographed sheets throughout the 12 practice sessions to follow.

Since the subjects did not receive instruction during the 12 days of practice, the writer assured them that following the completion of the post tests, further specifics of the game would be taught. These specifics included the flat serve, scoring procedures and the rules of the game. Approximately 2 days were spent teaching these three facets of the game.

The writer was especially pleased with the attitudes of the subjects involved in this study. Although instruction was not available to them during the practice sessions, the majority of the subjects seemed to look forward to these practice sessions near the end of the study in much the same way as they had done during the beginning phases of the investigation. This could possibly have been due to the fact that interscholastic tennis for girls was available at this school; the sport was not included, however, in the activity phase of the physical education program. A second factor could have influenced the attitudes of the groups. During a phase of this study, the state high school tennis championships

were held locally. The defending girls singles champion was enrolled at this high school.

Practice Sessions

Subjects in both groups received 12 days of practice and stroked 24 balls each day. Twenty-four balls were hit using the forehand and backhand strokes. Group I hit 12 consecutive forehands followed by 12 consecutive backhands. Group II hit an irregular combination of forehands and backhands during the 24 balls.

During the practice sessions, there was no rope located above the net as there had been during the skills tests. A daily score was kept on each of the 24 balls hit by the subject. The scoring system was the same as that used in the Shepard Skills Test (see Figure 3). These scores were tabulated daily and posted in the gymnasium in order that the subject might know the total score she had made on the two strokes the preceding day. This was the only feedback the subject received from the investigator regarding her success or failure in performing the two strokes. There was no verbal feedback about how the subject might adjust her strokes for a better performance.

The 12 days of practice were not continuous according to the school calendar. Weather conditions caused the practice schedules to become irregular at times. All subjects, however, hit the same number of balls throughout the study.

In order to prevent a subject from viewing a practice session of another subject, a designated order was employed for reporting to the tennis court. The subjects in each class were assigned specific numbers. The system operated in

such a manner that subject number three reported to the tennis court when subject number one returned to the gymnasium. At this same time, subject number two was involved in the practice session. This procedure was used daily until all subjects within a class had participated in the practice session. The writer felt that this system would prevent subjects from observing each other and possibly influencing the learning and performance of various individuals.

Treatment for Group I

The subjects in Group I practiced the forehand and backhand strokes in a stable, closed environment. One Ball-Boy machine was used to create this type of practice environment.

The procedures used in conducting this type of practice environment were identical to those utilized in the administration of the stationary skills test described earlier in the study. The Ball-Boy was placed at the same location on the court and the balls projected with the machine set on a slow speed.

Each subject was given the same initial starting position as in the Stationary Skills Test. The positioning of the machine in order to project balls within the subject's reaching distance was accomplished the same way. (see Figure 5.)

Treatment for Group II

The subjects in Group II practiced the forehand and backhand strokes in an open, unstable environment. Two Ball-Boy machines, switched on simultaneously, created this type of practice environment.

Ball Projection Schedules for Group II. Prior to the time that one of the Ball-Boy machines projected a ball, the other machine was turned off electrically. The subject was unaware as to whether the projected ball would be of a high or low trajectory, a forehand or backhand, or a ball travelling at a slow or medium speed. Based on the angle, direction and speed factors, the writer established four projection schedules which were used intermittently on the two machines.

The area on the court to which the projected ball would bounce was determined by the schedule being used at that particular time. The four projection schedules and the area to which the ball would bounce are shown in Figure 6 and described as follows:

Schedule 1: Slow speed, angle 1, color code of red

This schedule produced a ball which fell shallow in the backcourt. The shallow area was defined as back of the service line and in the front half of the backcourt, including the alley. The specific half of the court to which the ball fell was dependent upon the machine used to project the ball.

Schedule 2: Medium speed, angle 1, color code of red

This schedule produced a ball which fell deep in the backcourt. The deep area was defined as inside the baseline, in the back half of the backcourt, including the alley. The specific half of the tennis court to which the ball fell was dependent upon the machine used to project the ball.

Schedule 3: Medium speed, angle 2, color code of black

This schedule produced a ball which fell deep within the service court. The deep area was defined as inside the service line, in the back half of the service court, including the alley. The specific half of the tennis court to which the

ball fell was dependent upon the machine used to project the ball.

Schedule 4: Slow speed, angle 2, color code of black

This schedule produced a ball which fell shallow within the service court. The shallow area was defined as inside the service line, in the front half of the service court, near the net. It also included the alley. The specific half of the tennis court to which the ball fell was dependent upon the machine used to project the ball.

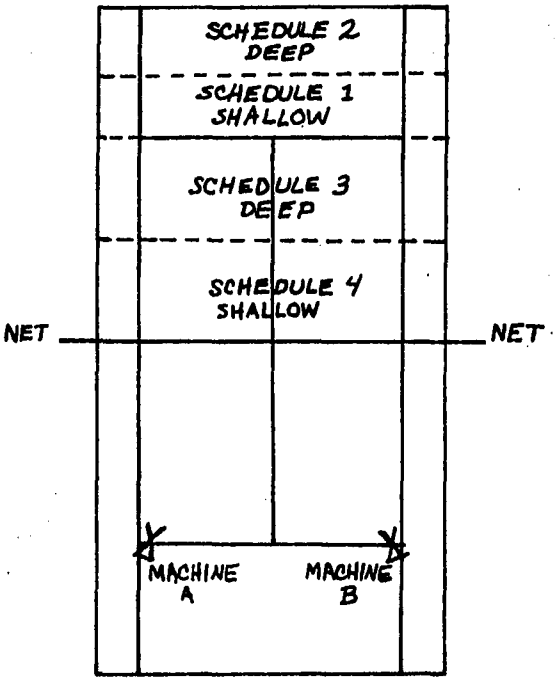

Figure 6. Ball Placements as a Result of Projection Schedules

To be able to create the open, unstable environment desired, it was necessary to use the four projection schedules and the two Ball-Boy machines in an irregular order. This order was determined by drawing at random the machine to be used in tossing each of the 24 balls. Once the machine order had been established for the tossing of the 24 balls, the four projection schedules

were added to this by following a modified round robin procedure. Table I presents a partial example of how the four projection schedules were assigned to the machine order for a single day's practice session. The projection schedule, once established, for a particular day, was administered to all subjects within the group. On each of the 12 days, however, a new schedule was employed.

