CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

EFFECTS OF DIFFERENT TYPES OF MENTAL PRACTICE UPON MOTOR LEARNING

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Arts in Physical Education

by

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July, 1973
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ABSTRACT

EFFECTS OF DIFFERENT TYPES OF MENTAL PRACTICE UPON MOTOR LEARNING

by

William Farris Robertson

Master of Arts in Physical Education

July, 1973

The purpose of this study was to compare the results of learning through a visual filmed practice, verbal taped practice, undirected mental practice, and no practice, and to determine the relative effectiveness of each method upon motor learning and performance.

One hundred and forty-seven male and female students who were enrolled in physical education classes at Bethany Junior-Senior High School, Bethany, Oklahoma, during the Fall semester 1971-72 volunteered as subjects for this study. Eighty-two of these subjects completed all practice and testing sessions.

The subjects were randomly assigned to one of four groups, A, B, C, or D, each performing under a different condition; Group A, the visual practice group, relied upon visual cues from a film of the novel task; Group B,
the verbal practice group, relied upon verbal cues derived from a taped recording of the novel task; Group C, the undirected mental practice group, relied upon undirected individual mental practice; and, Group D, the control group, received no practice. The ball hitting task consisted of an underhanded hitting of a tennis ball toward an archery target for points. The non-dominant hand was used and each subject received twenty-four attempts at the task. The study lasted fourteen days including seven days for the male subjects and seven days for the female subjects (boys had physical education on the even days of the month, girls on the odd numbered days).

The seven-day program for each group consisted of one day for the introduction and pre-test; two days for mental practice; one day for mid-test; two days for mental practice; and, one day for post-test.

The analysis of variance test was used to analyze the data. Results indicated that there was no significant difference (.05 level) between any groups throughout the investigation. The results supported the null-hypothesis that there was no significant difference in the degree of learning of a novel motor task resulting from the learning methods employed in this study, namely: visual filmed, verbal filmed, verbal taped, undirected mental, and no practice.
CHAPTER I

INTRODUCTION

Today, the educational process is concerned with any avenue which might lead to a more advanced and efficient system of learning. Due to a tremendous increase in population and greatly expanded areas of knowledge in education, time has become a very precious commodity. Educators are striving to promote learning in the most efficient way. Investigations concerned with the nature of learning have become increasingly and vitally important. A better understanding of the nature of learning could lead to a more advanced and efficient system of learning.

Much of the past research in motor learning has dealt mainly with the physical aspects of learning motor tasks. However, more recent investigations have recognized the complexities involved in learning motor tasks and have investigated the mental and physical aspects. In physical education, motor learning is fast becoming a prominent area of research. How one mentally learns to perform a motor task has received considerable attention in recent years.
To learn to perform a motor task, it seems obvious that one must practice the task physically. However, several investigators agree that physical performance of a motor task can be enhanced to some degree by mental practice. In some cases, mental practice can serve as well as, but not better than, physical practice.

The vast majority of mental practice studies in motor learning deal with the comparison of physical and mental practice. Richardson (14:95) in his review of literature regarding mental practice, reported eleven previous studies in which significant positive findings were obtained indicating that mental practice procedures improved performance of a given task. He cited seven other studies which showed a tendency in favor of mental practice. It is now generally accepted that mental practice can have a positive effect on the performance of a physical task.

Importance of the Study

While recent research has proven that mental practice can improve physical performance, there has been very little research to determine if one type of mental practice is superior over others. More specifically, it has not been determined if one learns a novel motor skill better
through visual instruction, verbal instruction, or directed or undirected mental practice methods of instruction. It would seem that an investigation of different types of mental practice which could be employed might lead to a better understanding of the total motor process. It was hoped that this study would lead to an improved understanding of mental practice as it relates to motor learning.

Statement of the Problem

The problem which stimulated this study was the lack of evidence discriminating among the effectiveness of various methods of mental practice.

Statement of the Purpose

The purpose of this study was to determine the comparative results of the learning of a novel gross motor task by relying upon: visual filmed, visual cues derived from a film of the novel task; verbal taped, verbal cues derived from a taped recording of the novel task; undirected mental practice, relying upon undirected individual mental practice; and, no practice of the novel task.

Specifically, the purpose of this study was to compare the results of learning through the above stated methods and determine the relative effectiveness of each
method.

Assumptions

To conduct this study it was necessary to make the following assumptions. It was assumed that the motor task was novel to everyone, had never been performed by the subjects at any time previous to this study, and that the subjects did not practice this task outside of the experimental situation.

Hypothesis

This investigation was designed to test the following null hypothesis: there is no significant difference in the degree of learning of a novel gross motor task by employing the differing methods of visual filmed, verbal taped, undirected, and no practice methods of mental practice.

Scope and Delimitations

This investigation was concerned with the comparison of performance scores made following the use of one of these methods for mental practice; filmed visual performance, verbal taped description of performance, undirected mental practice, and a no-practice method of practice in the learning of a novel gross motor task. There were
eighty-two junior and senior high school students (grades eight through eleven) at Bethany Junior-Senior High School, Bethany, Oklahoma, used in this study conducted during the Fall semester of 1971. The subjects included were males and females. Due to the structure and size of the physical education classes at Bethany Junior-Senior High School, it was not possible to limit the investigation to any one sex, grade or age level.

The mental practice period consisted of two weeks of mental practice with two practice sessions each week. One day was allotted before, in the middle, and at the end of the two-week period to perform the pre-test, mid-test, and post-test respectively. Each practice period lasted approximately three minutes daily. The same amount of time was allotted for mental practice as was needed to complete the prescribed number of physical trials on each test. In the pre-test, mid-test and post-test, each student was given one trial of twenty-four attempts to perform the novel gross motor task. This number of attempts was selected after an examination of the results of two pilot studies which were performed to determine the reliability of the testing instrument and the learning curve of a sampling of a similar age group. The study was conducted in six physical education classes at Bethany Junior-Senior
High School. These classes met on alternating days; the
three boys' physical education classes met on the even
numbered days of the month, and, the three girls' physical
education classes met on the odd numbered days of the
month.

