THE DIFFERENTIAL EFFECT OF TWO DIFFERENT FORMS OF MENTAL PRACTICE UPON THE ACQUISITION OF A SWIMMING SKILL

by

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ABSTRACT

The purpose of the present study was to compare the effects of two different forms of mental practice, combined with physical practice, upon the acquisition of a swimming skill, the kip.

Twenty-seven female college students enrolled in beginning swimming classes were the subjects in this experiment. The subjects were randomly assigned to one of three treatment groups: Group number one--the physical practice group, Group number two--the guided mental practice group, and Group number three--the non-guided mental practice group. Three AAU rated synchronized officials evaluated each of the subjects on the kip. The judges scores were combined and the mean score of each subject was used in the one-way analysis of variance statistical procedure.

The results of the one-way analysis of variance test produced no significant differences between group number one, group number two, or group number three. Results of this test indicated that the use of either guided mental practice, physical practice, or non-guided mental practice was equally effective in the skill acquisition of the kip. The findings of this study led to the conclusion that for beginning swimmers, the use of guided mental practice as

well as non-guided mental practice, when used in combination with physical practice, can be advantageously used in the acquisition of swimming skills, particularly the kip.

CHAPTER I

NATURE AND SCOPE OF THE STUDY

Introduction

To acquire proficiency in a motor skill, the individual needs to practice or rehearse the desired terminal behavior. No condition is of greater importance to this acquisition of motor skills than is practice. The two most obvious effects of practice are first, increasing the speed of performance, and second, increasing accuracy, or the reduction of errors in performance. Practice also serves as a director in the learning process through various individual developmental ability levels toward skill proficiency.

Two forms of practice that are very different in nature are physical practice and mental practice. The former is by far the most common and widely used form of practice employed by physical educators. However, it is possible to facilitate learning of a motor skill by mentally practicing the skill in addition to physically practicing the task. Although numerous studies consistently have confirmed this fact, little systematic application of mental practice principles has occurred in physical education classes. Sage (1971, p. 328) stated that "the general belief that physical learning is different from mental learning and

the knowledge that actual practice of the movements of a skill are necessary for skill acquisition has probably perpetuated the notion that the only way to learn motor tasks is by performing the task."

Mental practice is a symbolic, conceptual, or mental rehearsal of a motor task, without any voluntary initiation of gross motor movement. Mental practice can be categorized into two broad areas: guided and non-guided. Guided mental practice structures or directs the mental practice session through the presentation of the skill in a systematic, ordered fashion. Non-guided mental practice merely requires complete concentration upon the skill by the subject without providing direction of specific elements involved in the skill.

The kip, a synchronized swimming skill, was selected as the motor sill for studying mental practice for several reasons. First, this skill was selected as a novel task for the given subjects to perform. Task novelty is an important consideration in order to place all subjects at the same level of learning. Second, the kip can be divided into three phases. These phases lend themselves to a more interesting mental practice experience than would a less complex skill. And, third, it was selected as a skill that could adequately discriminate between skilled and non-skilled

performers, which made it challenging for all subjects, yet one in which the subjects could develop some degree of proficiency.

Statement of the Problem

The purpose of this study was to determine the differential effects of three different methods of practice (guided mental-physical practice, non-guided mental-physical practice, and physical practice) upon the skill acquisition of the kip, a swimming task.

Hypotheses

To statistically test the effect of the different forms of practice upon the skill acquisition of the kip, the following hypotheses were formulated:

Hypothesis 1

There will be no statistically significant differences, at the .05 level of confidence, between performance scores on a test of the kip for the group experiencing guided mental-physical practice and the physical practice group.

Alternate: The group which experiences guided mental-physical practice will have significantly higher performance scores on a test of the kip then will the group which experiences physical practice.

Hypothesis 2

There will be no statistically significant differences, at the .05 level of confidence, between the performance scores on a test of the kip for the group experiencing guided mental-physical practice and the non-guided mental-physical practice group.

Alternate: The group which experiences guided mental-physical practice will have significantly higher performance scores on a test of the kip than will the group which experiences non-guided mental-physical practice.

Hypothesis 3

There will be no statistically significant differences, at the .05 level of confidence, between the performance scores on a test of the kip for the group experiencing physical practice and for the non-guided mental-physical practice group.

Alternate: The group which experiences physical practice will have significantly higher performance scores on a test of the kip than will the group which experiences non-guided mental-physical practice.

Definition of the Terms

The following operational definitions were used for the study:

Guided Mental Practice: Guided mental practice is the act of directing and structuring the concentration of the

subject through an informational practice session during which time there is no physical practice. In the present study the visual-verbal mode of guided mental practice was utilized.

Non-guided Mental Practice: Non-guided mental practice is a non-directed, unstructured practice session, involving total concentration of the subject upon the skill during which time there is no physical practice.

Physical Practice: Physical practice is the act of using motor movements to practice a motor skill.

Limitations of the Study

This study was limited by the following factors:

1. Since the sample was drawn from two beginning swimming classes offered at The University of Arizona, the available number of subjects was limited. Furthermore, the conclusions reached in the study cannot be generalized beyond the sample. The beginning swimmers were all female students enrolled in beginning swimming at the University during the spring semester of 1975.
2. The study focused upon the effects of mental practice at the beginner level of skill. Therefore, it does not give insight into the relationship of mental practice at higher levels of skill.