Angles on Machine's Projection Plate. The setting of two angles on the machine's projection plate was used to create the high and low ball trajectory. Angle number one was 25^{o} above horizontal, as measured by a gravity protractor, while angle number two was 18^{o} above horizontal. Angle number one produced a ball of a higher trajectory.

Since the angle on the machine had to be set manually prior to the ball projection, color codes were established to assist the individuals operating the machines. The two projection angles on the machine were marked with paint, one with red and one with black. Schedules one and two were identified with a red mark on the machine, while schedules three and four were identified with a black mark. A diagram showing the machine markings is available in Appendix F.

Location of Machines and Central Control Box. Machines A and B were located in the same positions each day throughout the study. The front center portion of the Ball-Boy machine was stationed directly over the center of the line intersecting the service line and the singles side line.

Each machine was connected to an electrical control box which, with manual manipulation, allowed the machines to be operated either singularly or

TABLE I

PARTIAL EXAMPLE OF COORDINATED MACHINE AND PROJECTION SCHEDULE AS USED IN GROUP II PRACTICE SESSION

Ball	Machine	Schedule
1	A	$\underline{1}$
2	B	$\underline{2}$
3	B	3
4	A	4
5	A	$\underline{2}$
6	A	$\underline{3}$
7	B	4
8	A	1
9	B	$\underline{3}$
10	B	$\underline{4}$
11	B	1
12	A	2
13	B	$\underline{4}$
14	B	$\underline{1}$
15	A	2
16	A	3
17	A	$\underline{1}$
18	B	$\underline{2}$
etc.		

Note: Numbers underlined indicate a new round robin sequence.

simultaneously. The manual controls operated in a manner similar to a light switch. Figure 7 shows the location of the machines and the central control box.

CB Control Box.

▲ Subject taking the test.

------- Electrical Connections to Control Box.

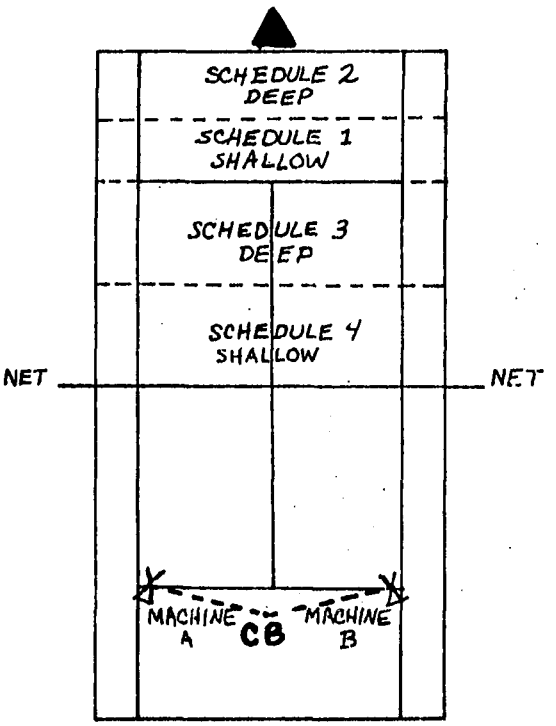

Figure 7. Location of Machines and Control Box for Group II

Management of Machines During Practice Sessions. Each of the machines used in this study had to project mechanically one ball before it initiated action to project any succeeding balls. The writer served as the person in charge of a central control box which regulated the two machines.

Three student assistants were stationed at each Ball-Boy and were responsible to either manually set the machine to produce the ball identified on the practice schedule, or, if their machine was not to project a ball to the subject, to allow the machine to rid itself of the ball it possessed. This was

necessary because the Ball-Boy machine is automatically equipped to produce a ball every 5 seconds. In order for the assistants to have full command of their responsibilities during the practice sessions, they were given several days of practice prior to the initiation of the study.

The information the assistants needed to properly set the machine for the tossing of the 24 balls was supplied to them in the form of a written schedule. One assistant maintained the written schedule and verbally indicated the settings required for each of the balls while the second assistant set the machine. The third assistant was needed only on specific occasions, at which time she handed objects to the second assistant. Once the machine had been set for a specific ball toss, the assistants were to look forward on the schedule to the next time their machine was to project and for the setting necessary for the next toss. An example of the written schedule appears in Table II.

A coordinated routine was established and followed by the persons administering the practice session in order to simultaneously start the Ball-Boy machines and allow only one machine to project a ball. The practice session consisted of the following sequential steps: (1) switching on of both machines simultaneously at the control box, (2) turning off of one of the two machines immediately prior to projection time, (3) allowing the other machine to project a ball, but turning it to off immediately following the projection and (3) turning on the first machine again in order for it to dispose of the ball it contained. This same routine was followed for each of the 24 balls the subject hit daily.

TABLE II

PARTIAL WRITTEN SCHEDULE AS FURNISHED TO ASSISTANTS IN GROUP II PRACTICE SESSIONS

	Machine A	Machine B
Ball # 1	------	Red, slow
Ball # 2	------	Red, slow
Ball # 3	Black, medium	------
Ball # 4	Red, medium	------
Ball # 5	Black, slow	------
Ball # 6	------	Black, medium
Ball # 7	------	Red, medium
Ball # 8	------	Red, slow
Ball # 9	Black, medium	
Ball #10		Red, medium
Ball #11	Red, slow	------
Ball #12	Black, slow	------
Ball #13	Red, medium	------
Ball #14	Red, slow	------
Ball #15	------	Black, slow
etc.		

The process of turning off one machine in step two was done empirically. The writer practiced several days in order to mentally ascertain the length of time allowed between the machine's initial action and the time it projected the ball. The tilt of the ball rack and the sound of the machine as it prepared to project, were primary factors that assisted the writer in achieving this endeavor.

After the subject had hit the ball projected to her, she then returned to the position at the center mark of the court to await another ball toss. While the subject was involved in this procedure, step number four was accomplished by the persons operating the machines and the control box.

In order to rid a machine of the ball it contained, a tennis racket cover was placed directly over the area of the projection plate by an assistant. The machine was then turned on and the ball was projected into the cover. This prevented the ball from being projected in the direction of the subject as she took her base position for the next toss. As a result of executing step four, the machines were now back on a simultaneous schedule because both of them had been turned off immediately following the projection of a ball.