All the students in all the physical education
classes were given a number from one to one hundred and
forty-seven. They were then randomly grouped by drawing
the numbers out of a box and placing them in one of the
four groups.

Two pilot studies were performed before the actual
study was undertaken. Eight male volunteer students were
used in the first study and three male volunteer students
were used in the second. The reliability of the testing
instrument and a learning curve were established and the
results were used to determine the direction of the inves-
tigation (see page 24 for specific results).

Definition of Terms

In order to facilitate common understanding, the
following definitions were established for this study.

Motor Learning. Motor learning is a relatively
permanent change in motor behavior or performance of a
motor task as a result of some form of practice. The
amount of learning may be measured by a comparison of scores before and after practice.

Mental Practice. The term mental practice is used to signify the introspective or covert rehearsal that takes place within the individual. References to mental practice and physical practice are somewhat misleading as they seem to indicate that the individual functions at either a purely physical or mental level. It is assumed that in the physical performance of a task there is some degree of related mental activity, and in mental practice certain subliminal neural and muscular responses are evoked. In light of this, the concept of mental practice could perhaps be understood better if it was thought of as sedentary practice (8:222).

Novel Gross Motor Task. A novel gross motor task is a task which involves gross or large bodily movement in the execution of a task which has not been performed or practiced before as a task. Primary elements which are important in the performance of gross motor tasks include balance, muscular strength, change in center of gravity, agility, and use of large muscle groups.

Organization of Remaining Chapters

Chapter II contains a review of investigations
related to mental practice and the learning of a motor task. The design, methods, and procedures employed in the investigation are described in Chapter III. An analysis of the data obtained from the study is reported in Chapter IV. A discussion of the findings is presented in Chapter V. Chapter VI contains the summary, conclusions, and recommendations for further study.
CHAPTER II

REVIEW OF LITERATURE

The problem under investigation in this study was to determine the effects of visual mental practice, verbal mental practice, undirected mental practice, and no mental practice in the learning of a novel gross motor task.

This chapter contains a selected chronological review of research related to this study in the areas of motor learning and mental practice, a brief review of theories of learning, and a summary of findings from the literature.

Chronological Review

Buegel (1) reported an investigation in 1940, designed to determine the effect of introducing three different simple ideational elements in the learning of a simple patterned motor performance. Ideational elements consisted of learning to light a series of twelve lights under four conditions. Each subject held a stylus in his preferred hand and touched contact points following a certain pattern. Buegel concluded that ideational elements
which are introduced in the learning of a patterned motor performance cause a distinct advantage in the initial stages of learning.

Vandell, Davis, and Clugston (24) conducted research in the area of motor learning in 1943. They tested male junior high school students and college freshmen on the motor skill of dart throwing. In addition, they tested male senior high school students on the basketball free throw. There was a daily thirty-minute practice period by the junior high school subjects, and a daily fifteen minute practice schedule for both the college freshmen and senior high school students. The authors did not explain why they had the different time schedules. This early study made two interesting conclusions: (1) it was found that in all three experiments "mental practice tends to improve the later performance of the related motor activity"; and also, (2), that "mental practice appears to be almost as effective as actual physical practice, under the conditions of the experiment" (24:249).

Twining (23) conducted a study in 1949 on mental and physical practice in learning a ring-toss motor task. He designed his study following much the same structure as the earlier study by Vandell, Davis, and Clugston (24). Twining designed an investigation to determine the
significance of the difference between mental and physical practice in the learning of a motor skill. The study lasted twenty days with an additional two days for a pre-test and a post-test. The physical practice period lasted approximately seven and one-half minutes daily. The mental practice period lasted fifteen minutes daily. This reviewer was interested in the design and procedure used in the study and felt that Twining might have biased his study in three ways: (1) the author did not equate or account for any inequalities of the experimental groups, (2) the study provided twice as much time for mental practice as for physical practice, and (3) the experimental subjects commented that, according to Twining's report, that "genuine mental effort was effective for about the first five minutes of each practice period. Beyond this concentration became increasingly difficult" (23:435). According to Twining, it was concluded that both mental and physical practice facilitated statistically significant learning of a simple motor skill. No significant improvement was found by subjects receiving no practice.

In 1960 Clark (2) conducted a study comparing physical and mental practice in the development of the Pacific Coast one-hand basketball foul shot. One hundred and forty-four high school subjects participated in one of
three groups of experience (varsity, junior varsity, and novice). Clark did not feel a control group was necessary. A pre-test and post-test were performed. The entire experiment lasted sixteen school days. Clark included supplemental considerations of the influence of arm strength, intelligence, and experience in the study. He found that intelligence exerted no statistically significant influence, and he also felt that the study was biased in that one coach "made facetious and deprecating remarks to the varsity subjects concerning the possibilities of mental practice" (2:566). The study was designed so one coach at each school could handle the instruction, but it developed that the investigator had to do the instructing in three of the cases. Clark found mental practice to be almost as effective as physical practice for the varsity and junior groups but not for the novice groups. One might conclude from this that some previous practice is necessary for mental practice to be effective.

In 1960, Start (18) conducted an experiment to determine if intelligence affected the results of mental practice as it related to learning a motor skill. The mental practice period lasted five minutes daily for nine periods. Thirty-five twelve year old boys participated. The motor skill involved was the underarm basketball free
throw. The scores from the Northern Test of Educability (England) were used to obtain the intelligence quotients of the subjects. This test was used in the school "as part of the assessment for streaming the children on intake" (18:645). The experiment required ten attempted free throw shots for the pre-test and the same number for the post-test. Start felt that a small number of subjects might have limited the results of his study. He felt that he should have established a graduated system of awarding points so that the shots that hit the rim but did not go in might have had some point value rather than none. Regardless of these two points, the study did find that mental practice did improve performance. Also, the study found that improvement was not significantly related to the intelligence of the individual performing the test. Clark (2), and Start (18), therefore, came up with similar findings in regards to intelligence and how it related to physical performance.

Kelsey (8) in 1961 studied how mental and physical practice affected muscular endurance. The study was designed in the same manner as studies by Vandell, Davis, and Clugston (24), and Twining (23). The daily practice period lasted five minutes as did Start's (18), and the study lasted for twenty-two days including pre-test and
The study found that a significant improvement occurred in the mental practice group, although this improvement was comparatively slight compared to the improvement shown by the physical practice group.