3. Since the kip was a difficult skill, it is possible that the "strong" swimmers in each group, regardless of the treatment, received higher performance scores on the test of the kip. However, through random assignment to groups, the effect of the "strong" swimmer upon the results was mitigated.

Significance of the Study

Practice itself plays a more significant role in skill acquisition than do the other variables which influence the learning of a motor skill. It, therefore, becomes important for physical educators to examine carefully the activities that comprise practice sessions, and ultimately to select those activities which are shown to be the most beneficial to students.

If mental practice is an instrumental tool in skill learning, it is essential for physical educators to determine the skill level at which it is most effective and the activities for which it can best be used. The present study attempted to determine if two different forms of mental practice combined with physical practice could be effectively incorportated at the beginning level of swimming. Very limited research has been done in mental practice within the swimming area.

The researcher can see many opportunities within the framework of teaching methods where the use of mental

practice can be very advantageous. With strictly outdoor activities, inclement weather can destroy a physical practice session completely. If mental practice proves to be effective, it can be incorporated into the rainy-day lesson plan, as well as its incorporation into the regular teaching plan. By using a combination of practice methods, student interest and motivation can be held high.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study was to compare the effects of three different techniques of practice, two of them mental and the other physical, upon the level of skill acquisition of the kip. An extensive review of the literature pertinent to this study was conducted in an attempt to answer the following questions: (1) What research has been completed which supports the use of mental practice in the acquisition of physical skills? (2) Does the existing literature refute the use of mental practice in the acquisition of physical skills? (3) What are the results of investigations studying different methods of mental practice? (4) What have been the findings of studies involving the use of the combination of mental and physical practice? (5) What are the results of studies related to mental practice or the design of this study?

Scope of the Literature

Richardson (1967) described the scope of the literature available in mental practice. She stated that to date, mental practice studies have investigated the relative effects no practice, physical practice, and mental practice

upon the acquisition of skill. The activities studied included tasks such as card sorting, mirror tracing, ring tossing, dart throwing, basketball shooting, bowling, and gymnastics skills. The length of practice periods ranged from 30 seconds to 30 minutes. The number of days of practice ranged from one to twenty-one.

Comparison of Physical Practice and Mental Practice

One of the first researchers in the area of mental practice was R.S. Sackett (1934). He found symbolic rehearsal, in the form of drawing, to be beneficial for the retention of a finger maze habit skill. The following year Sackett (1935) completed a similar study, using varying amounts of symbolic rehearsal to determine its effect upon the retention of a maze habit. He concluded that symbolic rehearsal in any of the amounts used was beneficial to the retention of the maze habit, i.e., the greater the number of rehearsals, the higher the degree of retention.

Eggleston (1936), as cited by Smith and Harrison (1962), has shown that physical practice is more effective then mental practice in the skill required for card sorting and digit symbol substitution tasks. However, mental practice also improves skill efficiency in the above tasks.

Perry (1939) investigated the effects of actual and imaginary practice in a series of selected tasks (pegboard test, card sorting, mirror tracing, hole tapping, and symbol

substitution) for five practice periods of 60 seconds. The mental practice group was asked to imagine themselves performing the task. He concluded that the relative effectiveness of actual and imaginary practice differs with each task, i.e., imaginary practice is more effective in tasks which consists of learning facts that may be observed without actual movement. However, his overall conclusions stated that imaginary practice, as defined in his study, is effective in improving the score in a variety of tasks.

Vandell, Davis, and Clugston (1943) conducted an experiment with junior and senior high school boys. Basketball free throwing and dart throwing were the tasks employed to study the effects of mental practice. Mental practice subjects were asked to think about the dart and basketball throws. The results showed that the extent of improvement of the group using mental practice was nearly comparable to that of the group using physical practice.

Twinning (1949) used college men for his study. He divided them into three groups and had them practice a ring-toss task. He found that the mental practice group showed significant improvement, but not as much as the physical practice group. The mental practice session for this study consisted of "mentally throwing" rings for fifteen minutes daily for twenty-one days. It was further concluded that five minutes of mental practice was sufficient for mental rehearsal without a pause.

Steel (1952) looked at the effect of mental practice upon a baseball throw for accuracy, with the mental practice group imagining that they were throwing the baseball. Both groups practiced for ten minutes on each of nine days. The results showed that the group receiving no practice improved 7.6 percent, the group practicing physically improved 15.3 percent, and the group practicing mentally improved 11.9 percent. He concluded that daily mental practice of a motor task produces a substantial increase in that skill.

Clark (1960) studied the effects of mental practice upon the development of effective basketball free-throw shooting, when a mental practice group was compared with a physical practice group. The subjects were varsity and junior varsity high school players. Those in the mental practice group were asked to read carefully through practice work sheets. The findings showed that physical and mental practice were equally as effective in improving basketball free-throwing for both the varsity and the junior varsity players. It was noted, however, that the novice group seemed to profit more from physical practice.

