CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

THE EFFECT OF VARIOUS PERIODS OF MENTAL PRACTICE ON THE LEARNING OF A NOVEL GROSS MOTOR TASK

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Arts in Physical Education by Jesusa Cuizon Curby

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The thesis of Jesusa Cuizon Curby is approved:

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TABLE OF CONTENTS

ACKNOWLEDGMENTS .................................................. iii
LIST OF TABLES ...................................................... vi
LIST OF FIGURES ...................................................... vii
ABSTRACT ............................................................. viii
CHAPERS

I. INTRODUCTION .................................................. 1
   Statement of the Problem
   Statement of the Purpose
   Scope and Limitations
   Hypothesis
   Assumptions
   Definition of Terms
   Organization of the Remaining Chapters

II. REVIEW OF RELATED LITERATURE ......................... 7
   Studies in Mental Practice Related to Physical Education
   Periods of Mental Practice Sessions
   Summary

III. RESEARCH PROCEDURES ..................................... 22
   Selection of Subjects
   Orientation
   Grouping of Subjects
   The Novel Gross Motor Task
   Description of the Task
   Equipment Utilized in the Task
   General Procedure
   Scoring Procedures
   Experimental Design
   Mental Practice Procedure
   Practice and Testing Environment
   Pilot Study
   Statistical Procedure
IV. PRESENTATION AND INTERPRETATION OF THE DATA

Criterion Test Reliability Analysis of Variance Discussion

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary Conclusion Recommendations for Future Studies

LIST OF REFERENCES

APPENDICES

Appendix A: Sample Survey Data Form for Selection of Subjects

Appendix B: Orientation of Subjects

Appendix C: Synchronized Live Demonstration and Verbal-Taped Instruction for Pre-test and Post-test

Appendix D: Reading and Verbal-Taped Instruction for Mental Practice

Appendix E: Sample Pre-test and Post-test Data Sheet

Appendix F: Individual Raw Scores
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Reliability Coefficients between Two Tests Using the Product-Moment Method</td>
<td>32</td>
</tr>
<tr>
<td>2.</td>
<td>Descriptive Statistics for the Pre-test and Post-test</td>
<td>33</td>
</tr>
<tr>
<td>3.</td>
<td>Analysis of Variance on the Post-test</td>
<td>33</td>
</tr>
<tr>
<td>4.</td>
<td>Analysis of Covariance</td>
<td>36</td>
</tr>
<tr>
<td>5.</td>
<td>Pre-test, Post-test, and Adjusted Post-test Means</td>
<td>37</td>
</tr>
<tr>
<td>6.</td>
<td>Tukey's Post Hoc Test</td>
<td>37</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1.</td>
<td>Bonus-Point Chart</td>
<td>24</td>
</tr>
<tr>
<td>2.</td>
<td>Graph of Improvement from Pre to Post-tests</td>
<td>34</td>
</tr>
</tbody>
</table>
ABSTRACT

THE EFFECT OF VARIOUS PERIODS OF MENTAL PRACTICE ON THE LEARNING OF A NOVEL GROSS MOTOR TASK

by

Jesusa Cuizon Curby

Master of Arts in Physical Education

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This experiment was conducted to determine the effect of various periods of mental practice time on the performance of a novel gross motor task.

Fifty-six college women who were enrolled at Los Angeles Pierce College volunteered as subjects for this experiment. The subjects were selected as a result of their unfamiliarity with the task.

Groups A, B, C, and D were randomly assigned from four similar activity classes. Group A mentally practiced the task for three minutes; Group B for six minutes; Group C for nine minutes; and Group D did not practice.

The experiment lasted five weeks with training sessions twice a week. The first week was devoted to the pre-test; the last week to the post-test.
The analysis of variance and covariance tests were used to treat the data. The data revealed significant differences between the three-minute mental practice group and the control group, but none of the three practice groups differed from each other. The results justified the null hypothesis that there is no significant difference in the degree of performance of a headstand for subjects who mentally practice for various periods of time.
CHAPTER I

INTRODUCTION

Finding the most effective way to teach a given physical activity is one of the major concerns of physical education teachers and researchers. There is a growing interest in improving the performance of physical education students, with an emphasis upon quick improvement and the retention of the desired performance.

Physical educators believe that one of the factors that facilitates learning and improvement is practice, or physical repetition of the assigned task. However, mental practice is another factor in the learning, improvement, and retention of a physical task. Mental practice is not superior to physical practice, but various studies have indicated that a combination of both is very effective for learning a motor skill. The function of mental practice as it affects the learning of a gross motor skill may be very significant in the teaching of physical education in our schools and in the coaching of various competitive sports.

Some of the many problems that prevail in our schools today are crowded facilities and limited physical education equipment. This is perhaps due to an increasing
number of students in physical education classes. Perhaps through mental practice, more efficient use might be made of these facilities and equipment. According to Oxendine (12:224):

Some research has shown that a systematic program of mental practice in conjunction with physical rehearsal might result in as much learning as would spending the full time in physical practice.

Problems of individual differences might be adequately met when techniques of mental practice are skillfully used (27). Start also suggests that individuals of low intelligence could also make use of mental practice (27:648).

According to Jones (7:271), research workers are beginning to realize more and more that the function of the brain in planning motor acts is a vital part of motor learning. It may be that physical practice which in the past has been deemed so important is primarily concerned with the refinement of movements, and that the major part of the mastery of an action is a central process, and not a peripheral one. It is pointed out by Cratty (4:215) that learning a complex motor act may be facilitated by "thinking through" the movement.

Oxendine (12:223) points out that the role of mental practice has not been thoroughly researched by general psychologists. He goes on to say that perhaps this is because they consider verbal learning, which consists solely of explanation and presentation, to be of greater
importance than the learning of motor skills.

Although many educators feel that the only way to learn a motor skill is through active participation, several experiments (6, 8, 12, 26, 27) support the contention that mental practice has certain advantages. Some of these advantages are: (a) specific mental practice aids in improving physical performance of a newly acquired motor skill (26); (b) highly skilled performers in athletics like gymnasts and divers always think their way through movement. They may be seen mimicking the movement prior to their performance (27). Therefore, highly skilled performers become more highly skilled; and (c) mental practice may save time and prevent physical exertion which results in fatigue (8).