Smith and Harrison (17) compared the effects of visual, motor, mental, and guided practice upon the speed and accuracy of performing a simple eye-hand coordination task. This study took place in 1962. The subjects were sixty male university students. They were each given a one-minute speed test and retest on a three-hole stylus punchboard. They were tested for ten seconds, read for ten seconds (reading material was not related to the test), and tested for ten seconds. This procedure was followed until the subject had completed six ten-second trials with the stylus. Smith and Harrison concluded: "...visual practice and mental practice improved accuracy on a punchboard learning task, whereas motor practice and guided practice did not" (18:307).

Egstrom in 1964 studied the effects of emphasis on conceptualizing techniques (mental practice) during the early learning of a gross motor skill. The subjects were six groups of twenty male university students. In discussing the study, Egstrom stated the following:
Each group was given physical performance tests on the first, seventh, and thirteenth days. The pattern of practice of the remaining days varied from all physical practice, or all mental practice, to all no practice. A fourth group alternated mental practice with physical practice, a fifth group received physical practice on the first five practice days and mental practice on the last five, and lastly, a sixth group which received mental practice on the first five days and physical practice on the last five practice days. The group which alternated mental practice and physical practice gained most but not significantly better than the all physical practice group which came second in amount gained (4:472).

Egestrom (4) pointed out that there might have been some advantages in using a method of alternating manual and conceptualizing practice which was not accompanied by frequent experiences of manual practice.

Jones (7) conducted a study in 1965 to determine motor learning ability under two conditions of mental practice when there was no demonstration of physical practice. Two groups met three days a week for two successive weeks. One group engaged in three undirected instructional periods while the other group received three instructional periods, two of which were directed. Jones found:

Undirected mental practice as used in this study is superior to directed mental practice as a method of learning when mental practice is used in combination with physical practice (7:275).
Richardson (14) in 1967 conducted a review of the experimental literature as it related to mental practice and performance. He also reviewed and discussed individual differences in the studies and how they related to the amount of gain obtained in these studies. In his review of studies he found eleven studies which show statistically significant positive findings where mental practice improved performance; seven studies which showed a positive trend toward the use of mental practice; and three studies which reported negative findings in regards to the use of mental practice.

Stebbins (19) engaged in a study to determine how mental and physical practice affected the learning of a selected motor skill. Differential effects of mental practice during different stages of the learning period were also studied. There were five groups: control, mental practice, physical practice, mental-physical, and physical-mental practice. Stebbins found that only the combination-type treatments showed significant improvement in performance. However, the study might have been biased due to the mental practice procedure. The mental practice subjects were instructed to stand beside the subjects who were physically practicing the skill. This could have caused distractions and taken away from the subject's mental
concentration or affected the performance of the physical practice group.

Surburg (20) conducted an experiment in mental practice and motor learning in 1968. He compared audio, visual, and audiovisual instruction in the performance of the forehand tennis drive. The subjects were 183 junior college male students. The study included seven groups: control, audio, visual, audiovisual, and three parallel groups which also engaged in ten-minute mental practice sessions immediately following their specific instructions. The author did not state the length of the film. This information would be necessary if one were to evaluate this study fully. Surburg's study supported the findings of previous studies by Twining (23), Start (18), Clark (2), and Kelsey (8). All of these investigators found that mental practice was an effective method for improving a motor skill. Surburg found that:

...an audio presentation of material pertinent to the motor skill used in conjunction with mental practice was the most effective method of those investigated for the development of the forehand tennis drive (20:734).

Oxendine (11) conducted a study in the area of mental practice in 1969. He chose three motor skills; pursuit rotor, a soccer kick for accuracy, and a modified basketball jump shot. Two hundred and twelve junior high
male subjects performed these tasks with varying degrees of mental and physical practice for a seven-day trial period. Oxendine found that the modified jump shot was inappropriate as a learning task for seventh grade boys under the conditions of his study. Among Oxendine's findings he stated that both physical and mental practice should be included in the practice time for the learning of a given motor task.

Phipps and Morehouse (13) studied the effects of mental practice on the learning of motor skills of varied degrees of difficulty. The three motor skills utilized were: the hock swing to a horizontal bar, jump-foot (Brace test), and a soccer hitch kick. Phipps and Morehouse found that mental practice, without prior physical practice, was specific to the skill and is more clearly indicated for simpler skills. It seems logical to assume that a motor task which is too difficult for an individual to perform physically will not be learned through the addition of mental practice.

**Selected Theories of Learning**

Oxendine (12:24) classified different learning theories into two general categories: stimulus-response and cognitive. Thorndike (22), Guthrie (5), Hull (6), and
Skinner (16), were classified as stimulus-response theorists, while the theories of Lewin (9) and the field theorists were referred to as cognitively orientated. This classification is very general as there are similarities and differences among and within each group of theorists.

The stimulus-response theories may be considered to be the more scientifically verifiable. The cognitive theories deal more with constructs which cannot be precisely measured. The stimulus-response theorists believe that the pleasure-pain principle can control behavior. Oxendine (12:25) stated that "the term stimulus-response (S-R) is used to indicate that a particular stimulus is connected or leads to a particular response." The cause and effect relationship and stimulus-response bond concept are considered important.

Cognitive theories deal with the learner organizing his stimuli or perceptions into a whole or pattern, whereas stimulus-response theory proposes the reception of certain stimuli either singularly or in groups. The cognitive theorists believed the stimuli from the environment were integrated parts of a whole; a whole which they believed was greater than the sum of the parts.
The classical field theories deal with perception, which is vastly important to the learning process, and, therefore, of major importance in learning theories. Some basic concepts which are fundamental to an understanding of the field theories are: the field and ground concepts in which both the figure (central object) and the ground (background) are primary factors in presenting the whole stimuli to the learner; insight as it implies that the learner suddenly and actually figures out the answer; and, the concept of Gestalt which means that "the whole is greater than the sum of the parts."