Treatment of Data

The hypothesis of the study states that there will be no significant differences in the final forehand and backhand ball placement ability of beginning tennis players who experience an unstable practice environment in which balls vary in trajectory, speed and direction and those who experience a more stable practice environment in which balls are more consistent in trajectory, speed and direction.

Sub-questions resulting from the hypothesis are:

1. Does either practice environment tend to develop more skill in the forehand than the backhand or vice versa?
2. What is the forehand and backhand ball placement ability of beginners who experience a practice environment of constantly changing conditions, consisting primarily of stroking oncoming tennis balls of irregular speed, distance, trajectory and direction, as provided by two Ball-Boy teaching machines?
3. What is the forehand and backhand ball placement ability of beginners who experience a practice environment of somewhat stable conditions, consisting primarily of stroking oncoming tennis balls of constant speed, trajectory, distance and direction, as provided by a Ball-Boy teaching machine?

Analyses of the data were performed through the use of analysis of variance techniques and t tests for related samples. A two-factor analysis of variance design with repeated measures was applied to the data for the Shepard and Stationary Skills Tests. The Hewitt Revision of the Dyer Backboard Test required the use of a one-way analysis of variance design.

Comparisons were made within Group I and Group II on each of the three skills tests, utilizing pre- and posttest scores. These comparisons were made through the application of t tests for significance of the difference between two means for related samples.

CHAPTER IV

TREATMENT, ANALYSIS AND INTERPRETATION OF DATA

It was the purpose of this study to determine the effects of two practice environments on the forehand and backhand ball placement ability of beginning tennis players. A Stationary Skills Test (Broer-Miller 1950), the Shepard (1972) Modification of the Broer-Miller (1950) Tennis Drive Skills Test and the Hewitt (1968) Revision of the Dyer (1938) Backboard Test were administered in ordered to study these effects.

Thirty-two female students, enrolled at Stonewall Jackson High School, Charleston, West Virginia, served as subjects for the study. They were divided into two experimental groups according to physical education class schedules. Both groups were given three tennis skills tests the first 3 days of the investigation. Upon completion of the skills tests, the subjects received 2 days of formal instruction on the forehand and backhand strokes. Group I then practiced 12 days in a stable practice environment; Group II practiced 12 days in an unstable practice environment. At the completion of the practice days the same three skills tests were administered to the two groups.

A null hypothesis was formulated and a significance of difference at the 5 per cent level of confidence was considered an acceptable standard at which to reject the null hypothesis. The null hypothesis stated that there will be no significant difference in the final forehand and backhand ball placement ability of beginning tennis players who experience an unstable practice environment in

which balls vary in trajectory, speed and direction and those who experience a more stable practice environment in which balls are more consistent in trajectory, speed and direction. In addition to the null hypothesis, three specific sub-questions were investigated:

1. Does either practice condition tend to develop more skill in the forehand than the backhand or vice versa?
2. What is the forehand and backhand ball placement ability of beginners who experience a practice environment of constantly changing conditions, consisting primarily of stroking oncoming tennis balls of irregular speed, distance, trajectory and direction, as provided by two Ball-Boy teaching machines?
3. What is the forehand and backhand ball placement ability of beginners who experience a practice environment of somewhat stable conditions, consisting primarily of stoking oncoming tennis balls of constant speed, trajectory, distance and direction, as provided by a Ball-Boy teaching machine?

Treatment of Data

In order to test the hypothesis of the study and to answer the three sub-questions, various statistical techniques were employed. Using Group I and Group II, a two-factor analysis of variance with repeated measures (Winer, 1971) was computed on the Stationary posttest scores and the Shepard posttest scores. The forehand and backhand scores were treated separately.

The Hewitt Revision of the Dyer Backboard Test does not score the forehand and backhand strokes separately; therefore, a one-way analysis of variance technique (Winer, 1971) was calculated on the posttest scores for Group I and Group II.

A t test for significance of the difference between two means for related samples (Weber & Lamb, 1970) was applied to each of the two groups of subjects in order to determine if any significant improvement in ball placement ability had occurred within either group between pre- and posttests. The forehand and backhand scores were totaled for this analysis of data.

Lastly, if a significant improvement occurred within a group, the investigator was interested in which of the four scoring areas of the Stationary Test and the Shepard Test the improvement was taking place. A t test for significance of the difference between two means for related samples (Weber & Lamb, 1970) was calculated, using pre- and posttest scores from each of the scoring areas (see Figure 3, p. 27). The forehand and backhand strokes were combined in examining the scores on each of the two tests.

Analysis and Interpretation of Data

Analysis of Hypothesis

To determine if there was a difference between subjects in Group I and Group II on final ball placement ability using the forehand and backhand strokes, a two-factor analysis of variance with repeated measures was computed for the posttest scores on the Stationary Test and the Shepard Test. The Hewitt Revision

of the Dyer Backboard Test required a one-way analysis of variance design.

Analysis of Stationary Skills Test Data. In order to test the effects of two practice environments on forehand and backhand ball placement ability, a two-factor analysis of variance design with repeated measures was computed on the Stationary posttest scores for Group I and Group II. Interaction was not present which may be interpreted to mean that the results obtained for the main effects should hold true for each of the levels of the design. This led the investigator to study the effects of the two variables, treatments and strokes.

Two non-significant F ratios were found for treatments and strokes; these were 3.56 and 3.87 respectively. The critical F for 1 and 30 degrees of freedom was 4.17 (Winer, 1971). Combined with the non-significant F ratio for interaction, this meant there was no difference between the means of those subjects experiencing the two practice environments, nor was there any difference between the forehand and backhand stroke means. The results appear in Table III.

Analysis of Shepard Skills Test Data. A two-factor analysis of variance with repeated measures was utilized on the two groups, with the posttest forehand and backhand scores treated separately. Non-significant F values were observed, indicating neither a difference between the forehand and backhand strokes, nor any difference between the two practice environments. Refer to Table IV for the specific F values.

TABLE III

TWO-FACTOR ANALYSIS OF VARIANCE WITH REPEATED MEASURES ON THE STATIONARY POSTTEST SCORES, UTILIZING FOREHAND AND BACKHAND STROKES IN GROUP I AND GROUP II

Source of Variation	df	SS	MS	F
Between Subjects				
Treatments	1	489.52	489.52	3.56
Error (between)	30	4120.84	137.36	
Within Subjects				
Strokes	1	260.02	260.02	3.89
Interaction effect; treatment by strokes	1	58.14	58.14	.87
Error (within)	30	2011.34	67.04	
Total	63	6939.86		

An F value of 4.17 was necessary to be significant at the .05 level of confidence.

