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To the Graduate Council:

I am submitting herewith a thesis written by Cecil Louis Ruth entitled "Comparison of the Effects of Mental and Physical Practice Upon Performance as Measured by Accuracy of the Two-Hand Chest Pass in Basketball." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Physical Education.

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COMPARISON OF THE EFFECTS OF MENTAL AND PHYSICAL PRACTICE UPON PERFORMANCE AS MEASURED BY ACCURACY OF THE TWO-HAND CHEST PASS IN BASKETBALL

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Cecil Louis Ruth

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ABSTRACT

The intent of this study was to investigate the effect of mental practice on skill acquisition and improvement of accuracy of the two-hand chest pass in basketball. The study involved 64 elementary physical education students in grades six through eight at Medford School, Anderson County, Tennessee.

After an initial test of the AAHPER Push Pass for Accuracy Test, the subjects were randomly assigned to a physical practice group, a mental practice group, and a control group. The subjects participated in four practice sessions, a midtest for motivational purposes, and four more practice periods. During the eight experimental practice sessions, the physical practice group actually made one practice pass and 10 passes at the target daily, the mental practice group conceptualized performing the skill with the aid of printed instructions concerning mental practice and directions about the skill, and the control group participated in the regular physical education class without actually performing the skill physically or mentally. Finally, a posttest was administered to all three groups.

Analysis of variance was used to determine whether there was a significant difference among the groups. Analysis

of covariance was also used to determine whether there was a significant difference among the posttest scores of the three groups.

Results indicated that all three groups improved as a result of the practice schedules. The analysis of variance showed a statistically significant difference between the unadjusted posttest scores of the groups. However, the analysis of covariance, which corrected the posttest differences for initial differences, indicated that there was not a statistically significant difference among the three groups.

Therefore, it was concluded that all three groups improved in performance from the pretest to the posttest and that improvement was not statistically significant when comparisons were made between the groups. Thus neither group improved significantly more than the other two in performance of the two-hand chest pass in basketball.

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CHAPTER I

INTRODUCTION

The teaching of motor skills in physical education classes and athletics is a very important aspect of the total physical education program. The methods by which students are taught generally include a verbal description, demonstration, practice and evaluation. For a teacher or coach to utilize the most beneficial methods of teaching, they must use the means by which students may learn the skills most effectively. Many teachers and coaches are not aware of mental practice and its importance in aiding motor learning.

For many years, most people have only considered physical practice in acquiring skilled performance. While physical educators are cognizant that a relationship does exist between the mind and the body, they have for the most part neglected the mind when developing physical attributes thought to be essential for successful performance of a motor skill. About the turn of the century, however, some researchers began to consider the phenomenon of mental practice and its effect on the acquisition and improvement of physical performance. Since then many studies have experimentally tried to demonstrate the improvement in physical performance which can follow specific mental practice of a

motor skill. Many authors also have become interested and concerned about the use of mental practice and advocate its acceptance by physical educators and coaches as a means of increasing skill acquisition, the level of skill performance and retention of motor skills (1, 3, 13, 17, 23, 24, 26, 27, 29, 30, 31, 36, 48). Because of an interest in athletic performances where physical skills are required, the author is interested in the phenomenon of mental practice and its effect on acquisition and improvement of a motor skill.

I. STATEMENT OF THE PROBLEM

The intent for the present study was to investigate the effect of mental practice on skill acquisition and improvement of the two-hand chest pass in basketball.

II. PURPOSE OF THE STUDY

The purpose of this study was to determine the effect of mental practice on accuracy of the two-hand chest pass in basketball using elementary physical education students in grades six through eight.

III. IMPORTANCE OF THE STUDY

To participate effectively in basketball, the players must be able to execute certain basic fundamentals. One of these fundamental skills is passing, especially the two-hand

chest pass. Therefore, this problem was concerned with determining whether the use of mental practice by players can save time for the physical education teacher or the athletic coach by increasing the effectiveness and efficiency of the teaching-learning situation.

IV. LIMITATIONS OF THE STUDY

This study was limited to 64 elementary physical education students in grades six through eight at Medford School, Anderson County, Tennessee during eight practice sessions and three testing periods. Although the mental practice sessions were supervised by the investigator, the primary weakness of this study was the difficulty in determining whether or not the subjects were actually engaged in mental practice during the mental practice sessions. Another weakness was the possibility that some of the subjects may have engaged in physical or mental practice of the basketball passing skill outside of the experimental periods. Because no effective control was possible, the investigator relied on the complete cooperation of the subjects concerning no physical or mental practice except during the experimental sessions.

V. DEFINITION OF TERMS

Mental practice. Mental practice is the symbolic rehearsal of a physical skill in the absence of any gross

muscular movements (36:95). Although mental practice has been the term most frequently used, the same topic has been investigated under a variety of names such as covert rehearsal, imaginary practice, imaging, implicit rehearsal, symbolic rehearsal, mental rehearsal, and conceptualizing (11:472).

In this study, mental practice is defined as conceptualizing the performance of the two-hand basketball chest pass for accuracy. Printed sheets of instructions and cues were used to aid the mental practice sessions.

Physical practice. Physical practice refers to the overt practice of a physical skill.

In this study, physical practice involved actual performance of 10 two-hand chest passes for accuracy at a target.

CHAPTER II

REVIEW OF LITERATURE

The effect of physical practice on various skills has been studied extensively and many facts are well established in this field. Recently, numerous studies have also been conducted to determine the effect of mental practice on motor learning. Although the variables involved in mental practice are difficult to isolate and measure, some facts have been established which support the theory that mental practice can be effective, under certain conditions, in acquisition, retention and improvement of varied motor skills.

There is little doubt that an understanding of the effects of mental practice would be valuable to physical educators and athletic coaches, because what goes on in the mind of a learner before and after a practice session does seem to affect his performance of a motor skill. Therefore, a review of the related literature on mental practice was conducted to gain better insight into this phenomenon.