The amount of time which should be devoted to mental practice is a major problem, one which researchers in physical education have been studying for more than two decades (14, 15, 17, 21, 22). Although there are researchers who have experimented using different amounts of mental practice time, the optimum amount to be spent on mental practice has not been determined (5, 14, 15, 17).

Statement of the Problem

The problem which stimulated this study is the lack of information regarding the optimum length of mental practice time that will promote the learning of a novel gross motor task.
Statement of the Purpose

The purpose of this study is to determine the effect of three-minute, six-minute, and nine-minute mental practice schedules on the learning of a novel gross motor task.

Scope and Limitations

It was not the intention of this study to compare the effects of mental and physical practice on the learning of a novel gross motor task, nor to determine what type of practice will best result in learning.

Sixty-two women who were enrolled in Body Dynamics classes at Los Angeles Pierce College during the spring of 1974 volunteered to participate in this study. They ranged in age from eighteen to twenty-four years. Fifty-six of these women completed the study. A short survey (Appendix A) was completed by students of each Body Dynamics class to determine which of these students would be acceptable to the study. Only those students without prior knowledge of gymnastics or related activities were chosen. Limitations of the study were: (1) lack of assurance that subjects did not engage in physical practice outside of the testing room which may have affected the results of the study, although it had been emphasized that subjects should refrain from such practice, (2) failure to control subjects' attitudes or thoughts before, during or after each experiment. The findings and results of this
study were confined only to the subjects used.

**Hypothesis**

The following null hypothesis was tested in this study: No significant differences exist among groups that mentally practice for various periods of time while learning a novel gross motor task.

**Assumptions**

It was assumed that the survey method used to select the subjects was accurate. Therefore, the subjects were assumed to be equal in ability prior to the pre-test. It was also assumed that each subject was performing to her maximum ability during both pre-test and post-test trials, without any type of motivation from the investigator. Furthermore, the subjects were assumed to be mentally practicing the task and that they understood the rest of the procedures.

**Definition of Terms**

For the purpose of interpretation and understanding of the terms used in this study, the following words were defined:

1. Mental Practice -- The practice of a task through reflective thinking. In mental practice, the physical movement of the body is eliminated. The method calls for the aid of recorded and visual instructions.
2. Novel Task -- Refers to a task that is new or unfamiliar to the subjects.

3. Gross Motor Task -- Refers to a motor activity which involves the whole body. In this study, a headstand was the given task. When the movement is properly executed, the center of gravity of the body is stable and balanced in relation to its base of support.

4. Learning -- The process by which a motor performance is developed or altered through practice or experience. In this study, the process is mental practice.

Organization of the Remaining Chapters

The contents of the remaining chapters include the review of literature in Chapter II which deals with the examination of studies that are explicitly concerned with effective mental practice. The experimental design, the methods, and the procedures used in this investigation are described in Chapter III. This chapter also includes further information regarding the subjects. Chapter IV contains the results, an analysis of the data, and a discussion of findings. The summary of the investigation, its conclusions, and the recommendation for future research related to this study are described in Chapter V.
CHAPTER II

REVIEW OF RELATED LITERATURE

It has been established that the learning of motor skills will occur in those organized physical education programs in which students actively participate (23:210). Moreover, the combination of mental practice with physical involvement is an effective learning technique.

The effectiveness of mental practice varies with the physical familiarity with the skill to be rehearsed (2). Even if the subject is only slightly familiar with the motor skill, mental practice can improve physical performance (26). Start contends that highly skilled performers in athletics have long been using mental practice:

Despite the fact that controlled experimentalations in the field is a recent feature, "mental practice" has long been used by top-level performers in most skills. The gymnast frequently "thinks" his way through movement. Similarly, whilst waiting on the high board, a diver frequently may be seen mimicking the movement he hopes to perform during his imminent dive (27:85).

In this chapter, the literature of the past five years of mental practice research will be reviewed.
Studies in Mental Practice Related to Physical Education

Perry (14) studied the relative effects of what he calls "actual" or physical and "imaginary" or mental practice using fifty-two boys and girls, ranging in age from nine to thirteen years. The IQ of the subjects ranged from 96 to 153. The subjects were divided into a control group, an actual practice group, and an imaginary practice group. They performed a variety of tasks such as a card sorting test, a three-hole tapping test, a peg board test, a symbolic digit substitution test, and a mirror tracing test. The results of the subjects' performances showed a significant improvement in the final score over the initial score. The duration of the experiment varied according to the task. The card sorting test took four days; the tapping test and symbolic digit substitution test lasted two days; five days were allowed for the mirror tracing test; and eleven days were used for the peg test. The final trials for each task were conducted immediately following four imaginary and four actual practice trials. The author concluded that: (a) imaginary practice is effective in improving the score in a variety of tasks; (b) the imaginary practice group improved two-thirds as much in the digit substitution test as did the actual practice group; (c) imaginary practice on the peg board test is almost as effective as actual practice; (d) there is no significant difference between the
imaginary practice group in the card sorting test and the actual practice group; and (e) imaginary practice is relatively less effective in the mirror tracing and hole-tapping tests.

A study on the psychology of memorizing piano music was conducted by Rubin-Rabson (19). Three skilled pianists were utilized in each of three groups. One group engaged in five physical trials followed by a four-minute mental practice, followed by more physical trials which were based on a criterion of one errorless repetition. This group showed significantly better retention one week later than either of the two other groups. One of these two groups engaged in physical practice based on a criterion of one errorless repetition, followed by a four-minute mental practice period. The other group engaged in physical practice based on the same criterion, followed by four minutes of further physical practice. The author concluded that intensive mental practice saves keyboard trials and is beneficial for memorizing piano music.

Vandell, Davis, and Clugston (35), attempted to isolate the effects of mental practice in the learning of dart-throwing and basketball free-throws. The subjects were selected from colleges, high schools and junior high schools. The investigators found that mental practice is about as effective as physical practice under the conditions of their experiment.
In a similar type of experiment, Twinning (34) used thirty-six college men who were randomly selected as subjects to toss rope rings at a wooden peg. He divided his subjects into a mental practice group, a physical practice group, and a control group. The experiment lasted for twenty-one days with mental practice and physical practice each lasting fifteen minutes per day. Results from the experiment indicated no significant learning among the control group, whereas the physical practice group improved 137 percent, and the mental practice group improved 36 percent. Both scores are significant at the .01 percent level of confidence. Some evidence from his study suggests that a period of five minutes is probably the longest period during which concentration can be maintained without a rest pause (34:435).