Wilson (1960) studied the impact of physical and mental practice upon the improvement of the tennis drive. The findings of the investigation indicated that either physical or mental practice was effective in the improvement of the drive.

Kelsey (1961) studied the improvement of muscular endurance through the use of mental practice. Students in four activity classes of the required physical education program at the University of British Columbia were selected as subjects. A five minute sit-up test was performed by the group physically practicing for a duration of 19 days. The group mentally practicing was asked to concentrate on nothing other than the sit-up task for a 5 minute period for 19 days. The mental practice group also was provided reading material on the topic. The findings of the study from results compared on a pre- and post-test were that subjects receiving no practice showed no significant improvement in muscular endurance; the group receiving physical practice improved 322 percent, or increased on an average of 102.52 sit-ups; and the group receiving mental practice improved 29 percent, or an average of 10.14 sit-ups.

Research Which Refutes Mental Practice

Gilmore and Stolurow (1951) investigated the transfer of training effects of mental practice using the Munn type of ball and socket learning task, with male elementary psychology students as the subjects. The results showed that mental rehearsal produced a negative transfer effect, which was significantly different from both the motor and the resting groups. The implications of these results were

discussed in terms of possible conditions leading to negative transfer effects, an atypical finding in this area of research.

Different Types of Mental Practice

Harby (1952), as cited by Whitehill (1964), conducted a study concerning the effects of mental practice upon the ability to learn the basketball free throw by using loop films and "live" demonstrations to assist the subjects. The subjects consisted of 250 males. Harby concluded that a significant amount of learning took place for the groups which practiced physically and mentally with the aid of the loop films.

Hertz (1956), as cited by Richardson (1967), studied three methods of instruction in one hand foul shooting: (1) overt practice, (2) implicit learning, and (3) kinesiological method. High school freshman boys were used as the subjects for this study. The overt practice and the implicit learning groups combined with physical practice. The mental imagery practice involved the aids of demonstrations and loop films. Hertz concluded that any one method of instruction results in improvement of foul shooting ability, but, that no one method is superior to the other.

Smith and Harrison (1962), compared the effects of visual, motor, mental, and guided practice upon the speed and accuracy of a simple eye-hand coordination task. Sixty

male university volunteers were divided into one of the five groups for this experiment: visual, motor, mental, guided, and control. All groups were given a one minute pre-test on the punchboard to measure their initial level of skill. Ten seconds of practice was followed by ten seconds of rest for a two minute period, and each subject received a total of six separate practice periods. The motor practice group physically practiced, the mental practice group were instructed to close their eyes and think about the performance completed in the initial test, the guided practice subjects were guided through the task by the experimenter to get the "feel" of the movement with their eyes closed, and the control group read for the full 2 minutes. The results warranted the conclusion that visual practice and mental practice improved accuracy on a punchboard learning task whereas motor practice and guided practice did not.

Winslade (1963) compared the effects of live demonstrations versus the use of an 8 mm. color film to teach basketball skills to a ninth grade class of boys. He found that the group which experienced the visual presentation made the same improvement on the Stroup Basketball Test as the other group who saw the live demonstration.

Whitehill (1964) investigated the use of four variations of mental practice in the learning of a one-wall handball serve. His subjects were ten through twelve year-old

boys. He found that the following three methods showed statistically significant improvement in skill: (1) demonstration and mental practice, (2) pure mental practice, (3) diagrams and mental practice.

Jones (1965) investigated directed and undirected mental practice in the learning of the hockswing upstart. His sample was comprised of male college students. The guided mental practice was conducted by reading to the group a description of the skill while they tried to imagine what it felt like to perform the movement. Jones found that undirected mental practice is superior to directed mental practice. However, undirected mental practice is only effective when it is used in combination with physical practice.

Surburg (1968) investigated the effects of audio, visual, and audio-visual forms of mental practice to develop skill acquisition in the tennis forehand drive. Using 183 subjects, he formed the following experimental groups: (1) audio group, (2) visual group, (3) audio-visual group, and (4) pure mental practice. His conclusions stated that audio instruction in the form of mental practice is the most effective method in the development of the forehand stroke in tennis.

Hughes (1969) studied different methods of mental practice upon the skill improvement of the forehand and

backhand drives in tennis. She used twenty-three intermediate and advanced female tennis players for her study. She drew the following conclusions: The presentation of audio, visual and reading instruction used in conjunction with physical practice results in significant improvement. However, the audio instructional technique of mental practice was the most effective technique for the improvement of the forehand and backhand drives in tennis.

Combination of Mental and Physical Practice

Rubin-Rabson (1941) compared the effects of two forms of mental rehearsal upon keyboard overlearning. The subjects, nine adults, were all skillful pianists. Three groups received the following treatment: The first commenced practice with a four minute period of mental practice or "imaginary" rehearsal after five keyboard trails or mid-way in the learning, then continued the keyboard trails until they reached a memorized performance. The second group memorized the performance, then added four minutes of mental rehearsal. Third memorized the performance, then added extra keyboard trails for four minutes. Her conclusion stated that the mid-way period of mental rehearsal or imaginary practice proved reliably superior to the other time distributions.