In addition to a review of studies concerned with mental practice, several authoritative opinions on this subject were found. As early as 1949, Twining (60:432) pointed out the need for physical educators to consider mental practice as a potential source for improving the teaching-

learning process. Harrison (17:75), Kretchmar (27:243), Frost (13:126), Buxton (3:18) and Richardson (36:95), in articles and reviews concerning mental practice indicated that mental practice should be used for skill acquisition and improvement. Several authors believed that just thinking about the physical performance of a motor skill, or mental practice, could result in physical changes within muscles that could aid actual physical performance. These authors were Morehouse and Miller (29:224), and Karpovich (23:45; 24:35). Other authors, Sorenson (48:387), Morrison (30:89), Oberteuffer and Ulrich (31:206), Kingsley (26:226), Lawther (28:78) and Barrow (1:281) advocated the use of mental practice to achieve better physical performance of motor skills.

Studies concerned with mental practice tend to substantiate these authoritative opinions and research in this area is extensive. A discussion of this research follows. For purposes of clarity, these studies will be discussed under the following headings: (1) mental practice and muscular activity, (2) mental practice and gross motor learning, and (3) mental practice and fine motor skill learning.

I. MENTAL PRACTICE AND MUSCULAR ACTIVITY

In the past two decades, some effort has been expended in experimentally demonstrating a relationship between mental processes and muscular activity. Shaw investigated the relationship between muscular activity and the mental processes. This research included imaginal lifting of weights ranging from 100 to 500 grams in 100 gram steps with a control weight of 250 grams. The conclusion of this experiment was that amplified muscle action potentials from the forearm during imaginal lifting of a weight showed that muscular activity occurs during such imaginal lifting (43:5).

After previously determining that more vivid imaginary lifting of weights by the wrists produced greater muscular action potentials of the forearm, Shaw further studied muscular action potential in imaginary typing, singing and playing a wind instrument. In this investigation, he also found that there was an increase in muscular action potentials in almost all of the muscle groups tested during the imaginary practice of the various tasks. However, Shaw concluded that there was not any good indication of localization to the muscle groups involved with the performances of the tasks (42:195).

Freeman, in an investigation of five intact muscle groups in humans, established "neuromuscular spread" during mental work and determined that a reduction of that neuromuscular activity could result from mental practice. He

studied levers that are concomitant with the flexion of the fingers of the right hand and found an increase in the tension of the quadriceps of both arms as a result of mental arithmetic. Therefore, Freemen conjectured that the "neuromuscular spread" was greatest to the muscular systems closely associated with the original action (12:479).

Start experimented with kinaesthesis, the perception of position and movement of one's body part in space, and mental practice. Twenty-one males attending a teachers' college were tested with the single leg upstart on the Olympic high bar after they had had six periods of mental practice. On the day after the test, the subjects' performances were rated by a group of experienced judges. The subjects also completed a kinaesthesis test which was compared to their performance scores. The findings of this study indicated that kinaesthesis was unrelated to the physical performance of a skill that was only mentally practiced (52:316).

According to Jacobson, contraction occurs in specific muscles when a person, lying relaxed with eyelids closed, engages in mental activity such as imagination or recollection. Evidence in this study indicated that the physiology of mental activity is not confined to closed circuits within the brain, but that muscular regions participate (20:677).

Kelsey reported a study with a two-fold purpose: testing the hypothesis that muscular endurance can be increased

through mental rehearsal of a particular item of endurance; and determining whether or not the increase would be as great or greater than that of physical practice. The total number of sit-ups was selected for the test. Practice conditions used in the study were mental, physical and no practice. Results indicated that muscle endurance of the abdominal and thigh flexor muscles is increased significantly over a twenty-day period by five minutes of daily mental practice of sit-ups. Because the increase was smaller than that achieved by physical practice, physical practice was recommended to increase muscular endurance (25:47).

Razor conducted a study using 91 male students enrolled in a junior college basic instruction program. The subjects were used to determine the effectiveness of mental, physical and a combination of mental-physical practice as a means of increasing dominant and nondominant hand grip strength. The Smedley Adjustable Hand Dynamometer was used to determine dominant and nondominant hand grip strength before, during and after the experimental periods. The experiment was conducted over a 10 week period with the physical practice group performing 10 "all out" contractions, five with each hand for 10 seconds each. The mental practice group followed the same procedure mentally. The physical-mental group practiced for nine sessions and then mentally practiced for nine sessions. Razor concluded that mental practice did not prove effective

as a means of increasing dominant hand grip strength and that physical practice was superior to mental practice as a means of increasing dominant and nondominant hand grip strength (35:93-95).

II. MENTAL PRACTICE AND GROSS MOTOR LEARNING

A number of studies have been reported concerning mental practice being beneficial in learning or improving physical performance of a gross motor skill. Vandell et al. studied the function of mental practice in the acquisition of motor skills by a series of standardized tests. The 36 subjects were males in junior high, high school and college. The physical skill utilized by the junior high and college level students was dart throwing while free throw shooting was the skill practiced by the high school subjects. After the initial test, the subjects were divided into three groups of fours. The groups were the nonpractice, actual practice and mental practice groups. The general conclusions indicated that a lack of definite mental or physical practice resulted in no improvement. However, daily physical and mental practice and mental practice resulted in improvement with mental practice appearing to be as effective as physical practice of the skill (61:243).

Start and Richardson investigated the efficiency of imagery being an important factor in the ability of a person

to improve in motor performance after mental practice. The vividness and autonomy of imagery of 32 male students were compared with the subjects' performance scores obtained at the first attempt to perform the single leg upstart on the high bar after it had been mentally practiced for six days. The vividness and autonomy of imagery were determined by tests during two weeks after the practice sessions. The results of this investigation indicated that neither vividness nor controlability of imagery separately predicts performance scores of a physical skill learned by mental practice (50:280).