Clark (2) experimented with both mental and physical practice on a physical education skill. He made a comprehensive study of the Pacific Coast one-hand foul shot. He found that mental practice was nearly as effective as physical practice. The fifteen-day study revealed that while both mental and physical practice methods led to significant improvement in varsity and junior varsity performance, the beginning group was more successful with physical practice.

Start (27) investigated the relationship between intelligence and improvement in the performance of a gross motor skill. Forty-four male college students mentally
practiced the single-leg upstart on the Olympic bar with which they were unfamiliar. At the end of the six-day period, the subjects' ability to physically perform the skill was assessed and was compared with the scores they had obtained on a test of general intelligence. A significant negative correlation was obtained. Start explains that:

In the breakdown of the relation between intelligence and improvement, it appeared that highly skilled subjects tended to have a significant negative correlation between their skill scores and intelligence (27:88).

In another study, Start (26) attempted to determine the effect of both intelligence and mental practice on skill performance. His subjects were thirty-five boys, each aged fourteen. He found a significant improvement in shooting free-throws which was reinforced by mental practice, and he also found that the improvement was not significantly related to the initial score or to the intelligence of the individual performing the test.

The value of mental rehearsal for increasing muscular endurance was investigated by Kelsey (8). Thirty-six college men practiced sit-ups for five minutes per day for twenty-one days. It was concluded that the physical practice group showed a 322.8 percent gain in skill while the mental practice group showed a 29.1 percent improvement (8:50). Although the mental practice group improved significantly, the improvement was relatively low when compared with the results of the physical practice group.
A comparison study of effects of visual, motor, mental, and guided practice upon the speed and accuracy of a simple eye-hand coordination task was performed by Smith and Harrison (24). A one-minute test on a three-hole stylus punch board was administered to each of the sixty subjects. The subjects were divided into six groups. They were given different types of practice between the tests. The subjects were asked to place a metal stylus into three evenly spaced holes with optimum speed and accuracy. The motor practice group performed the task six times for ten seconds in the same manner as the initial test. The visual practice group focused their eyes on the holes and moved their eyes in the same direction as if they were performing the task. The reversed-visual group practiced by moving their eyes in the opposite direction as that of the visual group. The mental practice group was asked to close their eyes and to think about the task. The guided practice group performed the task with the help of the experimenter. With the subjects' eyes closed, the experimenter held their hand and guided them through the movement. The control group was instructed to read a text for the duration of the practice period. The results of the study indicated that the motor practice group, the reversed-visual practice group, and the control group improved significantly in the performance of a simple eye-hand coordination task in terms of correct hits and total number of trials. However, these groups did not reduce
The experimenter found the visual group and the mental practice group did reduce their total number of errors, and that they had improved their performance significantly in terms of correct hits and total number of trials. Therefore, the authors concluded that visual practice and mental practice improve accuracy in performing a simple eye-hand coordination task, whereas motor practice, reversed-visual practice and guided practice do not.

Another of Start's (28) investigations was concerned with relationships between a measure of kinesthesis and performance of a gross motor skill after a period of mental practice. The subjects were twenty-one male students who were unfamiliar with the criterion skill, the single-leg upstart on the Olympic bar. The subjects mentally practiced this skill for five minutes for six consecutive days. On the day following the final practice, the subjects were asked to perform the movements they had been mentally practicing, and their attempt was rated by three experienced judges. Subsequently, the subjects were given the Wiebe Test of Kinesthesis, and the scores obtained on the two were compared. It appeared that kinesthesis, as measured by the test used in this study, was unrelated to the physical performance of a gross motor skill which had been mentally practiced previously.

Start and Richardson (29) investigated the relation between combined vividness and control of imagery and
percent gain score from mental practice on a simple gymnastics skill. Vividness of visual and kinesthetic imagery was measured with the Sutcliffe test of voluntary imagery, while control of imagery was measured on a modified version of the Gordon test. The authors predicted that those with vivid controlled imagery would perform best; those with weak controlled imagery would come in second; and those with weak uncontrolled imagery or vivid uncontrolled imagery would come in third and fourth respectively. The results supported this prediction and a significant difference was found between these groups. The authors concluded that:

...perhaps there are only good and bad imagers without any real variation in modality, although from habit people might tend to use one imagery more than another or favour one because of the ease with which it can be verbalized (29:284).

Egstrom (6) conducted a study to investigate the effect on performance of varying combinations of mental practice and physical practice trials. Twenty males in each of six groups were used as subjects. Each group was given a physical performance test on the first, seventh, and thirteenth day. The subjects were asked to hit a small rubber ball against a target using a wooden paddle held in the subject's non-preferred hand. Different types of practice were utilized on the remaining days. The first group used manual practice, the second group practiced mentally, and the third group did not practice. A fourth
group alternated mental practice with physical practice. A fifth group received physical practice on the first five days and mental practice on the last five days. A sixth group received mental practice on the first five days and physical practice on the last five days. The group which alternated mental and physical practice improved most, but was not significantly better than the physical practice group. Egstrom concluded that mental practice is effective for learning a gross motor skill, and that alternating mental and physical practice exhibits certain advantages.

Ninety-three male volunteers were used as subjects in a study conducted by Stebbins (31) to compare the effects of physical and mental practice in learning a motor skill. The initial and final tests were administered to determine the increase in skill. The subjects were randomly assigned to a control group, a mental practice group, a physical practice group, a mental-physical practice group, and a physical-mental practice group. The subjects engaged in eighteen practice sessions. The practice periods consisted of throwing rubber balls at a target from a distance of fifteen feet. Different types of practice methods were given each group. The control group did not practice. The mental practice group was instructed to stand beside the subjects who were physically practicing the skill. They were asked to think and feel all the movement on the initial test and to mentally practice throwing twenty-five balls at a target. The physical
practice group practiced throwing twenty-five balls at the target. The mental-physical practice group was assigned to mentally practice the skill from the first through the tenth practice sessions. From the eleventh through the eighteenth practice sessions, the subjects were asked to practice the skill physically. The physical-mental group physically practiced the skill from the first to the tenth practice sessions, and mentally practiced the skill from the eleventh through the eighteenth practice sessions.