The "life space" concept as expressed by Lewin (9) includes both the external and internal forces that act upon the individual learner. The internal forces include physiological and psychological stimuli. The external influences consist of man's interaction with other men and also the complexity of stimuli that comes from his environment. The combined forces of external and internal stimuli and their effect upon the individual determine his behavior.

Summary

A selected chronological review of literature was presented in this chapter. Twining (23), Clark (2),
Start (18), Kelsey (8), Smith and Harrison (18), Egstrom (4), Jones (7), Stebbins (17), Phipps and Morehouse (13), and Oxendine (11), all found that mental practice was an effective method of improving motor skill. Start (18) and Clark (2) found that intelligence exerted no statistically significant influence on skill improvement and performance. In addition, eight of the studies mentioned in this review suggested that a combination of physical and mental practice was the best practice method. Also, it was found through this review that most research follows the design of allotting the same amount of time for mental practice as was allotted to complete the prescribed number of physical trials on each test.

This selected review of literature suggests that mental practice of a physical skill does produce positive learning and performance results. However, there has been very little research to determine if one type of mental practice is superior to another. This study was designed to determine if one learns a novel gross motor task better through visual instruction, verbal instruction, or through undirected mental practice.

Educators are striving to promote learning in the most efficient way. A better understanding of the nature of learning could lead to a more advanced and efficient
system of learning. Understanding learning through the study of and establishment of learning theories is a fundamental step in the direction of better education. According to Oxendine (12:22), "Learning theories are attempts to explain what learning is and how it takes place."

One must understand basic learning theory concepts to fully understand any study designed to measure learning.

Chapter III contains a description of the design and procedures involved in this study.
CHAPTER III

DESIGN AND PROCEDURES

The purpose of this study was to determine the effects of: visual mental practice, verbal mental practice, undirected mental practice, and no practice on the learning of a novel gross motor task.

This chapter contains a description of the design, procedures and techniques involved in the investigation.

Preliminary Procedures

Two pilot studies were performed before the actual study was conducted. Eight male volunteer students were used in the first pilot study. These students were sophomores at Pasadena High School-West Campus, Pasadena, California. Three male volunteer students, also from Pasadena High School-West Campus, were used in the second pilot study. All personnel were within the age range of the students who participated in the investigation.

Each subject participated by performing the novel task one hundred times. The findings recorded in these pilot studies gave the investigator an opportunity to
construct a learning curve based on the data, to use the equipment based under experimental conditions, and to practice a routine procedure for conducting the investigation and collecting data.

On the basis of these preliminary studies it was concluded that the task met the criteria of being novel, challenging, and had a good degree of difficulty. For these reasons the novel gross motor task was considered to be a valid instrument for measuring learning of a gross motor task. The coefficient of correlation for reliability of the task, an r of .99, was established by using the test-retest method.

Selection of Subjects

This study included eighty-two right-handed students enrolled in physical education classes at Bethany Junior-Senior High School, Bethany, Oklahoma, during the 1971 Fall semester. The subjects included forty-one boys and forty-one girls. There were twenty-nine eighth grade subjects (sixteen boys and thirteen girls), forty ninth grade (twenty-two boys and eighteen girls), six tenth grade (one boy and five girls), and seven eleventh grade subjects (two boys and five girls).

All the students in all the physical education
classes were given a number from one to one hundred and forty-seven (total number of physical education students used). The subjects were then randomly selected for groups by drawing the numbers out of a box and placing them in one of the four groups. Amount of class time available, absences, and dominant-hand characteristics all influenced the elimination of students after they were randomly grouped and throughout the study until the final number remaining was eighty-two.

Orientation of Subjects

Prior to taking the pre-test on the novel task, all subjects were grouped together and given instructions concerning the general nature of the study (see Appendices A and B). The students were told that the study involved learning and that they were requested to do their best at all times. All subjects were asked not to practice between trials and were further requested not to discuss the study with anyone else since this might invalidate the scores. The students were told that on the first, middle and last days of the study they would be tested on twenty-four attempts of the novel task. They were also instructed that the study would last for three weeks. There were four practice sessions, each of which lasted approximately three
Description of the Novel Gross Motor Task

The Task: The novel gross motor task which was used in this study involved the underhanded hitting of a tennis ball at a target as the ball dropped from a closed tube. This task utilized the non-dominant hand and arm (see Figure 1).

Equipment and Task Execution: To execute this task the student stood behind a taped line on the floor. A tennis ball was rolled at a downward angle through a three inch diameter pipe five feet in length. The tennis ball dropped from the lower end of the pipe at a point three and one-half feet from the floor and at a distance of twelve inches in front of the subject. The subject held a shortened tennis racket in the non-dominant hand. The tennis ball had to be struck after it left the pipe before it hit the floor.

Scoring: The subject was asked to hit the ball against a target on a wall directly to the right (for right-handed subjects). The target was a standard forty-eight inch diameter archery target which was fastened to the wall. The target was divided into six scoring areas (see Figure 1), with the following point values:
Figure 1: Equipment for Novel Gross Motor Task
<table>
<thead>
<tr>
<th>Target Areas</th>
<th>Color</th>
<th>Point Values</th>
</tr>
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<td>blue</td>
<td>zero points</td>
</tr>
<tr>
<td>target border</td>
<td>white</td>
<td>one point</td>
</tr>
<tr>
<td>outer circle</td>
<td>white</td>
<td>three points</td>
</tr>
<tr>
<td>next circle</td>
<td>black</td>
<td>five points</td>
</tr>
<tr>
<td>next circle</td>
<td>blue</td>
<td>seven points</td>
</tr>
<tr>
<td>next circle</td>
<td>red</td>
<td>nine points</td>
</tr>
<tr>
<td>center circle</td>
<td>yellow</td>
<td>eleven points</td>
</tr>
</tbody>
</table>

A ball that landed on a line or between two areas was given the higher of the two score values. The subjects were given twenty-four attempts on each test: pre-test, mid-test, and post-test. Scores for each subject on each test were composed of the total number of points scored on the twenty-four attempts.

Experimental Design

This investigation utilized four groups which were randomly constituted. The four groups involved in this study used different practice methods during the practice sessions, and all instructions and procedures were conducted by the investigator.