Webb conducted an investigation to determine the effects of spacing various amounts of implicit rehearsals on the learning of an archery skill. The number of implicit rehearsals used were 8, 12 and 16 sessions over a period of seven weeks. Results of the study indicated that the greatest improvement was shown in the pattern of 12 implicit rehearsals for the one- and two-week periods. Webb also concluded, which was contradictory to most other findings, that implicit rehearsal was more effective in the beginning learning stages (62:2-4).

In another experiment, Twining selected a group of 36 college men at random and had them practice a ring-toss skill under one of three conditions. The first group of 12 subjects threw 210 rings at a target 10 feet away on the first and

twenty-second days. The second group threw 210 rings on the first and twenty-second days and 70 rings per day for the intervening 20 days. The third group mentally rehearsed the performance of throwing 210 rings on the first day, then mentally practiced the skill for 15 minutes daily for the 20 intervening days and then actually threw 210 rings on the last day of the experiment. Experimental results indicated a 4.3 percent improvement in the nonpractice condition whereas an increase in performance under the physical and mental practice conditions was 137.3 percent and 36.2 percent respectively. Conclusions, based on the results of this study, can be drawn that mental practice is effective in facilitating the learning of a simple motor skill (60:432).

Jones, using 71 male students from four college activity courses in badminton, compared the learning of the hock-swing upstart under two conditions of mental practice. The subjects did not receive any prior demonstration or physical practice procedures of the skill. One group received directed mental practice which included reading a mechanical analysis of the skill and the other group received undirected mental practice. After six periods of mental practice, extending over two successive weeks, the subjects were tested to determine how many had learned the skill. For a pass mark the subjects had to perform it successfully on two consecutive tries. Jones concluded that male university students could learn a gross

body skill by reading a mechanical analysis of a skill and then mentally practicing the skill. Moreover, undirected mental practice was found superior to directed mental practice as a method of learning (22:270).

Clark investigated the effect of mental practice compared with that of physical practice on learning the Pacific Coast one-hand foul shot. The 144 high school boys used in the study were equated into physical and mental practice groups. The basis for the grouping was the subjects' arm strength, intelligence and varsity, junior varsity and novice basketball experience. After an initial test of 25 foul shots, the physical practice group actually shot 25 foul shots on each of 14 days. Between the initial and final tests, the mental practice group shot 25 imaginary foul shots on each of the 14 intervening days. Results from this experiment indicated that mental practice was more effective for varsity and junior varsity subjects than for the novice group. However, physical practice was superior to mental practice in all groups (4:560).

Sheldon, in an investigation of the relative effects of mental practice and physical practice in improving the efficiency of the breast stroke, used 28 college women of varied swimming ability. The subjects were assigned to groups according to the distance they could swim using five breast strokes and efficiency in performing the breast stroke. For the three week experimental period the subjects in the

physical practice group swam five pool lengths using the breast stroke and five with a flutter board using the whip kick. Using coaching clues the mental practice group mentally rehearsed the same procedure. Sheldon concluded that improvement in ability was not significant even though both groups improved (45:28).

Tolley used the performances of a two-ball juggling task of 40 female college students to determine the effect of mental rehearsal in combination with distributed practice sessions. One group in this study followed a distributed practice schedule in executing 20 juggling attempts with mental rehearsal of the skill during five minute intervals between every five attempts. One attempt was defined as the number of successive catches made without missing the ball. Tolley concluded that a combination of distributed practice schedule and mental practice did not significantly improve college women's ability to perform a two-ball juggling task (59:31-3).

Shaw conducted a study to determine the effect of two methods of practice, physical and mental, on the shooting of free throws by a group of tenth grade boys. After an initial test of 25 free throws, the subjects were divided into the following three groups of 12 each: (1) a mental practice group, which practiced free throws mentally, (2) a physical practice group, which actually practiced free throws, and

(3) a control group, which after the initial test were allowed to continue their daily routine until the final testing day. Shaw concluded that tenth grade boys using mental practice or physical practice could improve in free throw shooting, but there was no statistically significant difference between the two methods (44:24).

Clayton used 56 male college beginning swimmers to determine the efficacy of the land-drill, implicit-rehearsal and the water-practice procedures in teaching the breast and crawl strokes. Before attempting the study the subjects were tested for personal fitness, swimming ability, motor ability and fear of water. After the screening, Clayton used modifications of four swimming tests to determine their improvement and concluded that neither method was significantly better. However, he felt that mental practice would have been more significant if the subjects were in advanced levels of skill development (5:118).

The problem of mental versus physical practice was investigated by Harby in a comprehensive study of a free throw shooting skill. Subjects were 250 males and the experiment involved varying the time span of mental practice periods from seven to 21 days. In the experiment, mental practice was obtained by viewing a movie which illustrated the skill. The results showed that a physical skill can be learned by using mental practice and that the effectiveness of mental

practice varies with the length of practice and subjects. It was also shown that there were no significant changes in four of the five groups which utilized the training methods involving mental practice. Harby concluded, however, that a combination of mental and physical practice is probably more effective than either mental or physical practice alone (16:507).

Twenty-nine female students in intermediate swimming courses in college were studied by Standridge to investigate the effects of mental, physical and mental-physical practice schedules in learning the whip kick. A pretest was given to determine the distance each subject could cover and a similar posttest was given after eight practice sessions. During each practice session the physical practice group actually swam five lengths, the mental practice group visualized swimming five lengths and the mental-physical practice group mentally swam five lengths for four sessions and actually swam five lengths of the pool the last four sessions of the study. Results indicated that all three groups improved, with only the physical practice group showing statistically significant improvement. Therefore, Standridge concluded that mental practice did not significantly improve performance of the whip kick but that a combination of physical and mental practice may be as effective as learning the whip kick solely by physically practicing the skill (49:24-6).

Burns studied girls in grades seven and 11 and college freshman women to investigate the effect of physical practice, mental and a combination of mental-physical practice on skill development of dart throwing. The procedure for each group was as follows: (1) the physical practice group actually threw 30 darts per day, (2) the mental practice group sat behind a ten-foot line while the instructor read written instructions on dart throwing and (3) the mental-physical practice group alternated physical and mental practice sessions on every other day. Conclusions were drawn that physical practice and a combination of mental-physical practice significantly improved the subjects' scores. However, the mental practice group did not show statistically significant improvement, even though this method seemed superior to the control group (2:49).