The results of the final test justified the author's conclusion that: the physical-mental practice and the mental-physical practice groups are superior to mental practice and control groups. "The position of the physical practice group was ambiguous. It was not significantly different from the control group and the mental practice groups, nor was it significantly different from the combination type treatments." (31:717)

Three separate experiments were conducted by Oxendine (13) to investigate the effect of different schedules of mental practice and physical practice on the learning and retention of three motor skills. Three out of four groups followed schedules which included different combinations of mental and physical practice, while one group engaged in physical practice only. Findings from the experiment led to the following conclusions:

...50 percent of the practice time (or trial) in mental practice can be as effective as 100 percent of the time in physical practice;
for the subjects within the normal intelligence range, IQ scores are not indicative of one's ability to benefit from mental practice; seventh grade boys respond favorably to the suggestion of mental practice. However, when used to excess (up to three-fourths) of the practice time some students become impatient with this technique... (13:755).

Phipps and Morehouse (15) investigated the effects of mental practice upon skills of varied difficulty. They utilized eighty male subjects, who were randomly assigned to either a control or mental practice group for the learning of three motor skills: the hockswing on a horizontal bar, the jump-foot, and the soccer hitch-kick. All subjects were tested individually on each of the skills, but one group engaged in five directed (verbal instruction) mental practice sessions spaced over a period of five days prior to being tested. Significant differences between groups were obtained for the hockswing but not for the other two skills. After mental practice was supplemented by physical practice, the mental practice group required fewer trials to achieve success in the hockswing and the jump-foot but not in the soccer hitch-kick. Phipps and Morehouse concluded that the effectiveness of mental practice prior to physical practice is specific to the skill and is more pronounced for the simpler skills.

Surburg (32) studied the effectiveness of mental practice when applied to three types of instruction. These were the audio, visual, and audio-visual presentation of
the forehand tennis drive. One hundred and eighty-three students were divided into six experimental groups and one control group. Of the first three experimental groups, one heard, one viewed, and one heard and viewed a sound filmstrip which described the tennis drive. The other three experimental groups received the same instruction, but they also engaged in ten-minute mental practices following each presentation. All six groups mentally practiced three times a week for a period of eight weeks. The last three groups showed a significant improvement in the execution of the forehand drive. Audio instruction used in conjunction with mental practice proved to be the most effective method.

In 1970 Shick (22) conducted three sub-studies to determine the effect of mental practice on serving and volleying skills in volleyball. The first sub-study compared three minutes of mental practice with no practice. Another sub-study compared three minutes of daily mental practice with an equal allotment of physical practice, and the third sub-study compared one minute of mental practice with one-minute physical practice. The first two sub-studies yielded significant results for the serving skills. Therefore, it was concluded that mental practice produces better results than no practice, and three minutes of mental practice added to equal time for physical practice is superior to one minute of mental practice plus equal
time for physical practice.

A recent study by Robertson (18) involved different methods of mental practice. The methods employ films to aid practice, verbal cues to aid practice, undirected mental practice, or no mental practice. The results of the study point out that:

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 (18:50).

**Periods of Mental Practice Sessions**

Different investigators have experimented with different periods of mental practice. Twinning (34) for example, ran his experiment for twenty-one days, with each mental practice session lasting fifteen minutes. However, he found that mental practice was effective only for the first five minutes, with concentration becoming increasingly difficult after that time. Rubin-Rabson (19) utilized four minutes of mental practice after five physical trials, and he found this practice period to be beneficial for memorizing piano music. Vandell, Davis and Clugston (35) used thirty minutes of mental practice on the second and nineteenth days of their twenty-day experiment, and concluded that mental practice is about as effective as physical practice. Steel (30) conducted his study for nine days, and found that mental practice lasting ten minutes
was effective. Similarly, Start (26) gave his subjects nine days of mental practice, but each practice lasted only five minutes. Surburg (32) directed ten minutes of mental practice three times a week for a period of eight weeks. Shick (22) concluded that three minutes of mental practice was superior to one minute of mental practice, when equal time was given to physical practice.

SUMMARY

The findings of each of the investigations discussed indicate that there is a positive relationship between mental practice and the acquisition of motor skill. Although much of the literature reveals that physical practice is superior to mental practice, a combination of physical and mental practice in some cases (7, 17) is more effective than physical practice alone.

Although there seems to be a general agreement that mental practice is a factor in learning specific skills, the relative effects of mental and physical practice vary with the task used.

Cratty (4:142-43) has drawn significant corollaries in regard to mental practice investigations:

- Mental rehearsal of the task will positively influence learning, particularly when combined with actual physical practice.
- The positive effects of mental practice are not influenced by slight differences in intelligence of the learner, and
Mental rehearsal is not influential on performance change in tasks requiring endurance.

Much of the literature establishes a close relationship between muscular activity and mental work. An increase or decrease may occur in muscular activity during the mental practice of a given task. Some authors (8, 14) also agree that there is involuntary neuromuscular activity during mental work.

Although the investigations discussed experimented with various periods of mental practice, they gave no indication of how much time should be spent on mental practice, thus suggesting this investigator's comparative study of various periods of mental practice.
CHAPTER III

RESEARCH PROCEDURE

The purpose of this study was to determine the effect of various periods of mental practice on the learning of a novel gross motor task. This chapter describes the general design of the study which includes the selection and grouping of subjects, the description of the task, the general procedure, and the experimental design.

Selection of Subjects

As noted previously, the subjects of this study consisted of sixty-two women enrolled in Body Dynamics classes at Los Angeles Pierce College in the spring of 1974. Their ages ranged from eighteen to twenty-four years. Because of absences and inconsistency in the training sessions, six of these subjects were eliminated from the experiment, leaving fifty-six subjects who completed the study.

A short survey (Appendix A) was completed by students of all Body Dynamics classes to determine which of these women would be acceptable to the study. Only those
students without prior knowledge of gymnastics or related activities were chosen. In addition, only those students enrolled exclusively in Body Dynamics were selected to make sure that the subjects were not participating in an activity related to the experimental task during the course of the study.