Group A (Visual) consisted of twenty right-handed subjects. Twelve girls and eight boys were included in this group. They were conducted into the coach's office immediately following class roll call. They were seated in the office which was then darkened (see Appendix C).
Then, the film was shown which demonstrated the novel task. This procedure was followed for all four practice sessions.

Group B (Verbal) consisted of twenty-one right-handed subjects. Nine girls and thirteen boys were included in this group. They were conducted into the coach's office immediately following Group A. They were seated in the office which was then darkened (see Appendix D). The verbal tape recording, which described the novel task, was played (see Appendix E). This same procedure was followed for all four practice sessions. Three minutes were utilized for each session.

Group C (Undirected) consisted of eighteen right-handed subjects. Eleven girls and seven boys were included in this group. They were conducted into the coach's office immediately following Group B. They were seated in the office which was then darkened. They were instructed to mentally "think through" the actions they performed on the test (see Appendix F).

The procedure described above was followed for all four practice sessions. Three minutes were utilized for each practice session. The investigator remained in the room during each practice session.
Group D (Control) consisted of twenty-two right-handed subjects. Nine girls and thirteen boys were included in this group. They were conducted into the coach's office immediately following Group C. They were seated in the office which was then darkened. Then they were instructed on fundamental rules governing the game of basketball. This procedure was followed for all four practice sessions. Three minutes were utilized for each rules session. The instructions and discussions were led by the investigator.

**Statistical Tool**

The analysis of variance was employed to determine the significance of differences of means among and within groups.

**Equipment**

**Target.** A standard forty-eight inch diameter archery target was used for the target area for the novel task. The target measured fifty-six inches wide by fifty-one inches high. Each circle was four and three-fourths inches in width.

**Tennis Ball.** Four dozen new Pennsylvania brand tennis balls were used.
Shortened Tennis Racket. A Wilson tennis racket was used for this experiment. The handle was shortened so that the total length of the racket was altered from the normal twenty-seven inch length to a length of seventeen and one-half inches.

Summary

The purpose of this study was to determine the relative effects of different methods of mental practice on the learning of a novel gross motor task. Group A (Visual) practiced the novel task while relying upon visual cues, Group B (Verbal) practiced the novel gross motor task while relying upon verbal cues, Group C (Undirected practice) practiced the novel gross motor task while relying upon undirected mental practice, and Group D (Control) received no practice time.

The eighty-two students were randomly grouped into one of the four groups. Each subject performed the pre-test, mid-test, and post-test. Each test consisted of twenty-four attempts at the novel task. Each mental practice group participated in one day of introduction and pre-test; two days for mental practice; one day for mid-test; two days for mental practice; and, one day for post-test. Three minutes were utilized for each mental practice
Chapter IV will present and analyze the experimental data obtained from this investigation.
CHAPTER IV

ANALYSIS OF DATA

This chapter contains a description and analysis of the experimental data obtained from this investigation.

Data

The experimental data were obtained through the administration of a pre-test, mid-test, and post-test to each of the eighty-two participants at Bethany Junior-Senior High School, Bethany, Oklahoma. Each individual was permitted twenty-four attempts at performing the novel task during each test. Each attempt was scored. The scoring for each of the three tests of twenty-four trials each made up the experimental data for each participant.

At the close of the post-test the individual data sheets were grouped at random into the four testing groups as described in Chapter III. The data were then processed by using a computer system; the IBM 1130 System (8k) Single Disk Drive. This consisted of the 1131 IBM Console Printer, the 1131 Processor, the 1132 IBM Printer and 1442 Card Printer.
Analysis of Data

The data were analyzed by the IBM computer using the analysis of variance method. First, the means were computed for each group for each test administered. The analysis of variance was computed to determine the significance of variations among and within groups. Tables I, II and III show the results of the analysis of variance for the pre-test, mid-test and post-test mean scores respectively, in the ball hitting task.

TABLE I
ANALYSIS OF VARIANCE FOR THE PRE-TEST

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>df</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Means</td>
<td>512.1</td>
<td>170.9</td>
<td>3</td>
<td>.12</td>
</tr>
<tr>
<td>Within Means</td>
<td>101858.3</td>
<td>1305.9</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>102370.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE II
ANALYSIS OF VARIANCE FOR THE MID-TEST

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>df</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Means</td>
<td>932.1</td>
<td>310.7</td>
<td>3</td>
<td>.23</td>
</tr>
<tr>
<td>Within Means</td>
<td>107310.8</td>
<td>1375.8</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>108242.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE III  
ANALYSIS OF VARIANCE FOR THE POST-TEST

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>df</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Means</td>
<td>1122.4</td>
<td>374.1</td>
<td>3</td>
<td>.24</td>
</tr>
<tr>
<td>Within Means</td>
<td>117743.4</td>
<td>1523.9</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>118865.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The resultant F ratios of .12, .23 and .24, respectively, for the three tests were not found to be significant at either the .01 (4.04) or the .05 (2.72) levels of confidence. As shown in Tables I, II, and III, there were no statistically significant differences found between the motor performance of any of the four groups throughout the investigation.

Examination of the mean scores presented in Table IV revealed that the motor performance of all groups improved throughout the investigation.

The t-test results indicated that Groups A (Visual) and D (no practice) improved between the pre-test and mid-test significantly at the .01 level of confidence, and Groups B (Verbal) and C (undirected) improved significantly at the .05 level of confidence. There was no statistically significant improvement in the motor performance mean
TABLE IV
MEAN SCORES BY GROUPS ON PRE-TEST, MID-TEST AND POST-TEST

<table>
<thead>
<tr>
<th>Group</th>
<th>Means on Tests</th>
<th>t Score Pre Mid</th>
<th>Significance</th>
<th>t Score Mid Post</th>
<th>Significance</th>
<th>t Score Pre Post</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Visual)</td>
<td>80.45</td>
<td>116.15</td>
<td>123.45</td>
<td>3.25</td>
<td>.01</td>
<td>.79</td>
<td>-</td>
</tr>
<tr>
<td>B (Verbal)</td>
<td>79.40</td>
<td>107.36</td>
<td>114.86</td>
<td>2.36</td>
<td>.05</td>
<td>.56</td>
<td>-</td>
</tr>
<tr>
<td>C (Undirected)</td>
<td>74.16</td>
<td>110.77</td>
<td>123.94</td>
<td>2.79</td>
<td>.05</td>
<td>1.03</td>
<td>-</td>
</tr>
<tr>
<td>D (No practice)</td>
<td>80.50</td>
<td>114.00</td>
<td>118.95</td>
<td>3.33</td>
<td>.01</td>
<td>.42</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Sigificance levels are indicated at .01 and .05.
scores between the mid-test and post-test in any one of the four groups. The motor performance mean scores for each group were all statistically significant between the pre-test and the post-test; Groups A, C, and D at the .01 level of confidence, and Group B at the .05 level of confidence.