Swartzendruber, in a study to compare the effects of physical practice with the effects of an equal period of physical practice supplemented by mental practice on the performance of basketball shooting, used 45 male university students. Two pretests and two posttests were administered the first two days and the last two days of the experiment. Each test consisted of five warm-up shots and 20 test shots from a point located on the baseline fifteen feet from the basket.

On the basis of the subjects' average pretest scores, they were divided into three groups. After the pretest, the control group did not meet again until the posttest was given. During the five week experiment, the physical practice group shot 25 times, three days a week and the mental-physical practice group shot 25 times, three days a week, with an additional five minutes of mental practice. Swartzendruber concluded that physical practice and a combination of mental-physical practice resulted in a significant improvement in basketball shooting. However, there was no significant difference between the two training methods (58:39-42).

Corbin studied the effect of imagined practice on skill performances after exposing 31 high school subjects to real performances of a wand-juggling task. The task was a wand-juggling skill that involved tossing an 18 inch wand held suspended on two 36-inch wands. After practicing the skill for five days, the subjects were assigned to one of three groups. The mental and physical practice groups practiced 30 times daily for 13 days. The mental practice group performed the task mentally while the physical practice group actually performed the skill. The results of Corbin's test indicated mental practice to be effective in facilitating juggling performance in subjects having experienced actual practice, although the physical practice group was found to

be the superior type. Also, mental practice seemed to be better utilized when based on experience and when the performance of the skill was preceded by actual practice (8:534).

Another study, conducted by Surburg, compared the effectiveness of mental practice used in conjunction with audio, visual and audio-visual instruction of the forehand tennis drive by 183 students at St Paul's College in Concordia, Missouri. After the initial test, the subjects were divided into six experimental groups and one control which met three times per week for eight weeks. Of the groups involved in the experiment, one heard, one viewed, and one both viewed and heard a filmstrip on the forehand drive. Three other experimental groups received similar instruction, but engaged in an additional 10 minutes of conceptualized practice immediately following the filmstrip. None of the experimental groups actually practiced or performed the skill except on the days used for testing. Results of Surburg's study point out that mental practice has to be of a concentrated nature without interference from external stimuli to improve motor performance of the forehand tennis drive. Further, the audio presentation used in conjunction with mental practice was the most effective variable of instruction used (57:728).

Egstrom utilized 120 college men that were randomly assigned to one of six different groups to determine the

effects of varying combinations of manual and conceptualizing practices during learning of a paddleball skill. The skill required that the subject, while using a wooden paddle held in his nonpreferred hand, strike a small rubber ball so that it would hit a large target. The target, consisting of six concentrice circles, was mounted on a wall 20 feet away.

The subjects were given an initial test on their ability to perform the skill. This consisted of hitting 25 balls, being dispensed from a machine at the rate of one every 12 seconds, at the target. After the initial test, the subjects were randomly placed in one of six groups. These groups were as follows: (1) manual practice only, (2) early manual practice, then conceptualizing practice, (3) early conceptualizing practice, then manual practice, (4) alternate periods of manual and conceptualizing practice, (5) conceptualizing only and (6) control. Conceptualizing practice consisted of a timed five-minute period of mental rehearsal of the skill. Manual practice consisted of hitting 25 balls at the target each session of the four week study. After the practice sessions, a final test was given which was similar to the initial test.

The findings of this study indicated that mental practice was effective in acquiring and improving a paddleball skill. However, the manual practice group showed the most improvement. Egstrom concluded that alternating the two types of

practice resulted in equal performance to that of the manual practice group (11:472).

Shick studied the effect of mental practice on improving volleyball skills. The experimental periods involved 68 subjects for a five week period and 36 subjects for three weeks. The first substudies compared three minutes and one minute of daily mental practice with no practice. The other substudies compared an additional physical practice period of equal time with three and one minutes of mental practice sessions. There was no significant improvement in volleying, but Shick did conclude that for serving mental practice produced better results than no practice and that three minutes of mental practice was superior to one minute of mental practice (46:88).

'Oxendine conducted a study in three Philadelphia junior high schools with the pursuit rotor, a soccer-type kick and a modified jump shot to find the effect of different schedules of mental and physical practice in learning and retention of a motor skill. Two hundred and twelve seventh grade subjects, who were divided into four groups, practiced for seven days. During the experimental period, three groups followed different schedules involving proportional amounts of mental and physical practice while one group only physically practiced the skills. He concluded that a combination of physical and mental practice could be as valuable in learning a motor

skill as devoting the entire time to physical practice. Oxendine further concluded that up to 50 percent of the time in mental practice is as effective as 100 percent of the time in physical practice (32:755).

Phipps and Morehouse wanted to find whether mental practice was effective without previous physical experience in learning a hock-swing to a horizontal bar, a jump-foot or a soccer hitch kick. For five days prior to all subjects being tested individually on each of the skills, one group engaged in mental practice of the skills. Phipps and Morehouse found that after physical practice was introduced, the mental practice group required fewer trials to succeed in the hock-swing and jump-foot, but not in the soccer hitch kick. Therefore, they concluded that the effectiveness of mental practice without prior physical practice is specific to the skill and is more pronounced for simpler skills (34:773).

Duff, using 122 high school students, studied the relative effectiveness of physical practice and mental practice in improving the underhand basketball free throw. The subjects were divided into two comparable groups on the basis of the initial test of 20 underhand free throws. During the practice sessions, one group practiced mentally 10 underhand free throws and then actually shot ten. The other group actually performed 20 free throws during the experimental

period which extended over four weeks with 12 practice sessions. During the last practice session, all subjects were given a final test of 20 underhand free throws. The difference between the mean gains of the two groups, according to Duff, was not statistically significant. As a result of the experiment, Duff stated that neither physical practice nor a combination of mental-physical practice was more effective in improving the underhand free throw (10:36-8).