Orientation

After the subjects were selected for the study, they were asked to stay after class while the investigator read a brief introduction of the study (Appendix B).

Grouping of Subjects

Four Body Dynamics classes that met twice a week were randomly assigned to: (1) Group A - three minutes mental practice; (2) Group B - six minutes mental practice; (3) Group C - nine minutes mental practice; and (4) Group D - control.

The Novel Gross Motor Task

Description of the Task

A simple gymnastics skill, the headstand, was selected as the novel gross motor task for this study. Prior to the trial periods, a description of the task was carried out with the aid of a live demonstration by the investigator and a tape recorded instructions (Appendix C). The tape recorded instructions were based upon several gymnastics books (3, 10, 16, 20, 33) and the investigator's
experience as a gymnast and as a gymnastics instructor.

**Equipment Utilized in the Task**

The following is the equipment which was involved in the task: (1) a sixty by one-hundred-twenty by two inch gymnastics mat; (2) a sixty-second stop watch; (3) a tape recorder; (4) scoring sheets; and (5) the sixty by sixty inch bonus-point chart illustrated in Figure 1.

**Figure 1**

**BONUS-POINT CHART**
The General Procedure

The initial test for the task was administered immediately after a series of instructions by the investigator which included a demonstration of how to proceed along with the tape-recorded description. Each subject was taken to the testing room individually and given instructions. The same procedure was applied for the final test. After each subject was tested, she was allowed to return to her Body Dynamics class and to resume her activity.

Scoring Procedures

Each subject was given a pre-test and a post-test on the headstand. From the starting position, which was either the squat or straight leg position, the subject was given a command: "Ready--Go", by the investigator. The timer was started as soon as the feet of the subject were off the mat. A command: "Stop", was given each time the feet were lowered onto the mat. The score was the time in seconds that the subject's feet were off the mat. It was decided that a maximum of five seconds was to be allowed for each trial. This was based on the investigator's experience that a simple gymnastics pose should be held for only three seconds. Since the task was unfamiliar to the subjects, a maximum of five seconds was utilized.

In addition to the time score, bonus points were
earned according to the form or position of the body during the execution of the task (Figure 1). Bonus points for form were added to allow more objectivity to the test. To determine these extra points, the following criteria were designed:

<table>
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<tr>
<th>Body Position</th>
<th>Points</th>
</tr>
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<tbody>
<tr>
<td>(a) Between $0^\circ$ to $15^\circ$</td>
<td>0</td>
</tr>
<tr>
<td>(b) Between $16^\circ$ to $30^\circ$</td>
<td>1</td>
</tr>
<tr>
<td>(c) Between $31^\circ$ to $45^\circ$</td>
<td>2</td>
</tr>
<tr>
<td>(d) Between $46^\circ$ to $60^\circ$</td>
<td>3</td>
</tr>
<tr>
<td>(e) Between $61^\circ$ to $75^\circ$</td>
<td>4</td>
</tr>
<tr>
<td>(f) Between $76^\circ$ to $90^\circ$</td>
<td>5</td>
</tr>
</tbody>
</table>

However, when the subject assumed any of the above positions with the legs bent, toes not pointed straight ahead, or the body unstable, a score of one point was deducted. For example, when the body was positioned between $76^\circ$ to $90^\circ$ it was unstable or the legs were bent, one bonus point was deducted from the possible five points. When the subject fell over on her back she received no points for form. The highest possible score for each trial was ten points, five points possible for time and five points possible for form.

The pre-test and the post-test consisted of five trials and the average of the last three trials was computed as the final score (Appendix E). This is a modification from the pilot study wherein the average of
the five trials was computed as the final score.

**Experimental Design**

The experiment was conducted for five weeks. The first week was devoted to the pre-test and the fifth week was used for the post-test. The mental practice sessions lasted for three weeks with each session carried out twice a week. After the administration of the pre-test, each group was assigned the following mental practice procedure:

**Group A - Three Minutes Mental Practice**

1. Reading of the headstand instructions.
2. Listening to taped analysis of the task.
3. Three minutes of mental practice.

**Group B - Six Minutes Mental Practice**

1. Reading of the headstand instructions.
2. Listening to taped analysis of the task.
3. Six minutes mental practice.

**Group C - Nine Minutes Mental Practice**

1. Reading of the headstand instructions.
2. Listening to taped analysis of the task.
3. Nine minutes mental practice.

**Group D - Control**

1. No practice
Mental Practice Procedure

The subjects of each group were seated on the floor of the testing room facing a blank wall. The written instructions were distributed to each one, with the top page facing the subject. The top page reminded the subjects not to turn the pages until instructed (Appendix D).

A tape recorder was placed in front of the group. The recorded instructions were exactly the same as the reading instructions. The investigator turned on the tape recorder and the subjects listened to the introduction (Appendix D). The subjects read the instructions at the same time as the recorded instructions. The objective here was to make sure that all subjects would start and end their reading at the same time.

A recorded analysis of the task was played for the group. This consisted of teaching suggestions, mechanical analysis of the body position, and important things to remember while performing the task (Appendix D).

The subjects were advised repeatedly to refrain from practicing outside of the testing room and to forget about the task.

The mental practice procedure may be summarized in the following manner:

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-test (1 Day)</th>
<th>Training (6 Days)</th>
<th>Post-test (1 Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Headstand</td>
<td>3 minutes</td>
<td>Headstand</td>
</tr>
<tr>
<td>B</td>
<td>Headstand</td>
<td>6 minutes</td>
<td>Headstand</td>
</tr>
</tbody>
</table>
Practice and Testing Environment

The pre-test, post-test and the mental practice sessions were administered indoors throughout the course of the study in the first-aid room of the Women's Physical Education Department at Los Angeles Pierce College. The floor area was approximately sixteen by twelve feet. The doors remained locked throughout the experiment. All efforts were made to keep the lighting and temperature the same for each group. Fortunately, the experiment was never interrupted by accidents, or a fire drill.

During the pre-test and the post-test each individual was summoned from class and brought to the testing room by the investigator. After the trials they were allowed to return to their Body Dynamics class and to resume their activity.

Pilot Study

A short and simple pilot study was conducted in the Fall of 1973. Fourteen women volunteered as subjects. They were divided into two groups of seven each. A pre-test and a post-test were administered. The training period lasted for three days. The first group mentally practiced for one minute and the second group mentally
practiced for three minutes. A student t test was used to determine significant differences between the initial and final trials of each group, and to determine significant differences among the two groups.