Trussell (1952) hypothesized that there would be a significant amount of learning occurring in a test-retest

situation due to interpolated mental practice of a complex motor skill. The skill she selected was a two-handed, three-ball juggling task. Her results showed that there was no significant effect of mental practice or physical practice upon the immediate learning of juggling. However, different combinations of physical and mental practice showed that significant learning of the task did take place. Her findings also showed that with either physical or mental practice occurring separately, neither type has a clear cut advantage over the other.

Waterland (1956), as cited by Sage (1971), encouraged her mental practice group to imagine the kinesthetic "feel" of the bowling movements just before delivering each ball down the alley. Under these conditions, the performers produced a smoother action, greater speed of delivery, and gained higher scores than the group which practiced without this pre-performance mental rehearsal.

Riley and Start (1960) studied the combination of mental and physical practice in practicing quoit throwing. Their study used fourteen and fifteen-year-old girls. They found that the group which alternated days of mental practice and physical practice showed the greatest significant improvement. Two other groups alternated physical and mental practice into six days each and did not prove as effective as the first group in the study.

Whiteley (1962), as cited by Richardson (1967), studied the effects of combined mental and physical practice upon a gymnastic skill. His design consisted of four groups of twenty-three boys each. The group which evidenced the greatest improvement practiced the skill by alternating five minutes of physical practice with five minutes of mental practice, for a twnety minute period. The second ranked group alternated ten minutes of physical practice with ten minutes of mental practice each day while the third ranked group physically practiced only. The group which improved the least only mentally practiced the skill.

Estrom (1964) studied six randomly selected groups of twenty male college students each with a right hand preference to determine the effects of varing emphasis on conceptualizing and manual practice during the early learning of a novel ballistic gross motor skill. The results indicated that alternating periods of emphasis on conceptualizing and manual practice is as effective as successive periods emphasizing manual practice. Conceptualizing practice consisted of timed 5 minute periods during which the subject was directed to focus his concentration upon the introspective rehearsal of the skill which he had performed during the initial test.

Corbin (1967) used a juggling task in which his mental practice group read an instruction sheet thirty times a day for 21 days. His research suggested that mental

practice can only be effective if the subjects have had prior experience with the task before mentally practicing it. The findings also suggested that skilled performers may benefit more from mental practice than beginners.

Luebke (1967), as cited by Sloan (1971), compared the relative effectiveness of physical practice with three combinations of mental-physical practice upon an over-arm softball throw's velocity. The subjects were seventh-grade girls. The mental practice group was asked to close their eyes and mentally practice six throws. Of the combined practice groups, one group alternated one mental practice throw with one physical practice throw, the other group alternated three mental practice throws with three physical practice throws, and the last group alternated six mental practice throws with six physical practice throws. The results indicated significantly equal performance gains for all three groups. Luebke concluded that when mental practice is combined with physical practice, and when all practice sessions are scheduled on a per trial basis, mental practice causes similar changes in performance as those caused by physical practice.

Stebbins (1968) conducted a study in which he sought to determine the relative effectiveness of mental and physical practice upon the learning of a target-ball throw task and to determine the differential effects of mental practice

during different stages of the learning period. Ninety-three male volunteers were used as subjects. The mental practice group was asked to stand behind the physically practicing group and visually imagine themselves as throwing 25 balls at a target. The results indicated that only significant improvement occurs in the combination type treatment conditions--physical practice/mental practice or mental practice/physical practice. Additionally, the results showed that both mental and physical practice are equally effective during the first half of the skill development period.

Oxendine (1968) suggested that the combination of mental and physical practice may be used immediately preceding, following, or coinciding with the performance. The pre-performance review can be illustrated by a bowler or a high jumper focusing his attention on the task at hand after-performance is illustrated by a golfer replaying his shot or the basketball player determining why he missed his shot. The during-performance rehearsal is the player concentration involved while executing the skill. A second technique mentioned by Oxendine involves mentally rehaearsing game strategy between contests, or during lulls within the contest.

Related Studies to Mental Practice And Design

Jacobson (1930) was able to demonstrate increased muscular action potentials in the muscles specific to the task imagined. Subjects reacted during mental practice by subconsciously flexing their muscles which were used in the overt performance of the task. He used needle electrodes on the subjects trained in relaxation. Shaw (1940) investigated action potentials and its effects upon varing degrees of vividness in mental practice. His findings showed that as weight lifters imagined themselves lifting weights, they exhibited muscular action, and that the activity increased linearly with increased weight.

Beattie (1946), as cited by Richardson (1967), conducted a study using mental practice to improve a bilateral transfer of training effect. His conclusions showed that mental practice can be instrumental to the bilateral transfer of training effect.

Start (1960) investigated the relationship between intelligence and the effect of mental practice upon the performance of the underarm basketball throw. This study used 12-year-old boys from a secondary school in England as subjects. The boys were divided into two groups. The high intelligency group ranged from intelligence quotients of 106 to 117, and the low intelligence group ranged from intelligent quotients of 83 to 105. Both groups mentally practiced

by picturing themselves performing the throw. Conclusions from data collected on and pre- and post-test led Start to conclude that mental practice does improve motor performance; however, the improvement was not correlated with intelligence.