Posttest Forehand Means: Group I = 32.69; Group II = 25.25
Posttest Backhand Means: Group I = 26.75; Group II = 23.13

TABLE IV

TWO-FACTOR ANALYSIS OF VARIANCE WITH REPEATED MEASURES ON THE SHEPARD POSTTEST SCORES, UTILIZING FOREHAND AND BACKHAND STROKES IN GROUP I AND GROUP II

Source of Variation	df	SS	MS	F
Between Subjects				
Treatments	1	165.76	165.76	1.27
Error (between)	30	3916.97	130.57	
Within Subjects				
Strokes	1	23.77	23.77	.40
Interaction effect; treatment by strokes	1	.39	.39	.01
Error (within)	30	1798.34	59.94	
Total	63	5905.24		

An F value of 4.17 was necessary to be significant at the .05 level of confidence.

Posttest Forehand Means: Group I = 26.69; Group II = 23.31
Posttest Backhand Means: Group I = 25.31; Group II = 22.25

Analysis of Hewitt Skills Test Data. The third skills test administered to the subjects was the Hewitt Revision of the Dyer Backboard Test. Due to the design of this test, it was impossible to separate each subject's score into forehand and backhand scores. This necessitated the use of a one-way analysis of variance design to determine if there were a difference between the means of the two groups of subjects experiencing the two practice environments.

No significant difference was found on the posttest scores indicating that the performance of the subjects in the two groups did not differ on this test. It should be noted that the sum of the posttest scores for Group I and Group II were identical, thus the sum of squares between groups equaled zero. The raw scores are presented in Appendix G. Due to this unusual occurrence the computed F ratio was zero. Table V contains information related to the analysis of the posttest scores on this particular test.

Discussion. The lack of significant differences between the two groups on the three skills tests indicates that, in this particular study, one practice environment was not superior to the other in developing the final forehand and backhand ball placement ability of beginning tennis players. The null hypothesis of the study, therefore, was accepted. The study neither supported nor refuted the conflicting tennis research literature describing the type of learning environment the beginning player should experience while learning the basic strokes. Tennis authors Barta (1962), Kraft (1963), and Xanthos (1968) tend to support a somewhat stable environment for the beginning player in which stimuli is regulated and limited. This allows the player to concerntrate on "grooving" the stroke. More recently, however, Lawther (1968), Gentile (1972), Spaeth (1972),

TABLE V

ONE-WAY ANALYSIS OF VARIANCE ON THE HEWITT REVISION OF THE DYER BACKBOARD TEST, UTILIZING FOREHAND AND BACKHAND STROKES IN GROUP I AND GROUP II

Source of Variation	df	SS	MS	F
Between Groups	1	0	0	0
Within Groups	30	89.50	2.98	
Total	31	89.50		

An F value of 4.17 was necessary to be significant at the .05 level of confidence.

Del Rey (1972) and others propose that possibly players learning open skills should initially be exposed to the types of stimuli appearing later in the game situation. This would not support a stable environment in which the players attempt to "groove" the stroke.

Several factors could have contributed to the non-significant differences found between the two groups of subjects. Statistically, the sum of squares of the posttest scores of Group I and Group II on the Hewitt Revision of the Dyer Backboard Test were identical, thus the sum of squares between groups equaled zero. This factor eliminated any possibility of a significant F ratio on the Hewitt Test.

Another factor which might have influenced the results of the study was the lack of enough instruction to provide a foundation upon which the subjects could build during the practice sessions. Purposely, no feedback or daily instruction was given by the investigator. The subjects possibly needed more time to establish the correct way to perform the skills.

Perhaps the greatest limiting factor of this study was the number of subjects within each group. It would have been impossible, however, to include more subjects due to the length of the class periods and the required mechanical organization of the Ball-Boy machines.

Analysis of Sub-question One

Sub-question one attempted to determine whether either the practice environment experienced by Group I or by Group II tended to develop more skill in the forehand than the backhand or vice versa. The two-factor analysis of variance with repeated measures was used in order to analyze the data on the Stationary

Test and the Shepard Test: Table III, p. 51, and Table IV, p. 52, indicate that the computed F ratios did not exceed the critical F values (Winer, 1971) at the .05 level of confidence. Neither practice environment developed more skill in the forehand than the backhand or vice versa.

Discussion. Since neither practice environment experienced by the two groups of subjects proved to be significantly superior to the other in developing the forehand better than the backhand or vice versa, one might conclude that one environment could be as beneficial as the other in attempting to develop the ground strokes of beginning tennis players.

Gentile (1972) suggested the need for research which would attempt to identify the structure the learning environment should possess in order to benefit best the individual involved in the motor learning process. Singer (1972) stated that the use of mechanical aids, such as the Ball-Boy machines, has not been investigated to any extent up to the present time.

Based on this information one might conclude that an attempt was made to expose the subjects in this study to two rather unique practice environments utilizing the Ball-Boy machines. Neither environment, however, proved to be more advantageous than the other in developing either the forehand or the backhand.

Analysis of Sub-question Two

Sub-question two was designed to identify the forehand and backhand ball placement ability of Group II. Subjects in this group had experienced an unstable

practice environment throughout the study. A t test for significance of the difference between two means for related samples was applied on each of the three skills tests administered to this group, utilizing the pre- and posttest total scores. Using the 5 per cent level of confidence, a t ratio of 2.13 (Weber and Lamb, 1970) was needed to be significant. The Shepard Test produced a significant t of 4.18, although the other two tests did not disclose any significant differences. The pre- and posttest means for Group II, as well as the t test results, on each of the three skills tests are presented in Table VI.

The investigator was also interested in determining the specific scoring areas where improvement might be occurring on the Stationary and Shepard Tests. The scores made on the forehand and backhand strokes in the Stationary Test and the scores made on the Shepard Test were totalled according to each scoring area (see Figure 3, p. 27).

Utilizing a t test for significance of the difference between two means for related samples, t ratios were calculated between the subject's pre- and posttest scores within each scoring area on the two tests. Two significant t ratios were obtained on the Shepard Test: one in scoring area two and one in scoring area four. The critical value for significance was 2.13 (Weber and Lamb, 1970). These were the only two areas where significant improvement from pretest to posttest was observed. Due to the small number of subjects within the group, the distribution of scores in areas six and eight was somewhat distorted; thus, the variance factor was affected considerably.