There was no significant difference between the means of the initial and final trials of the one-minute mental practice group. A student t of 2.00 was not significant at the .05 level of confidence. However, the three-minute mental practice group improved significantly at the .05 level of confidence (t=3.43). Furthermore, the findings resulted in a significant difference between the final trial of the two groups. A t of 4.91 was significant at better than the .01 level of confidence in favor of the three-minute group.

The purpose of the pilot study was to determine whether the experimental task was workable, to establish a reliable apparatus, to determine the number of trials, and to recognize any modification that might be necessary in the experimental procedure.

**Statistical Procedure**

Because the pre-test scores differed for each group, an analysis of covariance was used to adjust the post-test means. When the covariance test resulted in a significant difference at a five percent level of confidence, Tukey's (9:471) post hoc test was used to determine which groups differed.
CHAPTER IV

PRESENTATION AND INTERPRETATION OF THE DATA

The purpose of this experiment was to investigate the effect of various periods of mental practice on the learning of a novel gross motor task. More directly, this study was conducted to determine which of the three mental practice groups would learn the most. The presentation and analysis of the data collected is presented in this chapter.

Criterion Test Reliability

For the sole purpose of determining the reliability coefficient of the experimental task, a group of thirty-nine women from various physical education classes volunteered to be tested on the headstand. Using the test-re-test method of correlation the r of .899 (Table 1) was established. The results are presented as evidence that the test is reliable.

Analysis of Variance

The analysis of variance test was used to determine
TABLE 1

RELIABILITY COEFFICIENTS BETWEEN TWO TESTS USING THE PRODUCT-MOMENT METHOD

<table>
<thead>
<tr>
<th>Test</th>
<th>No. of Subjects</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>39</td>
<td>10.60</td>
<td>2.69</td>
<td>.899</td>
</tr>
<tr>
<td>Day 2</td>
<td>39</td>
<td>12.71</td>
<td>2.36</td>
<td></td>
</tr>
</tbody>
</table>

the significant differences between the four groups on the pre-test and the post-test. Descriptive statistics for the pre-test and the post-test are presented in Table 2. In addition, a graph of analysis of variance from data gathered of all groups is shown in Figure 2.

An F ratio of 2.422 on the pre-test scores indicates differences in the means although the differences were not significant at the five percent level of confidence.

The analysis of variance on the post-test indicated significant differences between groups [P<.05] (Table 3). Specifically, the significant differences existed between the three-minute mental practice group and the six-minute mental practice group, and between the three-minute mental practice group and the control group.
### TABLE 2

DESCRIPTIVE STATISTICS FOR THE PRE-TEST AND THE POST-TEST

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deviation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
</tr>
<tr>
<td><strong>Pre-test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>4.75</td>
<td>2.09</td>
</tr>
<tr>
<td>Group B</td>
<td>2.59</td>
<td>2.37</td>
</tr>
<tr>
<td>Group C</td>
<td>3.19</td>
<td>2.29</td>
</tr>
<tr>
<td>Group D</td>
<td>3.04</td>
<td>2.28</td>
</tr>
<tr>
<td><strong>Post-test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>6.01</td>
<td>2.41</td>
</tr>
<tr>
<td>Group B</td>
<td>3.01</td>
<td>2.47</td>
</tr>
<tr>
<td>Group C</td>
<td>4.61</td>
<td>2.50</td>
</tr>
<tr>
<td>Group D</td>
<td>3.00</td>
<td>2.39</td>
</tr>
</tbody>
</table>

*Significant at P<.05

### TABLE 3

ANALYSIS OF VARIANCE ON THE POST-TEST

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Samples</td>
<td>88.04</td>
<td>3</td>
<td>29.35</td>
<td></td>
</tr>
<tr>
<td>Within Samples</td>
<td>310.59</td>
<td>52</td>
<td>5.97</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>398.63</td>
<td>55</td>
<td></td>
<td>4.913*</td>
</tr>
</tbody>
</table>

*Significant at P<.05
Figure 2

GRAPH OF IMPROVEMENT FROM PRE TO POST-TESTS

Average Score of Three Trials

Pre-test

Post-test

F = 2.42

F = 4.91*

Group
A
B
C
D

4.75 4.61
3.19 3.00
3.04 3.01
2.59

05*
However, the investigator felt that the result may be due to the rather large differences in the pre-test mean scores of the groups. Consequently, an analysis of covariance technique was used to adjust the post-test mean scores (Tables 4 and 5). A comparison of the adjusted mean scores yielded an F ratio beyond the required 2.75 for significance at the five percent level of confidence (Table 5). In order to determine where the differences existed between the groups, Tukey's post hoc test was used to treat the data (Table 6). The multiple comparison of the adjusted means revealed that the only significant differences were found between the three-minute mental practice group and the control group [P<.05].

**Discussion**

The findings in this experiment have indicated that there are no significant differences in learning between groups that mentally practice for various periods of time.

Although the analysis of variance on the post-test has determined that there were significant differences between the groups, the investigator assumed that this was due to the differences between the pre-test scores. Subsequently, an analysis of covariance technique was used to adjust the post-test mean scores. This treatment resulted in a significant F score of 3.032 [P<.05]. Tukey's post
### TABLE 4

**ANALYSIS OF COVARIANCE**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>YY</th>
<th>Sum-Squares (Due)</th>
<th>Sum-Squares (About)</th>
<th>DF</th>
<th>Mean Squares</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>3</td>
<td>88.0420</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>5.2</td>
<td>310.5894</td>
<td>156.9777</td>
<td>153.6117</td>
<td>51</td>
<td>3.0120</td>
<td></td>
</tr>
<tr>
<td>Treatment Error</td>
<td>5.5</td>
<td>398.6262</td>
<td>217.3934</td>
<td>181.0052</td>
<td>54</td>
<td>9.1311</td>
<td>3.032*</td>
</tr>
<tr>
<td>Difference for Testing Adjusted Means</td>
<td></td>
<td>27.3934</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at P < 0.05
TABLE 5