Karlin and Mortimer (1962) studied the effects of visual, verbal, and visual-verbal cues upon the learning and retention of a crank-turning task. Their findings indicated that the verbal cue is not as effective as either the visual cue or the verbal-visual cue.

Start (1964a) used twenty-one first-year students at a teachers' training college to investigate the relationship between kinesthesis and the performance of a single leg upstart after a period of mental practice. The mental practice group read from instruction sheets, and they were told to imagine themselves performing the task. His results showed that scores from the Weibe Test of Kinesthesis and those from a skill test after mental practice were not significantly related. Start (1964b) conducted another study where he compared intelligence and the improvement in a single leg upstart after mental practice. Forty-four male teacher's college students were his subjects, and they were given five minutes of mental rehearsal on each of six days. The results showed that intelligence has a low to trivial correlation with both estimates of physical performance and the efficiency of learning by mental practice.

Summary

Studies done in which mental practice is compared with physical practice indicate that mental practice is an effective tool in the pursuit of skill acquisition. However, it is the concensus of most studies that physical practice is superior to mental practice in terms of skill improvement. Gilmore and Stolurow (1951) is the only study reported which refutes the use of mental practice as an influencing factor in motor skill development.

Researchers supported the use of guided mental practice, including visual, verbal, and audio cues, as being very effective in skill acquisition, with the exception of Jones (1965). However, the most effective form of mental practice occurs when used in combination with physical practice. Many studies indicated that either combination of mental/physical or physical/mental was effective in skill acquisition.

Evidence from studies showed that there is a positive relationship between mental practice and action potentials in muscles, and possibly in a transfer of training effect. However, studies showed no significant relationship between mental practice and kinesthesis or intelligence.

CHAPTER III

DESIGN OF THE STUDY AND PROCEDURES USED

The purpose of this study was to determine the effects of three different types of practice upon the acquisition of a swimming skill. The three different types of practice involved physical practice, guided mental-physical practice, and non-guided mental-physical practice. Specific criteria were used in the selection of a suitable test for this study. This chapter contains information about the subjects, a basis for test selection, administrative procedures, and a statistical treatment of the data description.

Subjects Participating in the Study

Twenty-seven females enrolled in two beginning swimming classes in the Department of Physical Education for Women at The University of Arizona during the spring semester of the 1974-1975 school year were the subjects for this study. Originally, the study was designed to include thirty subjects, but due to experimental mortality the sample was reducted to twenty-seven. The subjects had limited or no previous experience in swimming prior to enrolling in the beginning class. All subjects participating in the experiment had reached an advanced beginning status in swimming,

as the experimental portion of the study was conducted in the later part of the semester. It was important that all participating subjects had progressed satisfactorily to the advanced beginner level of performance in order that fear of the deep water would not be a precipitating learning variable in the study.

Securing Permission and Cooperation of the Participants

Both beginning swimming classes were contacted by the researcher and were asked for their cooperation and participation in this experiment. The students were then informed that the experiment would include five consecutive class periods, and the administration of the experiment would take place during their regularly scheduled class period. The subjects appeared to remain enthusiastic and interested throughout the duration of the experiment. This was manifested by their eager cooperation for the five experiment days.

The Test

Criteria for the Selection of the Test

There had been limited research in the swimming area, and there are no available tests in the synchronized area. Specific criteria for task selection were created, and they are as follows:

1. The skill must be of a "novel" nature to the subjects so that previous knowledge and learning would not affect the experiment as a moderator variable.
2. The complexity of the skill should be intricate enough that it would remain interesting to the mentally practicing groups. However, at the same time, it must be simple enough for the subjects to learn and to show their improvement through scores indicative of that performance.

Description of the Task

A test of the kip was used to collect data for this study. The kip is a synchronized swimming skill. The figure is started in a back layout position. The knees are drawn toward the chest with the knees and toes at the water's surface until a tuck position is assumed. A ½ back tuck somersault is executed until the legs from the knees to the toes are perpendicular to the water's surface. At this time, overhead support skulling skill is important to keep the legs and buttocks above the surface of the water. The legs extend upward to establish a vertical line through the entire body. At the time the skulling stops, and the vertical body decends to complete the skill.

Design of the Experiment

A chart of the experimental design can be found in Table 1. It can be seen that on the first day all groups physically practiced 10 minutes, and then the two mental practice groups practiced mentally for 5 minutes while the physical practice group physically practiced for 5 minutes. This cycle repeated itself once, to end of the first day of the design. On days two through four, all groups physically practiced for 5 minutes and then the two mental practice groups mentally practiced for 5 minutes as the physical practice group physically practiced for 5 minutes. This cycle repeated itself once.