The purpose of the study by Codispoti was to determine the effect of mental and physical practice in relation to each other and a control situation. The two experimental situations and the control were given a pretest condition which was followed by a test score consisting of 20 basketball free throws.

The subjects were 20 male students from the regular physical education program at The University of Maryland. A five week training period for learning the test technique of shooting free throws was provided. Then, each subject was tested three times with each experimental condition for a total of nine test trials. Codispoti concluded that no statistically significant difference at the 0.05 level was found to exist among the three test conditions. The mental practice phases with and without the basketball produced better results. There was the possibility that mental

practice may have been influential since it was a common element in both experimental conditions (6:24-5).

Stebbins, using 93 subjects in five different men's physical education classes at Georgia Southern College, sought to determine the effectiveness of mental and physical practice in acquiring a motor skill and the possible differential effects of mental practice during stages of the learning period. The skill used was throwing rubber balls at a target from a distance of 15 feet. After a pretest of 100 throws, the subjects practiced for 18 sessions in one of five treatment conditions. Finally, all subjects were given a post-test. Results of this test showed that neither mental or physical practice was effective during the first half of the skill development period and that mental practice alone did not improve learning. Stebbins concluded that the only significant improvement occurred in the mental-physical treatment condition (55:714).

Corbin, in his test concerning mental practice and motor learning, investigated the effect of covert rehearsal and a combination of covert-overt rehearsal in the development of a motor skill. Corbin also attempted to ascertain whether or not different skill levels of performers might benefit from any specific type of rehearsal and to test the lasting effects of covert and overt rehearsal over a period of time. A wand-juggling task was used by 120 college volunteers. After a

pretest and 21 days of practice, the four experimental groups were retested. Then, for 30 days the subjects did not rehearse the skill. Finally, they were given a final test of the number of successive wand-juggling attempts out of thirty. Results of the study indicated that mental rehearsal alone did not improve skill learning and that no interaction effect between rehearsal type and skill level existed. Also, no type of rehearsal seemed to have a more lasting effect. The conclusion was drawn that actual experience at the task might be necessary if covert rehearsal is to be a variable in improving skill development (7:143).

Steel attempted to match 45 fourteen-year-old male subjects according to chronological age, intelligence, motor ability and physique to investigate the effect of mental practice on ball throwing. The mental practice subjects mentally rehearsed throwing a ball at a target ten minutes per day for ten days. The physical practice group actually threw 25 balls at the target for the same number of days. Steel concluded that daily mental practice produced a substantial increase in ball throwing accuracy, although a comparison of the improvement resulting from mental and physical practice revealed no significant differences (56:108).

Sixty junior high school boys were divided by Wills into three equated groups on the basis of a test of passing a football with accuracy and the Johnson Motor Educability Test.

One group practiced three days per week for five weeks taking five warm-up throws and then 30 passes at the target daily. The mental practice group read instruction sheets and then thought through the physical performance of throwing a football at the target. The control group participated in regular physical education classes. On the final football passing test, the physical practice group had a 50.4 percent gain in accuracy, the mental practice group had a 70 percent gain and the control group had a 12 percent gain. Wills concluded that the physical and mental practice groups had significant gains. The mental practice group increased significantly more in accuracy than the control group. The final differences between the physical and mental practice groups and between the physical practice and the control groups were not statistically significant (63:37).

Howe, using 122 volunteers enrolled as undergraduates at Texas Women's University, investigated the influence of five schedules of mental practice upon the physical performance of a novel gross motor skill after a criterion measure of a skill had been attained. For three consecutive days the subjects were allowed to physically practice the skill of juggling three balls for five minutes. On the fourth day an initial test, which consisted of the high number of successive catches achieved by each subject, was given. Then for six periods the five experimental groups practiced according to

their respective mental practice schedules and were tested to determine the influence of the various mental practice schedules.

Howe concluded that: (1) a combination of mental and physical practice of the skill of ball-juggling on a massed practice schedule was the most effective method to improve the performance of college women subjects, (2) massed mental practice utilizing the conventional technique of reading prepared instructions appeared to be more effective than any other practice schedule which employed mental practice only, (3) little improvement was evidenced between the initial and final tests of juggling ability by groups which employed distributed mental practice, (4) the technique of having the subjects prepare their own written instructions for the skill did not appear to be more effective than the method of reading prepared instructions, and (5) there was a positive correlation between the initial performance of ball-juggling by college women after physical practice and the improvement of their scores after periods of mental practice (19:73-4).

In regard to the relationship of intelligence to mental practice, Start conducted three similar studies (51, 53, 54). The studies involved high school and college students using the underhand basketball free throw and the single leg upstart. Generally, the results of these three studies showed that intelligence did not appear to aid physical

performance of gross motor skills after specific mental practice.

III. MENTAL PRACTICE AND FINE MOTOR SKILL LEARNING

Many studies have been reported concerning mental practice and its effect upon learning or improving physical performance of fine motor skills. One of the earliest studies was by Perry in which he used five tests to determine the efficiency of imagined practice and physical practice in learning motor skills. The tests involved three-hole tapping, card sorting, symbol digit substitution, peg board and mirror tracing. After completing preliminary and initial tests, the 52 elementary subjects were divided into three equated groups according to their initial scores. These were a control group, actual practice group and imaginary practice group. Perry utilized the subjects in a series of selected tests for five practice periods of 60 seconds for each test. The data indicated that imaginary practice was effective in improving the score in a variety of tasks, although the relative efficiency of actual and imaginary practice varies with the test being used. Perry also concluded that imaginary practice was more effective in tasks which consisted of learning facts that may be observed without actual movement (33:73-5).