PRE-TEST, POST-TEST, AND ADJUSTED POST-TEST MEANS

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Adjusted Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.75</td>
<td>6.01</td>
<td>4.96</td>
</tr>
<tr>
<td>B</td>
<td>2.59</td>
<td>3.01</td>
<td>3.62</td>
</tr>
<tr>
<td>C</td>
<td>3.19</td>
<td>4.61</td>
<td>4.76</td>
</tr>
<tr>
<td>D</td>
<td>3.04</td>
<td>3.00</td>
<td>3.27</td>
</tr>
</tbody>
</table>

TABLE 6

TUKEY'S POST HOC TEST

<table>
<thead>
<tr>
<th>Groups</th>
<th>Adjusted Means</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3.26</td>
<td>3.62</td>
<td>4.76</td>
<td>4.96</td>
</tr>
<tr>
<td>A</td>
<td>3.26</td>
<td>0.1984</td>
<td>1.3379</td>
<td>1.6950*</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>3.62</td>
<td>1.1395</td>
<td>1.4966</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>4.76</td>
<td></td>
<td>.3571</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at P < .05
hoch test, when used to treat the adjusted mean scores, indicated that the only significant differences were found between Group A which mentally practiced for three minutes, and Group D which did not practice.

The six-minute mental practice group and the nine-minute mental practice group were not significantly better than the control group.

There are several reasons which might account for the lack of significance in the findings. One of these is concerned with the approach or focus of the classes in which the subjects were enrolled. Although each class' activities were similar, one group may have been undergoing circuit training, while other groups may have been concentrating on the AAHPER fitness program, or working on slimnastics and dance exercise, or perhaps emphasizing posture, balance and coordination. These differences may have had an effect upon the performance of the subjects in the experiment because of fatigue, or lack of it.

The insignificance of the findings may also be explained by the fact that six or nine minutes of mental practice is too long for the subjects. The subjects may have become bored and may have started thinking about something other than the experiment.

Another bar to concentration may have been the experimental environment. Despite the fact that the environment was kept as quiet as possible, various sounds such as automobiles, lawn mowers, and screams from other
activities nearby were audible. These noises may have interrupted the subject's concentration.

The duration of the experiment seemed too short. Six days of mental practice twice a week are probably not adequate. Scheduling problems for the subjects prohibited additional practice time. The literature indicated that most of the experiments lasted from seven to forty days (2, 6, 8, 32, 34). In addition, the interval of several days between practice sessions may have had an effect on the subject's attitude and performance. There was usually a four and five-day interval between each mental practice sessions.

The only other reason within the limit of this experiment for lack of significance in the findings is the difficulty of the training method itself. "Thinking" is too difficult to control. There is no way to measure what or how much the subjects are or are not thinking.

One positive finding that may be drawn from this experiment is that the group that mentally practiced the task for three minutes was significantly better than the group that had no practice. This indication appears to be similar to the findings of several researchers (6, 15, 30, 35), that mental practice may not be superior to physical practice but is better than no practice.

The conclusion based upon the analysis and interpretation of the data is presented in Chapter V. The chapter also includes the summary and recommendations.
CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

This experiment was designed to determine the effect of various periods of mental practice on the learning of a novel gross motor task. This was accomplished by having groups mentally practice for different periods of time.

Fifty-six women enrolled in physical education activities at Los Angeles Pierce College completed the study. Only those who were unfamiliar with the task were chosen. Four classes were randomly assigned to groups; Group A mentally practiced for three minutes, Group B mentally practiced for six minutes, and Group C mentally practiced for nine minutes. Group D was the control group.

The experiment lasted five weeks. The first week was a pre-test period followed by three weeks of mental practice (twice a week), and followed by a one-week post-test.

The test-retest method of correlation resulted in reliability coefficient of .899. An analysis of covariance indicated that there were significant differences.
between the groups \( P < 0.05 \). Tukey's post hoc test revealed that the significant differences were between the three-minute mental practice group and the control group.

**Conclusion**

The findings of the study indicate that while the group that mentally practiced for three minutes was significantly better than the control group, there were no significant differences between the mental practice groups.

The null hypothesis is accepted. Within the limitation of this experiment, the following conclusion appears justified: The success of headstand performance will not be affected significantly by mentally practicing for different periods of time.

**Recommendations for Future Studies**

The following recommendations are presented for future studies:

1. Since four selected classes were assigned to be groups, future investigation could employ a more random sampling of subjects.

2. The study could be repeated using another group for mental practice using only one minute.

3. One could use a gross motor task that is better suited to the age group, or use a fine motor task.
4. If possible, the experimental environment should be obscured from any sound.

5. Future study could use a longer duration of training. Instead of six days, ten to twenty days would be preferable.

6. The training sessions should be administered continuously with no more than one-day intervals.
LIST OF REFERENCES


APPENDICES
APPENDIX A

SAMPLE SURVEY DATA FORM

FOR SELECTION OF SUBJECTS
SAMPLE SURVEY DATA FORM
FOR SELECTION OF SUBJECTS

I am conducting a research on motor learning. The questions below will enable me to choose the subjects that would qualify for the study. Please answer carefully.

Thank you,
Mrs. J.C. Curby

Name _______________________________ Age ___ Class Time
and Day _______

Address: _____________________________________________
City: _________________________________________________
Home Phone: ____________________ Work Phone: __________

Please check the following physical activities that which you have participated in the past:

_____ a. gymnastics
_____ b. stunts and tumbling
_____ c. trampoline
_____ d. yoga headstand

Please check: Can you do a headstand?

_____ Yes  _____ No
APPENDIX B

ORIENTATION OF SUBJECTS
Thank you for staying ladies. As you recall your class was asked to fill out a small questionnaire pertaining to the activities that you have had before. The data collected enabled me to select the subjects that would qualify for the experiment. And you qualified for it.

Let me make it clear that this experiment has nothing to do with your physical education activity. It will not affect your grade nor your class participation.

You will be taught a skill that you have not done before. It is very easy, and there is no cause for alarm. I assure you that you will not be hurt, nor be made uncomfortable. All you do is listen, follow instructions, and try your best.

We will start learning this new skill on your next class meeting. I will call each one of you and will take you to the experimental room with me. When we finish you may return to your activity. I only need a few minutes of your time.