Experimental Administration

All subjects were previously notified by the individual teacher that they would have the opportunity of participating in the study. On the first day, the subjects were greeted by the experimenter and told that the experiment was being conducted in conjunction with a Master of Science thesis for the Department of Physical Education for Women, and that their cooperation was very much appreciated by the experimenter. Then, the experimenter randomly assigned the students in each class to one of three treatment groups. The subjects were asked to remember the number of the group they had been assigned and were then asked not to

Table 1. Experimental Design of Three Methods of Practice

	CYCLE I		CYCLE II	
1st Day	10 min.	5 min.	10 min.	5 min.
2-4th Days	5 min.	5 min.	5 min.	5 min.
Physical Practice	PP	PP	PP	PP
Guided Mental Practice/Physical Practice	PP	GMP	PP	GMP
Non-guided Mental Practice/Physical Practice	PP	NMP	PP	NMP

PP = Physical Practice
GMP = Guided Mental Practice
NMP = Non-guided Mental Practice

discuss the events or information given to them in their group with any of the subjects in the other two groups.

All groups were asked to go to the deep end of the pool. A general lesson including instruction, demonstrations and a skill breakdown of the kip was conducted for twenty minutes. Ms. Nancy Angle gave this presentation. She was selected to administer this portion of the experiment for two reasons. She was the synchronized swimming specialist at The University of Arizona, and the researcher felt she was the best qualified to teach the kip efficiently and

correctly. To eliminate bias during the learning of the skill, a neutral party to all subjects was used.

Following the general instructions, all groups were asked to sign a statement slip, verifying that the kip was a skill that they had never seen before the demonstration. A copy of this statement can be found in Appendix A.

All groups were then asked to physically practice the kip for ten minutes. The subjects were then given the following instructions:

> Group number one will remain in the pool, and hang on the edge until given further instructions.
>
> Group number two will follow the experimenter to their station.
>
> Group number three will follow a research assistant to their station.

After all groups were stationed at their appropriate places, group number one, the physical practice group, was read the following instructions:

> You are asked to physically practice the kip for five minutes.

Group number one was supervised by a lifeguard while they practiced.

Groups two and three were stationed at separate rooms, adjacent to the pool deck. The following instructions were given to group number two, the guided mental-physical practice group:

> Your will see a video-tape presentation of the performance of the kip, along with tape recorded instructions. You are asked to mentally rehearse the presentation. The duration of the presentation is five minutes.

The procedure for this presentation and a manuscript of the tape recorded portion can be found in Appendix B. Group number two was supervised by the researcher, while they received the five minute guided mental practice session.

Group number three, the non-guided mental physical practice group, was read the following instructions at their station:

> You are asked to mentally, not physically, rehearse the skill you have just learned. Mentally rehearse movements involved in the skill. Please do not discuss the skill.
>
> Be very quiet so that each individual can concentrate. You will practice for five minutes.

Group number three was supervised by a research assistant to assure their session a quiet atmosphere for mentally practicing.

After the five minute treatment session, all groups returned to the pool and were asked to physically practice the kip for ten minutes. All groups were supervised by a lifeguard while they physically practiced. At the conclusion of that practice session they were again given the five minutes treatment session in their previously assigned groups.

On the second, third, and fourth days, all groups were asked to physically practice the kip for five minutes.

Then, they broke into their groups to receive the five minute treatment session. All groups again physically practiced for five minutes and once again received the five minute treatment session.

The experimental design provided ten minutes of physical practice on the first day to ensure the mental practice groups an interesting and worthwhile session. The initial practice time hopefully enabled the mental practice groups to familiarize themselves with the kip to such an extent that a benefit could be gained through practicing mentally.

On the fifth day, three rated AAU Synchronized Swimming judges evaluated the performance of each of the subjects doing a kip. The judges reported their scores through the use of flash cards. The experimenter recorded the score given by each judge, and recorded the group number of the participating subject. A copy of the score sheet can be found in Appendix C.

One week prior to the final day of testing the judges met and scored twenty-seven female beginning synchronized swimmers on their performance of the kip. The subjects were enrolled in a beginning synchronized swimming class at The University of Arizona during the spring semester of 1975. The researcher numbered the subjects at random one through twenty-seven. The judges, through the use of flash cards,

evaluated each subject on their performance of the kip. The researcher recorded a score for each girl under the appropriate judge's column. A test for interjudge objectivity was run on the data. A copy of the score sheet used to evaluate the synchronized swimmers can be found in Appendix D.

Scoring the Test

The kip is a figure used in competition on synchronized swimming as listed in the Official 1975 AAU Synchronized Swimming Handbook. The AAU has established specific point breakdowns of the figure competition scoring. Ten points are possible for the execution of a perfect performance. Five of those points are for design. Design includes the categories of horizontal body position, and a tuck position. The remaining five points are for control, which includes full body extension, smooth transitions within the figure, constant speed of action, compactness of tucks, confidence or seemingly effortless execution, proper elevation, and the performance of the figure in a relatively stationary position. The points were reported from 0 to 10, to the nearest ½ point.

Treatment of the Data

The data gathered from the study were analyzed by the use of the one-way analysis of variance statistical

method. To establish a reliability of the judges, an analysis of variance was calculated on pilot data, followed by a Scheffé test. A reliability of average ratings formula was then applied to the pilot data to establish the required reliability for this study.

Scores obtained from the three judges on the performance of the kip, were tabulated and converted into a mean score for each individual subject. The mean data was then divided and placed under the correct treatment group so that comparisons could be made between groups. Finally, a Bartletts test for homogenity of variance was run on the data to determine if the three groups had identical variance. The results were considered significant at the .05 level of significance for all of the statistical procedures reported in this study.