Rubin-Rabson attempted to evaluate a further period of study or mental rehearsal situations after the subjects had already accomplished some keyboard learning. Prior to the keyboard trials the nine subjects received five minutes of analytical study away from the piano. The subjects were then divided into three groups which performed the experiment three times. After five trials, or midway in the learning, the subjects in the first group were asked to perform the material mentally with eyes closed and to refer to the music only if there was uncertainty in their mental performance. After four minutes of mental rehearsal, the subjects were required to complete a criterion of one smooth memorized trial. The second group carried the keyboard trials to the criterion and then added four minutes of mental rehearsal. The third group also reached the keyboard criterion and then added four minutes of additional keyboard trials. Rubin-Rabson concluded that mental practice was beneficial to retention in memorizing piano music. The midway period of mental rehearsal was proven superior to the other time distributions (38:600).

Gilmore's problem consisted of determining the relative effects of three conditions on the performance of a Munn type ball and socket learning task. A total of 108 randomly selected right-handed male elementary psychology students were used. Each of the 18 groups involved in the experiment

contained six subjects. In Phase I of the experimental design, three groups received a 50 motor trial pretest; three groups received directed mental pretest trials; and three groups rested. In Phase II, one pretest group, one mental pretest group and one nonpretest group received 50 motor training trials; one of each experimental conditions received 50 directed mental training trials; and one of each group rested. A posttest was given for all groups and Gilmore concluded that mental rehearsal produced a negative transfer effect which was significantly different from both motor and rest conditions (14:295).

Three groups of 20 subjects were used by Sackett to determine whether or not symbolic rehearsal has a beneficial influence upon the retention of a maze habit. Two groups were involved in two types of symbolic rehearsal and the third group was the control. One group was told to draw the maze as often as possible during the interval of seven days after learning. A second group was told to think through the pattern of the maze as often as possible during the week but not to draw or trace the maze. The following conclusions were drawn by Sackett. First, symbolic rehearsal in the forms of drawing and thinking were beneficial to the retention of a maze habit. Second, drawing rehearsal seemed to be more effective in its influence on retention than thinking (40:394).

Sackett, in another study, attempted to determine the relationship between varying amounts of symbolic rehearsal and retention. In this study Sackett used four groups of 25 women college students in learning a high relief finger maze. The rehearsal was in the form of thinking through the pattern of the maze in the interval between learning and relearning. The subjects in one group were instructed not to think of the pattern during the interval. Those in the other groups rehearsed the patterns mentally one, three or five times each evening, according to their group assignment. Sackett concluded that symbolic rehearsal in all groups was beneficial to retention of the maze after one week. There was also some evidence that the greater the number of rehearsals produced better retention. However, the gain was not proportional to the higher number of rehearsals (41:126-7).

Hackler used male industrial education students at The University of Maryland in an experiment to determine the role of mental practice in developing a selected psychomotor task. The manipulative criterion test utilized in the study consisted of having each subject run a manual arc welding bead in the horizontal position. The subjects' relative ability to control the arc gap and maintain the proper electron travel speed was reflected in the resulting scores. In this study, it was found that college level males learn the manual arc welding task by engaging in a combination of mental

and physical practice. The investigator suggested using mental practice in having students learn similar psychomotor tasks (15:5584).

Smith, in a study investigating the value of mental practice upon speed and accuracy of a skill, tested 60 university students in a one-minute speed test-retest on a three-hole stylus punchboard. Mental practice reduced the number of errors and increased the subjects' performances in this study. Smith concluded that accuracy was improved by mental practice, but that motor and guided practice did not (47:299).

IV. SUMMARY

A review of the literature found that some studies indicated an increase in muscular activity as a result of mental practice of various tasks. Start and Richardson (50), Shaw (42, 43), Freeman (12) and Jacobson (20) determined that mental practice increased muscular action potentials in muscle groups associated with the performance of various motor skills. Kelsey's study (25) found that mental practice increased muscular endurance of the abdominal and thigh flexor muscles, but Razor (35) determined that mental practice did not prove effective as a means of increasing dominant hand grip strength. Start (52), however, found that kinaesthesis was unrelated to the physical performance of a skill that was only mentally practiced.

Numerous studies were reviewed that concerned mental practice and performances of different gross motor skills. The majority of these studies have indicated that mental practice was effective in learning or improving physical performance of the skills. Of the studies reviewed, 31 studies found a positive relationship between mental practice and gross motor skill acquisition or improvement. Two studies, Stebbins (55) and Corbin (7), determined that mental practice did not improve gross motor skill acquisition or improvement.

Of the studies reported concerning mental practice and its effect upon acquisition, improvement or retention of fine motor skills, six investigations showed a positive relationship with only one finding a negative relationship. While Perry (33), Hackler (15) and Smith (57) found improvement as a result of mental practice, Rubin-Rabson (38) and Sackett (40, 41) determined that mental practice was beneficial in retention of fine motor skills. Gilmore's study (14), however, found that mental rehearsal produced a negative transfer effect.

Very few studies have been reported concerning an investigation of the effect of intelligence and mental practice on the performance of various motor skills. Only three experimental studies were reviewed in this paper and all three were conducted by Start (51, 53, 54). The general

conclusion based on the results of these studies was that intelligence did not appear to significantly influence motor gain after specific mental practice.

The effect of using mental practice in beginning and advanced levels of skill development was found to be more beneficial to subjects in advanced stages (4, 5, 8, 30). One study by Webb (62), however, indicated that mental practice proved to be more advantageous in beginning learning stages.

CHAPTER III

PROCEDURE

This study was conducted to compare the effects of mental and physical practice on accuracy of the two-hand chest pass in basketball. Primarily, the investigation had the purpose of determining whether the use of mental practice by players can save time for the physical educator or the athletic coach by aiding skill acquisition, improvement and retention.

I. SUBJECTS

The study initially involved 70 elementary physical education students in grades six through eight at Medford School, Anderson County, Tennessee. However, because of more than one absence six subjects were eliminated. Therefore, the study actually involved a total of 64 subjects.

II. TESTING PROCEDURE

The day before the experiment began the investigator discussed the study with the subjects and presented an outline of the testing sessions. At this time, the subjects were informed of the skill to be used in the study and given a description of the test, rules and scoring involved.