TABLE VI

t TEST FOR SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE PRE- AND POSTTEST TOTAL SCORES OF GROUP II ON THE THREE TENNIS SKILLS TESTS

Skills Test	N	M	$\bar{d}$	t
Stationary	16			
Pre		40.00		
			7.75	1.03
Post		48.38		
Shepard	16			
Pre		29.31		
			16.25	4.18*
Post		45.56		
Dyer	16			
Pre		8.75		
			.88	2.05
Post		9.63		

*Significant at the .05 level of confidence.

There were no significant t ratios obtained in the Stationary Test for Group II. With the small number of subjects in the group, there is a chance of committing a Type II statistical error; thus, interpretations here should be made with caution. The results for the Shepard Test and the Stationary Test appear in Table VII.

Discussion. In an attempt to explain the significant improvement of Group II on the Shepard Test alone, it seems appropriate to consider the similarity of the practice environment and the Shepard Test environment. In both environments, the subject was required to move to the location of the ball and then make a decision about when to intercept the ball with the racket.

Stallings (1973) stated that "the need for decision-making and problem-solving are obvious in game contests such as basketball and tennis (p. 130)." Del Rey (1972) proposed that diversification of movement patterns, not fixation, is the desired goal in the open skills performance.

If diversified movement patterns are desirable in tennis and the Shepard Test evaluates the subject's ability to perform the forehand and backhand in ways similar to a game situation, then perhaps some faith should be placed in the environmental setting which initially allows the beginner to experience stimuli similar to the type she will encounter later in the game situation.

After hitting only 24 balls per day for 12 days, the subjects in Group II significantly increased their pretest to posttest scores on the Shepard Test, as well as in two of the four scoring areas. It is possible that this type of practice environment could, with further investigation over a greater period of time, prove

TABLE VII

t TEST FOR SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE PRE- AND POSTTEST SCORES OF GROUP II IN THE SPECIFIC AREAS OF THE SHEPARD AND STATIONARY TESTS

Pre- and Posttest Scores	N	sd	$\bar{d}$	t
Shepard				
Area 2	16	2.28	2.50	4.39*
Area 4	16	7.24	4.38	2.42*
Area 6	16	9.97	4.88	1.96
Area 8	16	11.58	4.50	1.55
Stationary				
Area 2	16	3.73	.75	.80
Area 4	16	9.28	-1.88	-.81
Area 6	16	14.07	3.38	.96
Area 8	16	9.63	3.00	1.25

*Significant at the .05 level of confidence.

to be very valuable to beginning players involved in learning the forehand and backhand strokes.

Analysis of Sub-question Three

Sub-question three attempted to identify the forehand and backhand ball placement ability of Group I. Subjects in this group experienced a more stable practice environment than had subjects in Group II. A t test for significance of the difference between two means for related samples was computed in order to denote any significant improvement by this group on each of the three skills tests. Pretest and posttest total forehand and backhand scores were utilized. In order to be significant at the 5 per cent level of confidence, a t ratio of 2.13 (Weber and Lamb, 1970) was needed. Significant t values were found on the Stationary and Shepard Tests. Table VIII presents the pre- and posttests means for Group I, as well as the t test results.

To further study the Stationary Test and the Shepard Test with regard to where improvement was occurring in the four scoring areas (see Figure 3, p. 27), the scores on the forehand and backhand strokes in each area were summed for each skills test. A t test for significance of the difference between two means for related samples was computed between the subject's pre- and posttest scores for the four independent scoring areas. This would indicate any significant improvements in the areas.

Table IX discloses that there was a significant difference between the means in scoring area six on the Shepard Test. The critical value at the .05 level of confidence was 2.13 (Weber and Lamb, 1970). The Stationary Test,

TABLE VIII

t TEST FOR SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE PRE- AND POSTTEST TOTAL SCORES OF GROUP I ON THE THREE TENNIS SKILLS TESTS

Skills Test	N	M	$\bar{d}$	t
Stationary	16			
Pre		44.63		
			14.81	2.51*
Post		59.75		
Shepard	16			
Pre		40.13		
			11.88	2.91*
Post		52.00		
Dyer	16			
Pre		9.38		
			.25	.43
Post		9.63		

*Significant at the .05 level of confidence.

TABLE IX

t TEST FOR SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE PRE- AND POSTTEST SCORES OF GROUP I IN THE SPECIFIC SCORING AREAS OF THE SHEPARD AND STATIONARY TESTS

Pre- and Posttest Scores	N	sd	$\bar{d}$	t
Shepard				
Area 2	16	3.70	- 1.25	-1.35
Area 4	16	9.98	5.25	2.10
Area 6	16	12.19	10.13	3.32*
Area 8	16	9.90	- 2.25	.91
Stationary				
Area 2	16	2.88	.81	1.13
Area 4	16	10.58	3.25	1.23
Area 6	16	13.61	3.19	.94
Area 8	16	17.47	8.00	1.83

*Significant at the .05 level of confidence.

however, failed to produce significant differences in any of the scoring areas. Due to the small number of subjects in the group, there is a chance of committing a Type II error; thus, interpretations here should be made with caution.

Discussion. Perhaps the reason for the significant improvement of Group I on the Stationary Test lies in the similarity of the daily practice environment and the Stationary Test environment. In both situations the subjects remained in a somewhat stationary position to stroke the oncoming ball; thus it is possible that this ability to stroke the ball transferred from one situation to another.

The significant improvement on the Shepard Test by Group I, and especially the significant improvement in scoring area six, is quite difficult to explain. Fitts (1965), in his progressive levels of motor skill learning, suggests that a motor task in which the performer remains stationary and the object to be hit is moving, is of less difficulty than one in which there is movement by both the performer and the object. If this is true, perhaps subjects in Group I were able to progress through the complexity levels of skill within the 12 days of practice. It is possible that the daily practice sessions developed enough skill foundation to allow the subjects to then move and stroke the balls successfully on the Shepard Test.

On the posttest performance subjects were given the freedom to run to a moving ball and attempt to stroke it across the net. For these subjects, this was the first time since the pretest they had been allowed to do this. Perhaps this

had an influence on the posttest scores.