Summary of the Chapter

Twenty-seven female subjects enrolled in beginning swimming classes at The Univeristy of Arizona, were the subjects for this study on mental practice. The subjects were tested on their performance of the kip, a synchronized swimming skill. They were randomly assigned to one of three treatment groups: (1) physical practice group, (2) guided mental-physical practice group and (3) non-guided mental-physical practice group. The experiment took place during

five consecutive class meeting days in the spring of 1975. Results from the test of the kip were compared between groups.

Prior to the actual testing of the subjects for this experiment, the judges rated twenty-seven synchronized swimmers on a performance of the kip. A reliability of average ratings statistic was run on this data to show the judges to be reliable and consistant.

The data from score means obtained from the judges scores on the kip of the subjects participating in this study were analyzed using a one-way analysis of variance. A Bartlett's Test for homogenity of variance was then run.

CHAPTER IV

ANALYSIS OF THE DATA AND PRESENTATION OF THE FINDINGS

The purpose of this chapter is to report the results of this study. Results were obtained and reported by the application of varied statistical procedures to the data. An analysis of these results in addition to a discussion of the findings can also be found in the contents of this chapter.

Interjudge Objectivity

The results of the interjudge objectivity test through the analysis of variance statistical procedure for establishing reliability for the judges indicated that the judges' scores were not homogenously aligned (Table 2). Application of the Scheffé test revealed that Judge 2 scores were consistently lower than Judges 1 and 3, and that the difference was significant. Because of the lack of rating objectivity, it was decided that an average score, based upon the scores given by all three judges would be the best indicator of an individual's ability to perform the kip. The reliability of average ratings formula showed a reliability coefficient of .903, by using the mean of the three

judges scores. The raw data gathered for these tests can be found in Appendix E.

Table 2. Interjudge Objectivity

	Analysis of Variance			
	Sums Squares	Degrees Freedom	Mean Squares	F-ratio
Subjects	66.90	26	2.57	10.48**
Judges	9.56	2	4.78	19.47*
Error	12.77	52	.25	
Total	80.23	80	1.12	

Significant ** .05 level $F_{crit.}$ 1.70
* .05 level $F_{crit.}$ 3.18

Reliability of average ratings forumula: for determing agreement among judges by the use of the mean.

$$\frac{S_{ms} - ERROR_{ms}}{S_{ms}} = \frac{2.57 - .25}{2.57} = .903$$

Analysis of Variance

The results of the analysis of variance test for interjudge objectivity can be found in Table 2. The F-ratios for both subjects (10.48) and judges (19.47) were significant at the .05 level of confidence. The critical F-tatios at the .05 level were 1.70 for subjects and 3.18 for judges. The judges' scores were indicative of the apparent

variability in the subject's skill level. However, the variability found among the judges was of much concern for the study. Their variability was also significant at the .05 level, indicating significant variability between the judges scores for each subject.

Scheffé

Since significant variance was found among judges, it was decided to apply Scheffé's test to the data to determine which judge was responsible for the variability. With a critical level of 6.36, the comparison of Judges 1 and 2 resulted in a value of 21.58; Judges 2 and 3 reported 8.71; and Judges 1 and 3 reported 3.10. The findings indicated Judge 2 to be responsible for the variability found when the analysis of variance was calculated. The comparison of Judges 1 ($\overline{X}$ = 4.46) and 2 ($\overline{X}$ = 3.63), as well as the comparison of Judges 2 ($\overline{X}$ = 3.63) and 3 ($\overline{X}$ = 4.14) showed a significant difference at the .05 level of confidence, while the comparison of Judges 1 ($\overline{X}$ = 4.46) and 3 ($\overline{X}$ = 4.15) showed no significant difference at the .05 level.

Relative Average Ratings Test

The use of three separate scores would not provide a meaningful score and a reasonable agreement among the judges was not obtained. Therefore, a reliability coefficient was calculated by using the average score formula (Ebel, 1967).

A coefficient of .903 was obtained, indicating that the use of the mean of all three judges' scores was the most statistically reliable method for reporting the scores on the test of the kip. The calculations can be found in Table 2..

Analysis of Experimental Data

A Bartlett's test for homogeneity of variance was applied to assure that the variance within the groups was not significant. Variance total within each group were as follows: Group number one--4.1350, Group number two--3.0864, and Group number three--3.3040. The Chi-squared value of .1812 was found; the critical value at the .05 level was 5.991. The distribution of scores on the kip test met the criteria of homogeneity of variance required for the application of an analysis of variance to the data.

When the raw data was obtained from the judges scores on the test of the kip, which can be found in Appendix F, it was converted into a mean score for each subject and applied to the one-way analysis of variance test. Table 3 shows the results of this test.