A graphic presentation of motor performance group mean scores for each of the four groups on each of the three tests appears in Figure 2. Observation of the performance direction lines for each group indicated that each group improved throughout the investigation, and were continuing improvement at the time of the post-test. Also, Groups A, B, and D were indicating a possible tapering off toward a performance plateau or possibly a decline, while Group C (undirected) appeared to be continuing a relatively greater improved performance as compared with the other groups.

Chapter V presents a discussion of the findings as determined from the preceding analysis of the data.
Differences Between the Pre-test, Mid-test, and Post-test Mean Scores for Each of the Four Groups
CHAPTER V

DISCUSSION OF FINDINGS

The problem under investigation in this study was to determine the effects of visual mental practice, verbal mental practice, undirected mental practice, and no practice in the learning of a novel gross motor task. This chapter contains a discussion of the findings.

Data

The experimental data were composed of pre-test, mid-test, and post-test mean scores computed from scores for twenty-four attempts on each test of the novel task. A set of totals cards containing the sums of a person's pre-test scores, mid-test scores, and post-test scores (Appendix G) were analyzed by using the IBM 1130 System (8k) Single Disk Drive Computer.

Analysis of Data

The means were computed from the respective test scores for each group, and the analysis of variance was then computed to determine the significance of variations among and within groups.
The analysis of variance computed on the mean scores of the pre-test, mid-test, and post-test revealed no statistically significant F ratios. It was determined that no differences occurred between the groups used (A, B, C or D) at the time of any one of the three tests.

The reasons for the low F ratios for the analysis of variance test could be any one of several possibilities. According to this study, as it was designed, the mental practice methods used were ineffective in changing motor performance significantly. It may also be noted that the number of practice sessions were limited to four, representing a relatively fewer number of practices than other studies, and perhaps an increase in practice sessions over a longer period of time would have been more appropriate to the nature of the mental practice methods used in this study. Also, the amount of time for each practice session could have been increased from three minutes. Possibly, one reason might have been the lack of consistency of individual scoring. Large variations occurred in scoring (one to eleven points) on the twenty-four attempts.

The novel gross motor task, on the pilot study, showed a test reliability of .99 established on scores made by ninth grade male volunteer subjects. This
investigation, however, used subjects of a slightly different age, and some of the different sex, both of these factors creating weaknesses in the study, possibly. The actual study included both male and female subjects, twenty-eight of which were eighth grade students. The physical development factors of those individuals in this age group varied considerably. Also, the concentration level seemed longer for the boys doing this physical task than the girls, perhaps indicating that the girls were not as challenged by this physical type test as were the boys.

Another possible reason for the lack of significant differences might have been the class schedule. The boys and girls alternated days in the gym which extended the study longer than originally planned for, and also allowed days between the study period which could have promoted boredom and indifference.

**t Test**

The t test was applied due to the relatively large increases between the group means from the pre-test to the mid-test and to the post-test. These tests were to check for variation between tests within each group.

The t tests conducted between the mean scores for each of the four groups on the three tests (pre-test,
mid-test, and post-test) indicated that each of the four
groups made statistically significant improvement in motor
performance between the pre-test and the mid-test, and be-
tween the pre-test and the post-test, and that no one
group improved significantly between the mid-test and the
post-test. Since the control group (Group D) improved as
much or more than the other groups, it was determined that
none of the experimental variables had a significant or
unique effect upon the performance. This may suggest that
improvement evidenced may be attributed to actual practice
of the task during the three testing administrations rather
than to the methods of practice employed.

Discussion

The findings from this study seemed to contradict
those from previous investigations in this area as seen
by the findings that no one mental practice method used in
this study was better than another or more effective in
significantly changing motor performance than another
method. The novel gross motor task proved to be a reliable
task and instrument for measurement of gross motor per-
formance. Therefore, since almost all previous studies
dealt with high school and college age subjects, it might
be concluded that the physical and mental development of
The age group which participated in this study might have influenced the statistics uniquely. It had been planned to use high school subjects (Grades 10-12), however, the teaching situation in physical education at Bethany Junior-Senior High School was such that requirements were usually fulfilled during the seventh and eighth grades for junior high, and during either the ninth or tenth grades for high school. Therefore, the majority of subjects for this study were eighth grade (twenty-eight) and ninth grade (thirty-eight) students rather than tenth through twelfth grade students. This may have
accounted for the apparent variability in scores, perhaps comprehension of task and practice methods, and possibly motivation.

It seemed evident that the concentration level of the subjects, especially eighth grade subjects, deteriorated toward the end of the study. When asked, after the experiment ended, what they thought about the experiment, most commonly expressed feelings were the following:

- tired of seeing the film (visual group)
- memorized practically the whole film (verbal)
- long sessions (undirected group)
- bored (all groups)

Through the introduction, pre-test, first two practice sessions, and the mid-test, the subjects in all groups seemed well motivated. However, after the mid-test subjects in all four groups seemed dissatisfied and bored. Figure 2 shows the increase in mean scores for all four groups, from pre-test to mid-test to post-test. It could be concluded that the majority of numerical increase in scores for all groups occurred from the pre-test to the mid-test.