The investigator observed some hesitation of Group I subjects to swing through the stroke when stroking the balls on the Shepard Test. It appeared that subjects stroked the ball with a good follow-through during practice sessions but were hesitant to do so when they were being tested. Since a score value was not given in the area behind the baseline, perhaps the subjects preferred to stroke the ball easier and score six points rather than swing through the ball possibly hitting it behind the baseline. This could account for the significant improvement in area six.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the effects of two practice environments on the forehand and backhand ball placement ability of beginning tennis players. The null hypothesis stated that there will be no significant differences in the final forehand and backhand ball placement ability of beginning tennis players who experience an unstable practice environment in which balls vary in trajectory, speed and direction and those who experience a more stable environment in which balls are more consistent in trajectory, speed and direction.

In addition to the null hypothesis, three specific sub-questions were investigated:

1. Does either practice environment tend to develop more skill in the forehand than the backhand or vice versa?
2. What is the forehand and backhand ball placement ability of beginners who experience a practice environment of constantly changing conditions, consisting primarily of stroking oncoming tennis balls of irregular speed, distance, trajectory and direction, as provided by two Ball-Boy teaching machines?

3. What is the forehand and backhand ball placement ability of beginners who experience a practice environment of somewhat stable conditions, consisting primarily of stroking oncoming tennis balls of constant speed, trajectory, distance and direction, as provided by a Ball-Boy teaching machine?

Thirty-two female students from four physical education classes at Stonewall Jackson High School were selected for this study. The subjects were divided into two groups, with 16 in each group.

During the first 3 days of the study three tennis skills tests were given: the Shepard Modification of the Broer-Miller Tennis Drive Skills Test, the Hewitt Revision of the Dyer Backboard Test and a Stationary Test which was a modification of the Broer-Miller Tennis Drive Skills Test. The next 2 days the subjects received formal instruction on the forehand and backhand strokes. Group I then received 12 days of practice in a somewhat stable practice environment using one Ball-Boy machine, while Group II practiced the same number of days in a more unstable practice environment using two Ball-Boy machines. The same three skills tests were administered again at the conclusion of the study.

The data were statistically analyzed through the application of analysis of variance techniques and t tests for related samples. A two-factor analysis of variance with repeated measures design was applied to the data for the Shepard and Stationary Tests; the Hewitt Revision of the Dyer Backboard Test data required the use of a one-way analysis of variance design.

Comparisons were made within Group I and Group II on each of the three skills tests, utilizing pre- and posttest scores. The comparisons were made through the application of t tests for significance of the difference between two means for related samples. All statistical comparisons were evaluated at the .05 level of confidence.

Conclusions

Within the parameters of this study and the results obtained from the data collected and analyzed, the following conclusions seem justified:

1. Female high school beginning tennis players did not differentiate between two practice environments, nor did they differentiate in forehand and backhand ball placement ability on total scores.
2. Neither practice environment developed more skill in the forehand than the backhand and vice versa.
3. An unstable practice environment in which balls varied in trajectory, speed and direction improved ball placement ability only on the Shepard Test.
4. Ball placement ability improved on the Stationary Test and the Shepard Test when beginning tennis players experienced a somewhat stable practice environment in which balls were more consistent in trajectory, speed and direction.

Recommendations

This study attempted to determine the effects of two practice environments on the forehand and backhand ball placement ability of beginning tennis players. No significant differences were found when the posttest scores for Group I and for Group II were compared. More significant, however, may be the information disclosed during the practice trials. This information poses interesting analyses and directions for further research.

One such analysis would be the daily practice scores. This approach could yield composite learning performance curves which would show the rate of achievement within each group. Additional analyses could be an increase in the number of subjects with controlled randomization and an increase in the number of practice trials and trial days to control for "ceiling effects." If the above analyses and directions were pursued, the results might reveal differences which could not be determined through testing alone.

Both groups made significant improvement during the study. Therefore, it seems further investigations are warranted to design unique learning environments for beginning tennis players which are distinctly different from those generally proposed by various tennis authors. Perhaps only initial attempts have been made to discover the type and amount of environmental stimuli a beginning tennis player is capable of accommodating during the early stages of learning.

Further study could also take a change in focus to discover the effect of feedback. No verbal feedback was given during the 12 practice sessions. The impact this made on the performance is unknown. The only feedback the subjects received

from the investigator was the number of points scored daily in the practice session. Whether the two groups would have differed as a result of the practice environments plus some verbal feedback remains unanswered.

The subjects viewed the Athletic Institute (1970) loopfilms, which demonstrate and describe the two basic ground strokes, after they had taken the pretests. It would be of interest to know the skill performance of the subjects had they viewed the loopfilms prior to the initial skill tests.

These are a few topics which suggest questions to be researched further, possibly adding to knowledge in motor learning.

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APPENDICES

APPENDIX A

SAMPLE SCORECARD FOR HEWITT REVISION OF THE DYER BACKBOARD TEST

Name Sue Jones

Class 9:00-10:00 a.m. Date May 24, 1974

Trial 1 9

Trial 2 10

Trial 3 11

Average of the 3 trials 10

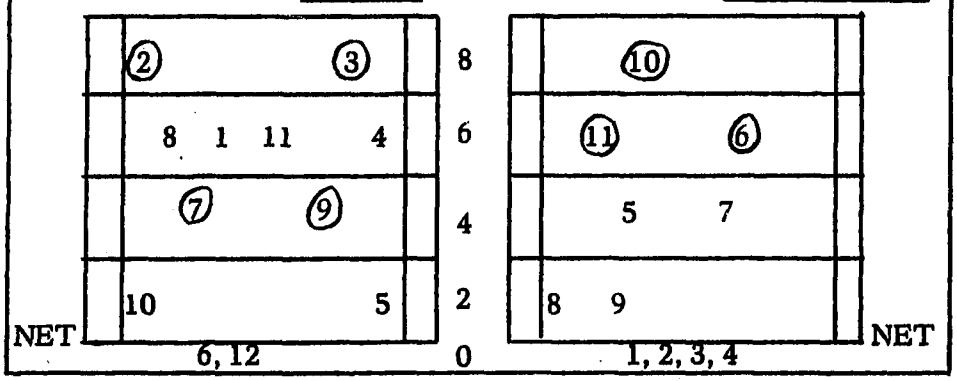
APPENDIX B

SAMPLE SCORECARD FOR SHEPARD AND STATIONARY TESTS

Name Sue Jones Class 9:00-10:00 a.m.