Written directions on the skill were distributed and discussed (see Appendix, page 59). Before dismissing the subjects, the investigator emphasized the need for complete cooperation on their part and perfect attendance.

The test used during the study was the AAHPER Push Pass for Accuracy Test. The purpose of the test was to measure accuracy with which a player could make a two-hand push pass at a target. The player with a basketball stood behind a line which was at a distance of 25 feet for boys and 15 feet for girls. The line was parallel to the face of the target and hung on a wall. The player used a two-hand chest pass and endeavored to hit the center of the target. The target was circular with three concentric circles separated by one-inch wide lines. The inner circle was 18 inches in diameter, the next circle was 38 inches in diameter and the outer circle was 58 inches in diameter. The bottom of the outer circle was three feet above the floor.

The rules of the test were:

1. Passes must be made with both feet behind the passing line.
2. The two-hand chest pass must be used.
3. Ten passes were taken, with one practice pass.

Scoring for the test was based on the three concentric circles. Three points were scored for balls hitting the center circle, two points for balls hitting the next circle

and one point for hitting in the outer circle. Hits on a line counted as the next higher area. Points as made on each pass were recorded and the total was the score. The maximum possible score was 30 points made on ten passes at the target (18:98).

On the day after the orientation meeting, the subjects read the directions on the skill again and were given an initial test which involved a practice pass and 10 passes at the target. The subjects were then randomly assigned to a physical practice group, mental practice group and a control group.

For the next four experimental sessions, the subjects practiced according to the following practice schedules:

Physical practice group. This group actually made one practice pass and 10 passes at the target each day.

Mental practice group. This group conceptualized performing the skill with the aid of printed instructions concerning mental practice (see Appendix, page 58) and directions about the skill (see Appendix, page 59).

Control group. This group did not practice the skill mentally or physically, but participated in the regular physical education program.

After the four practice sessions, the subjects were given a midtest. The purpose of this test was primarily motivational and was not intended to measure improvement.

Four practice sessions, similar to the previous four, were then attended by the three experimental groups. Finally, all subjects were given a final test identical to the initial test.

The results of the study were analyzed through the University of Tennessee Computing Center. An analysis of variance was used to determine whether there was a significant difference among the groups and an analysis of covariance was used to determine whether there was a significant difference among the posttest scores of the three groups.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this study was to determine the effect of mental practice on accuracy of the two-hand chest pass in basketball. Specifically, the intent of the study was to investigate the effect of mental practice on skill acquisition and improvement.

The purpose of this chapter is to present the statistical treatment of the data from the initial and final tests for the three groups.

Data were computer analyzed through The University of Tennessee Computing Center. The means and standard deviations of the pretest and posttest for each group are shown in Table I. For example, the mean scores for the physical practice group increased from 22.545 on the pretest to 24.364 on the posttest, indicating a mean difference of 1.819. The mean scores for the mental practice group improved from 20.435 on the pretest to 21.870 on the posttest. This illustrated a mean difference of 1.435. The mean scores of the control group also showed an improvement. The pretest mean was 21.158 and the posttest mean was 22.158, indicating a difference in the mean scores of 1.000. The pretest and posttest standard deviations for each group were as follows:

TABLE I

MEANS AND STANDARD DEVIATIONS OF PRETEST AND POSTTEST SCORES OF THE THREE GROUPS

Group	N	Mean Pretest	SD Pretest	Mean Posttest	SD Posttest	Mean Difference
Physical	22	22.545	4.925	24.364	4.604	1.819
Mental	23	20.435	6.841	21.870	5.102	1.435
Control	19	21.158	5.188	22.158	5.305	1.000

(1) physical practice group: 4.925 and 4.604, (2) mental practice group: 6.841 and 5.102, and (3) control group: 5.188 and 5.305. This data indicates that each group improved in performance during the experimental period.

The analysis of variance of the unadjusted posttest scores of the three groups appears in Table II. The analysis of variance was used to determine whether there was a significant difference among the groups. The calculated F value of 17.599 was significant at the 0.0001 level, indicating a statistically significant difference between the unadjusted posttest scores of the three groups.

The means of the adjusted posttest scores may be found in Table III. For example, the adjusted posttest mean for the physical practice group was 23.6901. This adjusted mean was lower than the unadjusted posttest mean of 24.364 shown in Table I. The mental practice group had an adjusted posttest mean of 22.4106 and an unadjusted posttest mean of 21.870. The control group showed an increase in the adjusted posttest mean of 22.2828 from the unadjusted posttest mean of 22.158 found in Table I.

The results of the analysis of covariance appear in Table IV. The analysis of covariance was used to determine whether there was a significant difference among the posttest socres. After posttest differences were adjusted for initial differences, an F test indicated no significant

TABLE II

ANALYSIS OF VARIANCE OF UNADJUSTED POSTTEST SCORES

Source	Sum of Squares	Degree of Freedom	Mean Squares	F	Prob>F
Regression	751.598	3	250.533	17.599	0.0001
Error	854.152	60	14.236		
Total	1605.750	63			

TABLE III

ADJUSTED POSTTEST MEANS OF THE THREE GROUPS

Group	N	Mean
Physical	22	23.6901
Mental	23	22.4106
Control	19	22.2828

TABLE IV

ANALYSIS OF COVARIANCE OF THE THREE GROUPS

Source	Sum of Squares	Degree of Freedom	F	Prob>F
Pretest	726.148	1	51.008	0.0001
Group	25.450	2	0.894	0.5828

differences between the groups. The calculated F value was .894, which was not significant at .05 percent level of confidence. Therefore, although the groups improved in performance from the pretest to the posttest, improvement was not significant when comparisons were made between the groups.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The intent of this study was to investigate the effect of mental practice on skill acquisition and improvement of accuracy of the two-hand chest pass in basketball. The study initially involved 70 elementary physical education students in grades six through eight at Medford School, Anderson County, Tennessee. However, because of more than one absence, six subjects were eliminated. Therefore, the study actually involved a total of 64 subjects.