Another factor which possibly could have influenced the outcome of the study was the design of the study. After the subjects were divided randomly into the four groups, they received their mental practice session
in the coach's office. The room was large and more than adequate for the sessions. It could be closed off easily and was very convenient to the gymnasium. However, as one group was practicing, the other three groups were engaged in some low-organized activity. From this activity a muffled noise could be heard in the coach's office. It was not loud, but nonetheless, probably caused some distraction especially later in the study. The distraction seemed to be greater later in the study due to a change in the low-organized activity which the students became very involved in and enjoyed. In addition, the subjects seemed anxious to return to the activity at times during the practice sessions. These various distractions seemed more apparent after the mid-test. Possibly this situation could have influenced the individual test scores and consequently the F and t test scores.

**Summary**

In summary, it can be concluded that no significant differences in performance were found between groups using the analysis of variance tests. Between the pre-test and mid-test, using the t test analysis, there was a slight significant difference (.05) found for Groups B and C, and a significant difference (.01) found for Groups A and D.
within groups. No degree of significant difference was found between any of the four groups mid-test and post-test mean scores. In addition, Table IV showed the performance of all groups to have increased significantly (Group B at the .05 level of confidence and Groups A, C, and D at the .01 level) between the pre-test and the post-test.

Since Group C (the undirected practice group) made the most significant gain numerically from the pre-test through the post-test (Table IV), and since no significant differences were found between any of the groups using the analysis of variance, it may be suggested that the differences of all the t test ratios (pre-test to mid-test, and pre-test to post-test) might not be due to the type of practice but possibly due to a practice effect when taking the test, and/or the various factors, such as motivation, concentration, and interest of the subjects throughout the duration of the investigation.

There may be indications drawn from the findings that the design of this study concerning mental practice apparently was not appropriately selected and/or executed for the age group ultimately and necessarily used.
CHAPTER VI

SUMMARY

This chapter contains the summary, major findings and conclusions of the study and recommendations for future studies.

Summary of Study

The purpose of this study was to determine the effects of visual mental practice, verbal mental practice, undirected mental practice, and no practice in the learning of a novel gross motor task.

Eighty-two students from Bethany Junior-Senior High School, Bethany, Oklahoma, were each randomly placed into one of four groups before the study began. On the first day of the study, the subjects were introduced and orientated to the experiment and then pre-tested. They engaged in two practice periods, each of which lasted three minutes, and performed the mid-test. Next, came two more practice periods (three minutes each) and the final post-test. The experiment lasted seven days for each group, boys and girls.
Each test consisted of twenty-four attempts at the ball hitting task. Each attempt was scored. The twenty-four scores were totaled for each test and this constituted the data for each individual.

An analysis of variance was used to determine comparisons of group mean scores for among and within group variations. A t test was computed to check for within group variations for the pre-test, mid-test and post-test mean scores.

The ball hitting task consisted of the underhanded hitting of a tennis ball against an archery target for points. The point system ranged from one to eleven. The tennis ball had to be hit after it left the lower end of the pipe structure and before it hit the ground. The subjects used a shortened tennis racket to strike the ball.

Major Findings
1. The results of the analysis of variance method used to analyze the data indicated that there were no significant differences found among Groups A, B, C, and D at the time of any one of the three tests administered.
2. None of the mental practice experimental training methods used had an effect that was
significantly more or less effective than no practice at all.

3. It was determined from the results of the t test applied to determine if differences existed for any one group between the pre-test, mid-test and post-test mean scores that:
   a. The majority of motor performance improvement for each group occurred between the pre-test and the mid-test.
   b. All groups increased performance significantly between the pre-test and post-test, and no one group increased performance significantly between the mid-test and the post-test.

4. Examination of the performance direction lines as presented in Figure 2 indicated that improvement for all groups was approximately parallel suggesting that all groups progressed at an equal rate.

Conclusions

The findings indicate an acceptance of the null-hypothesis within the scope and limitations of this study:
There is no difference in the degree of learning a novel gross motor task resulting from visual filmed, verbal taped, undirected mental, and no practice methods of practice.

It may be further concluded that the design of this study concerning mental practice apparently was not appropriately selected or executed for the age group ultimately and necessarily used.

Recommendations

If this or a similar study was to be conducted in a physical education classroom, several factors relative to the design and procedure of the study should be considered as cited below:

1. It seemed that the age group used, (twenty-eight eighth and thirty-eight ninth grade students), lacked the level of maturity needed for prolonged self-concentration and self-motivation required. Perhaps high school and/or college age students would have been more desirable subjects for this study.

2. Any distractions in the form of nearby noises and activities, especially curious and interesting ones, should be eliminated or minimized.

3. It would be considerably better to have all four
practice sessions going on independently of each other and at the same time.

4. It would seem advisable, for supervision purposes, to use an individual other than the instructor for recording the scoring attempts on the pre-test, mid-test, and post-test.

5. The total length of the study and testing and practice sessions might be lengthened to include more and longer practice sessions. The longer study would necessitate a deeper concern about promotion of motivation, concentration, and interest factors of the subjects. (A five-day physical education week for the subjects, rather than an alternating class schedule should be more suitable for this type of study). Possibly, this longer study would allow the learning curve to continue to rise to reach a plateau or decline.
LIST OF REFERENCES


   Teachers College, Columbia University:
   New York, 1913.

22. Thorndike, Edward L. *Educational Psychology.*
   Teachers College, Columbia University:
   New York, 1914.


APPENDIX A

EXPERIMENT ORIENTATION
(Taped Recording)

I am pleased that you students are going to help me conduct my Master's Degree thesis experiment. This is a study designed to examine different types of practice in learning a novel physical task. A novel task is simply a task with which you are not familiar and have not performed before. The different types of practice involve different ways in which we might practice and learn to perform a task.

The study will last approximately three weeks. You will be given a pre-test which consists of performing the novel task twenty-four times. This will be done by all groups. We will then divide up into different groups. Each group will meet approximately three minutes a day two days a week for one week. After the first week you will perform a mid-test which again is twenty-four attempts at the novel task. You will then engage in three minutes of practice a day two days a week for another week. You will then perform the post-test which, again, is twenty-four attempts at the novel task. That will complete the experiment.
A tape recording will be used to explain all equipment and test procedures utilized in the experiment. This is to insure that all of you will receive identical instructions.