Date May 24, 1974

Forehand Total 40 Backhand Total 22

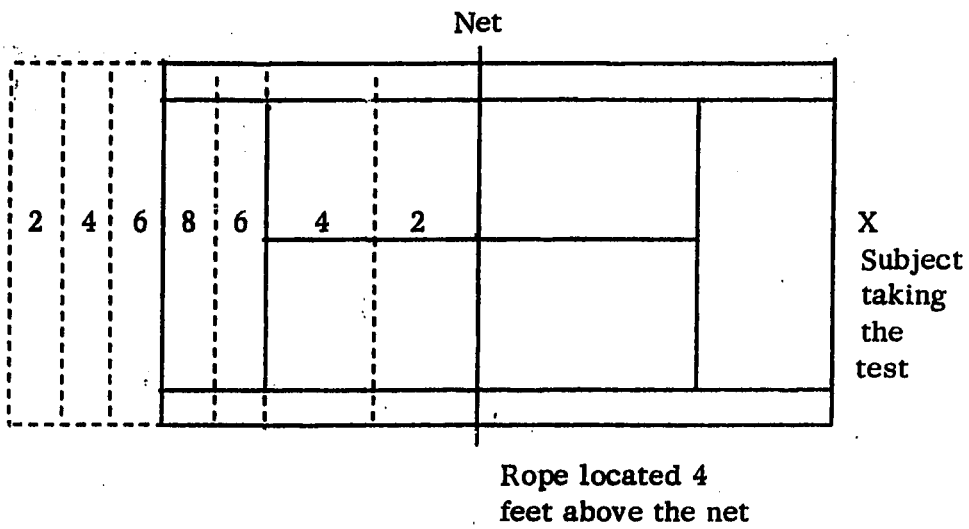


APPENDIX C

BROER-MILLER TENNIS DRIVES SKILL TEST

The purpose of this test is to classify and grade women students. It may also be used for pointing up relative weaknesses and strength in the forehand and backhand drives. The test consists of hitting a given number of balls so they pass between the top of the net and a restraining rope placed above the net, and of attempting to place these balls into the back 9 feet of the court.

Testing Area: A regulation tennis court is used, with a rope stretched four feet above the top of the tennis net. The court must have special markings as shown below:



Testing Procedures: The player taking the test stands behind the base line, bounces the ball to herself, hits the balls, and attempts to place them in the back 9 feet of the opposite court. Each player is allowed 14 trials on the forehand and 14 trials on the backhand.

Scoring Procedures: In order to score the values as illustrated in the diagram shown above, balls must go between the top of the net and the rope and land in the designated area or on lines bounding the area. Balls that land on a line receive the highest score for that area. Balls that go over the rope score one-half the value of that area in which they land. If the player misses the ball in attempting to strike it, this is considered a trial. All "let" balls are taken over.

APPENDIX D

February 26, 1975

Ms. Betty Roberts
Assistant Professor
Marshall University
Huntington, West Virginia 25701

Dear Ms. Roberts:

This letter is written to verify the Athletic Institute is hereby granting you permission to include the "Techniques & Pointers" listed in our Tennis Loop Film Guide.

This permission is granted with the understanding the Athletic Institute will receive a credit line in your dissertation.

Sincerely,

Don Bushore

D. E. Bushore
Executive Director

DEB:pr

APPENDIX E

MIMEOGRAPHED MATERIAL ON TENNIS TECHNIQUES

The beginner's first concern is to contact the ball with the racket utilizing enough force so that the ball will clear the net. A player must also be concerned about placing the ball within the designated court boundaries.

The guide (Athletic Institute, 1970) developed here is to help the beginner use the proper tennis techniques to accomplish the various shots and strokes necessary to achieve the above goals. The techniques described herein assume that the reader is right handed.

Loop 1 FOREHAND STROKE

FOREHAND TECHNIQUES

Grip

1. Racket Face Vertical to Ground.
2. Gripping Fingers.
3. Bracing Fingers.

Stance

1. Assume Ready Position.

Forehand Stroke

1. Draw Racket Back--Pivot on Right Foot.
2. Keep Eyes on Ball.
3. Transfer Weight to Pivot Foot.
4. Flex Knees Slightly.
5. Step Toward Ball.
6. Racket Makes Hairpin Turn.
7. Extend Arm Fully.
8. Swing Racket Forward and Upward.
9. Keep Wrist Firm.
10. Contact Ball Waist High.
11. Follow Through.

When using the forehand stroke the Eastern grip is recommended. This film will show that the grip begins by placing the racket face vertical to the ground. The hand is placed on the racket handle with the top beveled edge of the racket bisecting the "V" between the thumb and the index finger. The first three fingers are the gripping fingers and the thumb and index finger act as bracing fingers. The index finger is slightly separated from the first three fingers and is sometimes referred to as the "trigger finger" position.

After the grip is mastered, assume a ready position, i.e. head up, knees flexed, feet parallel, weight on balls of feet, racket head up and both hands on racket.

From this position the player reacts to where the opponent hits the ball. If the opponent hits the ball a few steps away use a shuffle or skip step. If the ball is hit further away a player must run to a hitting position.

As the player reaches the stroking or hitting position, plant the right foot, with the weight to the rear for balance. Draw racket back, and simultaneously pivot and transfer weight to right foot. Knees are slightly flexed and the eyes are focused on the ball.

As the player steps toward the ball the racket makes a hairpin turn, with the arm fully extended. The hairpin turn will enable the racket to swing forward and upward. As the racket swings forward the weight is transferred forward in the direction the ball will travel.

As the racket makes contact with the ball the wrist remains firm. The contact point should be in front of the body and waist high.

Loop 3 BACKHAND STROKE

BACKHAND TECHNIQUES

Grip

1. Racket Face Vertical to Ground.
2. Rotate Racket 1/4 Turn Counterclockwise.
3. Place Thumb Diagonally Across Handle.

Stance

1. Assume Ready Position.

Backhand Stroke

1. Pivot on Left Foot.
2. Draw Racket Back.
3. Left Hand on Racket Throat.
4. Keep Eyes on Ball.
5. Transfer Weight to Pivot Foot.
6. Lift Racket Upward.
7. Flex Knees Slightly.
8. Step Toward Ball.
9. Racket Makes Hairpin Turn.
10. Swing Racket Forward and Upward.
11. Keep Wrist Firm.
12. Contact Ball Waist High.
13. Follow Through.