Your attendance is very important to my study. I hope that everyone of you will continue with me until the study is completed.
APPENDIX C

SYNCHRONIZED LIVE DEMONSTRATION AND VERBAL-TAPED INSTRUCTION FOR PRE-TEST AND POST-TEST
I am going to show you how to perform a headstand. Please listen carefully and observe very closely. After my demonstration you will be asked to do the headstand. You will not be allowed to practice.

First, you assume a squat position, and place your hands on the mat with your fingers facing forward and slightly spread apart. Make sure that your hands are shoulder-width apart and are placed directly under your shoulders.

Next, place your head forward on the mat between your hands. Make sure to place that part of your head between the forehead and the top of the head on the mat. Also try to make the spaces between your hands and your head equal. You are actually making a triangle with your hands and your head.

Then try to straighten your back slowly upward. Next, raise your feet slowly over your head at the same time maintaining your balance. Gradually straighten and pull your legs upward including your toes, and keep your feet together. Arch your back very slightly. Keep looking down and try to feel your movement. Balance most of your body's weight on your head and some of it on your hands.
Keep your arms parallel from each other.

To recover, bend your legs and place them back on the mat as in squat position.

I am going to repeat the headstand. Please watch very closely. (Demonstrate slowly without verbal instructions).

Here is another way of doing the headstand. First, assume a kneeling position. Place your hands on the mat followed by your head. Straighten your back slowly by pushing from your feet in a tiny walking fashion, and keeping your legs straight.

Next, kick one leg upward followed by the other leg until both feet reach a point directly over your head. The legs should be straight, together, and toes pointing upward.

Recover by bringing down one leg first, followed by the other leg. Or, you may recover by bending both legs and bringing them back to squat position.

I will now repeat this demonstration. Please watch very closely. (Demonstrate and omit verbal instruction).

Now, it is your turn to do the headstand. You are not allowed to practice. You will be allowed five trials. You should start each trial only when you hear my signal "ready - go". Your score will be the length of time your feet are off the mat in the headstand position, and body form. The longer you hold the position the higher you will
score. I will stop this stopwatch as soon as your feet are on the mat. You will get extra points for maintaining good body form. You should stop when you hear my signal "stop". Any question?

(Before dismissing each subject):

Please do not practice the headstand at all. Also, please do not discuss with anyone about what you did today. Just forget everything that we did. You may now go back to your class.
APPENDIX D

READING AND VERBAL-TAPED

INSTRUCTION FOR MENTAL PRACTICE
READING AND VERBAL-TAPED
INSTRUCTION FOR MENTAL PRACTICE

Top Page of the Reading Instructions

PLEASE DO NOT TURN THE PAGES UNTIL YOU ARE TOLD TO DO SO.
You are requested to read the instruction sheets with me. Please turn your paper to page 1.

The following instructions are the steps on how to perform a headstand from two different starting positions.

A. From a Squat Position

Step 1

Place your hands on the mat with your fingers facing forward and slightly spread apart. Your hands should be shoulder-width apart and should be placed directly under your shoulders.

Step 2

Place your head forward on the mat between your hands. Make sure to place only that part of your head between the forehead and the top of the head on the mat. The spaces between your hands and your head should be equal as in a triangle.
Step 3

Straighten your back slowly upward. Next, raise your feet slowly over your head at the same time maintaining your balance. Gradually straighten and pull your legs upward including your toes and keep your feet together.

Step 4

Arch your back very slightly. Keep looking down and feel your movement. Balance about two-thirds of your body's weight on your head and one-third on your hands. Your arms should be parallel to each other.

Step 5

Recover by bending your legs and placing them back on the mat as in the squat position.

(Taped: Please turn your paper to page 3.)
B. From a Kneeling Position

Step 1

Place your hands on the mat followed by your head. Maintain the triangular shape between your hands and your head.

Step 2

Straighten your back slowly by pushing from your feet in a tiny walking fashion, keeping your legs straight.

Step 3

Kick one leg upward followed by the other leg until both feet reach a point directly over your head.

(Taped: Please turn your paper to page 4.)
Step 4

Straighten your legs and keep them together. The toes should be pointing upward. Arch your back very slightly.

Step 5

 Recover by bringing down one leg followed by the other leg. Or, you may recover by bending both legs and bringing them back to a squat position.

(Verbal-taped Instructions)

Please turn down your instruction sheets and listen to me carefully. Remember that in performing a headstand, you should always maintain that equal spaces between your hands and your head. Also, do not forget to place only that part of your head between the forehead and the top of the head on the mat. Keep your hands facing forward and arms parallel to each other.

Start moving your feet only after you have
straightened your back in a vertical position. Hold the headstand position as soon as your feet are directly over your head. Remember to keep your legs straight and together, and extend your toes upward. Arch your back very slightly.

You are now requested to think about how to perform a headstand. You will be allowed a specified length of time. Please wait for my "go" signal and stop when you hear my signal "stop".

(Live: You are allowed ______ minutes to think about how to perform a headstand. Ready...
Go! ............ Stop!)

Please remember this: It is very important for this study that you do not practice the headstand. Also please forget about what we did today and do not discuss this with anybody. Your attendance is vital to the results of this study. I will see you again during your next class meeting. Thank you.
APPENDIX E

SAMPLE PRE-TEST AND POST-TEST

DATA SHEET
### SAMPLE PRE-TEST AND POST-TEST DATA SHEET

#### Score Sheet

**Group:** A B C D

**Date:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Time in Seconds</th>
<th>Bonus Points</th>
<th>Total Score</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3rd Trial</td>
<td>4th Trial</td>
<td>5th Trial</td>
<td>3rd Trial</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
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<td>3.</td>
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<tr>
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<td>6.</td>
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<td>9.</td>
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<td>10.</td>
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</tr>
<tr>
<td>11.</td>
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</tbody>
</table>
APPENDIX F

INDIVIDUAL RAW SCORES
INDIVIDUAL RAW SCORE - GROUP A

THREE-MINUTE MENTAL PRACTICE

<table>
<thead>
<tr>
<th>Subject</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.33</td>
<td>1.40</td>
</tr>
<tr>
<td>2</td>
<td>2.50</td>
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<tr>
<td>3</td>
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<td>6.10</td>
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<tr>
<td>4</td>
<td>7.33</td>
<td>8.00</td>
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SIX-MINUTE MENTAL PRACTICE

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