The experiments success is dependent upon you. It is very important that you listen and follow all instructions carefully. It is necessary that you try your best in both the practice and testing sessions. You are asked not to discuss the experiment with anyone and not to practice on your own. Only during the practice and test sessions should you concentrate on the novel task. Again, I hope you will try to follow directions and do your very best throughout the experiment.

If it is possible to do so, I will report back to you after the experiment, what the results of the study indicated.

I appreciate your participation in this study.
APPENDIX B

INTRODUCTION TO PRE-TEST NOVEL GROSS MOTOR TASK

(Remember the students will be looking at the novel task structure.) You are going to perform a novel task for me. As you may remember a novel task is simply a task with which you are not too familiar and have not performed before. You will stand facing the lower end of the pipe with a short tennis racket in your non-dominant hand. If you are right handed you would hold the racket in your left hand and if you are left handed you would hold it in your right hand. A tennis ball will be placed in the upper end of the pipe and allowed to roll down freely. The object of the task is to hit the ball after it leaves the lower end of the pipe and before it hits the ground and to hit it at the center of the target. The ball will be hit toward the archery target and points will be recorded for each attempt. The point system is as follows: target border equals one point; outer most or white circle equals three points; black circle equals five points; blue circle equals seven points; red circle equals nine points; and the yellow center or "bulls eye" circle is equal to eleven points.
As soon as you hit one tennis ball another one will be placed in the upper end of the pipe. You will receive twenty-four attempts in performing the novel task.

Try to concentrate and do the very best you can each time you practice or perform the test.
APPENDIX C

INTRODUCTION TO VISUAL PRACTICE SESSION

You are now going to practice the novel task. It is very important that you watch carefully the film recording. I hope you will concentrate and try to do your very best in visualizing yourself going through the procedures on the film.

It is important to the study that you try to get as much from each practice session as you possibly can.
APPENDIX D

INTRODUCTION TO VERBAL PRACTICE SESSION

You are now going to practice the novel task. It is very important that you listen carefully to the tape recording. I hope you will concentrate and try to do your very best in visualizing yourself going through the procedures on the tape.

It is important to the study that you try to get as much from each practice session as you possibly can.
APPENDIX E

VERBAL PRACTICE SESSION

Tape Recording

Structure. The equipment for this task consists of two wooden supports with a metal pipe resting at a slight angle (15°) on them. The opening at the lower end of the pipe is cut at a 45° angle to allow for a view of the ball just prior to its leaving the pipe. From the lower end of the pipe to the ground is a distance of three and one half feet. The ball coming out of the pipe would hit the floor approximately twelve inches in front of the pipe if allowed to drop.

A forty-eight inch archery target is placed at a 90° angle ten feet away and to the side of the pipe structure. The middle of the target is placed directly in front of the spot where the tennis ball reaches the three foot level. Also the "bulls eye" or center of the target is three feet above the ground.

A shortened tennis racket is held in the non-dominant hand. If you are right handed you would hold the racket in the left hand and if you are left handed you would hold it in your right hand.
Stance. You should stand facing the lower end of the pipe and approximately three feet away from it. The feet should be shoulder width apart and parallel to each other. You should bend your knees slightly and bend forward at the waist to gain proper balance and posture control. Due to the limited amount of reaction time available to you when the ball comes out of the pipe, there should not be a back swing to the racket. The arm is extended away from the target at a 15° to 45° angle away from the mid line of the body. The left elbow should be bent at approximately a 45° angle and the wrist "cocked" back. The forward swing is begun from this position. The eyes are focused on the lower end of the pipe waiting for the tennis ball to come out. When the ball is contacted it is necessary to follow through toward the target. The follow through could be described as reaching toward the target after the ball is contacted. As you hit one tennis ball another will be placed in the upper end of the pipe and allowed to roll down freely.

Procedure. Each attempt is scored. The point system is as follows: target border equals one point; outer most or white circle equals three points; black circle equals five points; blue circle equals seven points; red circle equals nine points; and the yellow center or
"bulls eye" circle equals eleven points.

Since the lower end of the pipe is three and one-half feet off the ground and the "bulls eye" of the target is three feet off the ground there is time to hit the ball while it is still higher than the "bulls eye". The tennis ball should be hit above the three foot level to allow for a downward fall of the ball toward the "bulls eye" of the target. You should allow for the twelve inch forward movement by the ball toward you as it comes from the pipe and realize that the ball should be contacted between the three and three and one-half foot level if possible.
APPENDIX F

INTRODUCTION TO UNDIRECTED PRACTICE SESSION

You are now going to practice the novel task. It is very important that you think carefully about the novel task that you performed on the pre-test. I hope you will concentrate and try to do your very best in visualizing yourself going through the procedures that you performed on the pre-test.

It is important to the study that you try to get as much from each practice session as you possibly can.
APPENDIX G

Format of the Totals Data Card

<table>
<thead>
<tr>
<th>Card Columns</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Identification</td>
</tr>
<tr>
<td>3</td>
<td>Sex 1=male 2=female</td>
</tr>
<tr>
<td>4-5</td>
<td>Group level</td>
</tr>
<tr>
<td>6-8</td>
<td>IQ score</td>
</tr>
<tr>
<td>10</td>
<td>Group 1=A, 2=B, 3=C, 4=D</td>
</tr>
<tr>
<td>12-14</td>
<td>Pre-Test Totals</td>
</tr>
<tr>
<td>18-20</td>
<td>Mid-Test Totals</td>
</tr>
<tr>
<td>24-26</td>
<td>Post-test Totals</td>
</tr>
</tbody>
</table>

Note: This is the format of the totals data card which contained each individual's total score on the pre-test, mid-test, and post-test. Columns 1-2 contain an identification number for each subject 1 through 82. The third column tells the subjects' sex; 1 equals male and 2 equals female. Columns 4-5 tell the grade level of the participants. And, 6-8 originally was designed for the IQ scores but those scores could not be obtained for all individuals. Column 10 indicates which group the subject was in, A visual, B verbal, C undirected, or D control. Columns 12-14, 18-20, and 24-25 indicate the total score by the individual on the pre-test, mid-test, and post-test respectively.