With the racket face vertical to the ground and using an Eastern grip, the player rotates the racket 1/4 turn counterclockwise. The rotation will place the knuckle of the index fingers on top and the thumb diagonally across the backside of the handle.

Starting from a ready position, the player will pivot on the left foot and step with right foot to position the body so it faces the sideline.

Simultaneously the racket is drawn back, the weight is transferred to the pivot foot, knees are slightly flexed, eyes are focused on ball and the left hand

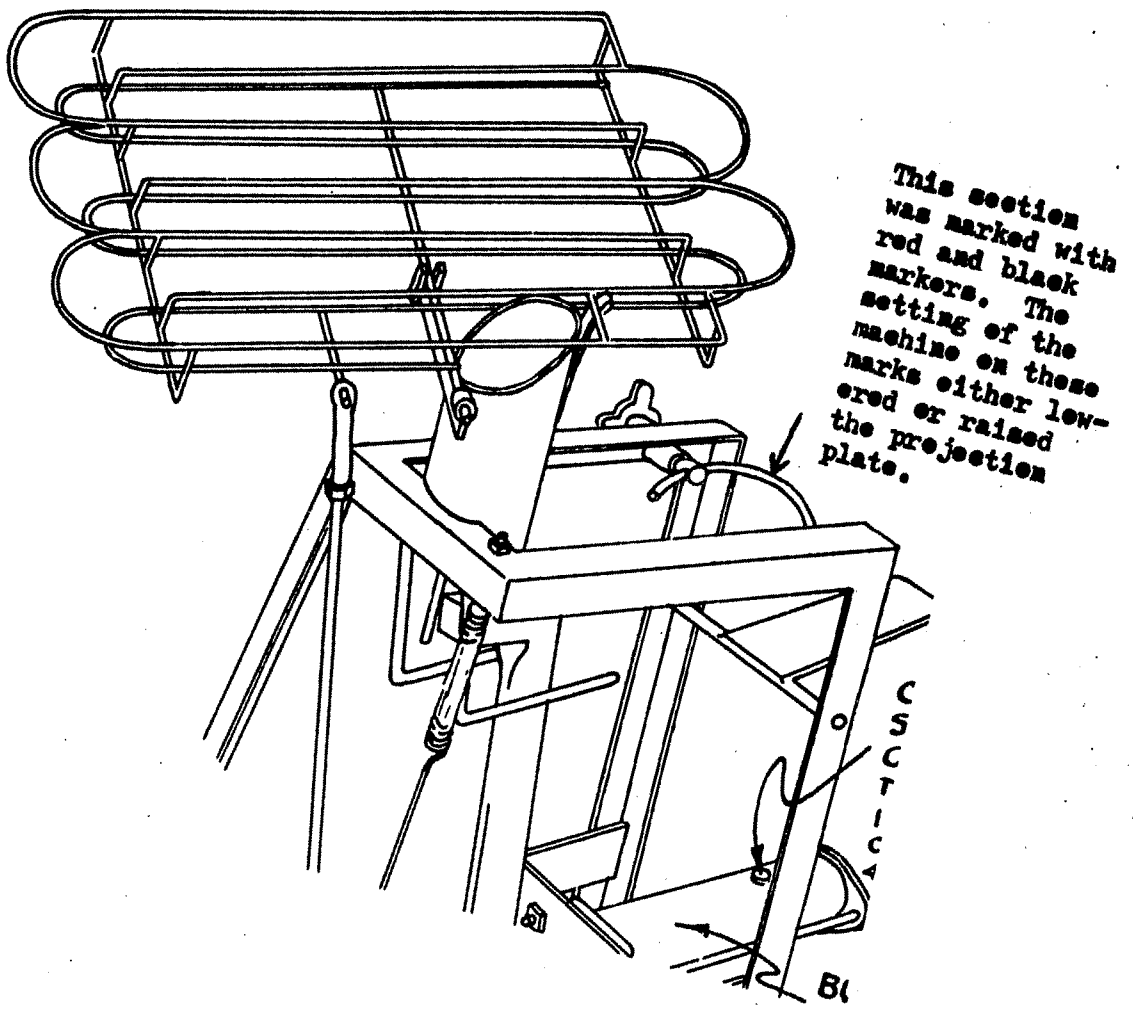
still remains on the throat of the racket.

As the racket goes back, it tilts slightly upward and makes a hairpin turn as the player steps forward with right foot to meet the ball.

Step forward, swinging the racket forward and upward with a firm wrist. Make sure the arm is fully extended on ball contact. Normal contact is made at waist level with a good follow through.

APPENDIX F

MACHINE MARKINGS FOR GROUP II PRACTICE SESSIONS



APPENDIX G

PRE- AND POSTTEST RAW SCORES FOR GROUP I AND GROUP II ON THE THREE TENNIS SKILLS TESTS

Group I (Subject)	Hewitt Revision of the Dyer Test		Shepard Test		Stationary Test	
	Pre	Post	Total Pre	Total Post	Total Pre	Total Post
1	11	6	49	50	48	43
2	9	12	59	64	59	70
3	7	9	35	36	29	26
4	7	8	22	62	30	62
5	13	13	85	82	47	91
6	8	10	42	21	54	25
7	12	10	47	71	41	91
8	10	8	37	51	38	59
9	9	11	29	64	62	49
10	8	12	55	52	41	50
11	10	9	44	52	66	58
12	12	9	48	64	53	94
13	8	9	28	46	19	59
14	10	10	30	56	35	71
15	8	9	7	36	46	50
16	8	9	25	25	46	58
Totals	150	154	642	832	714	956

Group II (Subject)	Hewitt Revision of the Dyer Test		Shepard Test		Stationary Test	
	Pre	Post	Total Pre	Total Post	Total Pre	Total Post
1	8	9	25	32	30	36
2	8	11	34	32	38	73
3	7	9	29	52	59	39
4	8	7	11	52	24	42
5	9	12	26	29	32	38
6	12	10	57	67	60	60
7	6	6	12	33	23	49
8	9	11	27	56	35	67
9	8	11	30	37	43	39
10	9	9	36	37	62	50
11	10	9	23	58	15	59
12	10	12	43	87	78	47
13	8	11	39	41	35	32
14	9	8	34	31	34	43
15	9	9	20	48	47	54
16	10	10	23	37	25	46
Totals	140	154	469	729	640	774