After an initial test of the AAHPER Push Pass for Accuracy Test, the subjects were randomly assigned to one of three groups. The groups were a physical practice group, a mental practice group, and a control group. During the eight experimental practice sessions, the physical practice group actually made one practice pass and 10 passes at the target daily, the mental practice group conceptualized performing the skill with the aid of printed instructions concerning mental practice and directions about the skill, and the control group participated in the regular physical education class without actually performing the skill physically or

mentally. Finally, a posttest was administered to all three groups.

Analysis of variance was used to determine whether there was a significant difference among the groups. In addition, an analysis of covariance was used to determine whether there was a significant difference among the posttest scores of the three groups.

The results of the analysis of variance indicated a statistically significant difference between the unadjusted posttest scores of the three groups. However, after the posttest differences were adjusted for initial differences, there was not a statistically significant difference among the three groups.

II. CONCLUSIONS

The results of this study indicate that the following conclusions may be made:

1. According to the differences of the means of the pretest and the posttest, all three groups improved their performance accuracy of the two-hand chest pass in basketball.

2. Although all three groups improved from the pretest to the posttest, a sampling error caused the groups to be unequal at the outset.

3. When the posttest differences were adjusted for pretest differences, there was no differential treatment effect. Therefore, although the three groups improved in performance from the pretest to the posttest, improvement was not significant when comparisons were made between the groups. Thus, neither group improved significantly more than the others.

III. RECOMMENDATIONS

As a result of this study, the following recommendations may be made:

1. The number of practice sessions should be increased to allow for better indication of group improvement.

2. Different methods of group assignment should be utilized in an attempt to equalize the groups.

3. Other gross motor skills should be used.

4. Various combinations of physical, mental, and control group assignments should be employed.

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APPENDIX

SCORESHEET

Name:_____ Age:_____

Grade:_____

Initial Test	Practice Sessions	Midtest	Practice Sessions	Final Test
_____	1._____	_____	5._____	_____
	2._____		6._____	
	3._____		7._____	
	4._____		8._____	

Group Assignment:_____

METHODS OF MENTAL PRACTICE

1. One reading aloud of the written instructions by the investigator.
2. One reading of the written instructions silently by each subject.
3. A period of mental practice during which each subject mentally rehearses the skill.* (4 minutes).
4. Subjects write instructions for performing the skill correctly.

* Instructions for step three:

   a. Close your eyes.
   b. Imagine yourself stepping up to the line.
   c. Hold the ball correctly.
   d. Focus your attention at the target.
   e. Pass the ball correctly.
   f. Follow the flight of the ball toward the target. What were your imagined scores?

Total time: 10 minutes

DIRECTIONS FOR TWO-HAND CHEST PASS

Holding The Ball:

1. The ball should be held with both hands on the sides of the ball.
2. The fingers should be spread with the thumbs behind the ball pointing inward and slightly upward.
3. The ball should not touch the palms of the hands.
4. The player should hold the ball directly in front of the body, chest high.

Execution Of The Pass:

1. The ball is held close to the chest with the elbows in to the sides of the body.
2. The player takes a forward step with the left foot (right-handed players).
3. At the same time shift the weight forward and push the ball away by straightening the arms.
4. As the ball leaves the hands, the wrist and fingers snap slightly. This will bring the thumbs under the ball and give it backspin.
5. The passer should always follow-through. The arms should be extended out, with the palms of both hands even and facing the floor, and the thumbs pointing downward (39:15-16).*

*Rupp, Adolp. Adolp Rupp's Basketball Guidebook. New York: McGraw-Hill Book Company, 1967, pp. 15-16.

TABLE V

PHYSICAL PRACTICE GROUP TEST SCORES

Subject	Pretest	Posttest	Difference
A	16	21	5
B	20	23	3
C	16	15	-1
D	20	20	0
E	27	27	0
F	20	21	1
G	25	18	-7
H	23	26	3
I	23	21	-2
J	29	26	-3
K	19	19	0
L	30	30	0
M	19	25	6
N	13	28	15
O	27	28	1
P	25	28	3
Q	24	28	4
R	30	30	0
S	26	27	1
T	15	17	2
U	23	29	6
V	26	29	3

TABLE VI

MENTAL PRACTICE GROUP TEST SCORES

Subject	Pretest	Posttest	Difference
A	12	14	2
B	22	16	-6
C	22	20	-2
D	10	17	7
E	10	12	2
F	16	25	9
G	11	13	2
H	15	20	5
I	28	30	2
J	24	23	-1
K	27	22	-5
L	13	21	8
M	20	25	5
N	10	19	9
O	28	23	-5
P	24	21	-3
Q	20	23	3
R	26	23	-3
S	28	25	-3
T	29	25	-4
U	29	30	1
V	22	26	4
W	24	30	6

TABLE VII

CONTROL GROUP TEST SCORES

Subject	Pretest	Posttest	Difference
A	18	17	-1
B	15	14	-1
C	17	21	4
D	10	11	1
E	14	19	5
F	22	20	-2
G	28	29	1
H	26	18	-8
I	15	25	10
J	24	17	-7
K	23	28	5
L	26	24	-2
M	26	29	3
N	25	21	-4
O	22	23	1
P	23	25	2
Q	18	24	6
R	28	30	2
S	22	26	4

VITA

Cecil Louis Ruth was born in Cleveland, Tennessee on January 2, 1948. He attended public schools in Bradley County, Tennessee and was graduated from Bradley Central High School in 1966.

The following September he entered Florence State University, Florence, Alabama on a basketball scholarship. In June, 1970, he received a Bachelor of Science degree in Health, Physical Education, and Recreation. In the summer of 1970, he accepted a teaching and coaching position with the Huntsville City Schools of Huntsville, Alabama.

He accepted a teaching assistantship with Anderson County Schools, Clinton, Tennessee and The University of Tennessee in the summer of 1972. He completed his requirements for a Master of Science degree in Physical Education in August, 1973.

He is married to the former Linda Jean Ensley of Huntsville, Alabama.