Results of the one-way analysis of variance test show the F-ratio at .0636, the critical F at the .05 level of significance being 3.40. Thus, the statistical results indicated a failure to reject the null hypotheses of the experiment. It was hypothesized that:

Table 3. One-way Analysis of Variance to Determine Significance from Mean Scores on the Experimental Subjects Performance of the Kip

	Sums Squares	Degrees Freedom	Mean Squares	F-ratio
Treatment	.4466	2	.2233	.0636
Error	84.2031	24	3.5085	
Total	84.6496	26		

Significant .05 level $F_{crit.}$ 3.40

1. Group number two, the guided mental-physical practice group, would receive significantly higher performance scores, on a test of the kip, than group number one, the physical practice group.
2. Group number two, the guided mental-physical practice group would receive significantly higher performance scores, on a test of the kip, than group number three, the non-guided mental-physical practice group.
3. Group number one, the physical practice group would receive significantly higher performance scores, on a test of the kip, than group number three, the non-guided mental-physical practice group.

Results indicated that there were no significant statistical differences at the .05 level of significance

between the physically practicing group, the guided mentally-physically practicing group, and the non-guided mentally-physically practicing group. It is, however, interesting to note that of the three treatment groups, which consisted of nine subjects in each group, the mean score of each group was computed as follows: Group number one $\overline{X}$ = 3.1852, Group number two $\overline{X}$ = 3.3519, and Group number three $\overline{X}$ = 3.0370.

Discussion of Results

While the variability found in the subjects' swimming aptitude reached a significant level, only the significant variance found between the judges' ratings of the swimming task posed a critical problem for the study. After a Scheffe test indicated that Judge 2 was responsible for the low reliability of judges' ratings, on the analysis of variance, the problem was partially alleviated by using the mean rating of the three judges for each subject. While a certain degree of precision was lost, the mean rating would approximate the "true score" for each subject.

Each of the null hypotheses tested by the experiment failed to be rejected, indicating that guided mental-physical practice is equally as effective in the acqusition of the kip as non-guided mental-physical practice or physical practice. Although the mean scores for the three groups were not significantly different, it is interesting to note that the guided mental-physical practice group had the highest

mean score, followed by the physical practice group, and then the non-guided mental-physical practice group, their mean scores being 3.35, 3.19, and 3.04 respectively. The limited number of subjects used for this study may be partially responsible for the mean differences between groups to be so close. A greater number of subjects would have accentuated this difference, and possibly caused a more significant variability between groups.

The findings of the present study are consistant with those done by Corbin (1967), Estrom (1964), Hughes (1969), Kelsey (1961), Luebke (1967), and Stebbins (1968) which indicate the combination of mental practice with physical practice to be equally as effective in the acquisition of motor tasks as physical practice along. It is at variance with the work done by Jones (1965), who found undirected mental practice to be superior to directed mental practice. However, the important point to notice is the fact that the implementation of mental practice can be used to effectively facilitate the learning of motor skills, specifically the kip as studied in this experiment. As indicated in the literature, perhaps the motivation of the subject for learning the kip was somewhat increased with the introduction of mental practice. It that is the case, the groups actually physically practicing less, would do as well as the group receiving the full amount of physical practice.

Summary

A reliability coefficient of .90 was obtained for the judges' ratings by using the mean of all three judges scores for each subject.

A one-way analysis of variance statistical procedure was used on the subjects participating in this study. A careful analysis of the data, using the one-way analysis of variance, revealed no significant differences at the .05 level of significance among the three groups tested. From the data received in this study, results indicate that physical practice, guided mental practice, and non-guided mental practice are all equally as effective methods for learning the kip. The use of the combination of physical and mental practice is in agreement with the findings of previous studies.

CHAPTER V

SUMMARY, MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS

Summary

This study sought to determine if a significant difference could be obtained in the acquisition scores of the kip when using three different methods of practice--guided mental-physical practice, non-guided mental-physical practice, and physical practice.

To test the hypotheses, the kip, a synchronized swimming skill, was used to measure the performance level of twenty-seven female beginning swimmers. The subjects were enrolled in beginning swimming classes at The University of Arizona, and were randomly assigned to one of three treatment groups (guided mental-physical practice, non-guided mental-physical practice, and physical practice).

Indications in the literature were that the mental practice groups, both guided and non-guided, would be effective in skill acquisition, when combined with physical practice, equal to that of physical practice alone.

At the completion of the experimental testing, the data were analyzed to determine if a significant difference occurred as a result of treatment of guided mental-physical

practice, non-guided mental physical practice, or physical practice. The use of the one-way analysis of variance allowed the investigator to test for any significant differences. Prior to the experimental testing of the subjects participating in this study, the judges were tested for their reliability. A relative average rating test was employed to establish the judges' reliability.

The primary value of this study served to provide knowledge concerning differing methods of practice, and to determine their effectiveness. Such knowledge was felt to be of importance to physical educators and coaches in swimming to aid them in the construction of beneficial practice sessions.

Major Findings

The major findings of this study were:

1. At the .05 level of significance, there was no significant difference between performance scores on a test of the kip between the guided mental-physical practice group and the physical practice.
2. At the .05 level of significance, there was no significant difference between performance scores on a test of the kip between the guided mental-physical practice group and the non-guided mental-physical practice group.

3. At the .05 level of significance there was no significant difference between performance scores on a test of the kip between the physical practice group and the non-guided mental-physical practice group.

Conclusion

Within the limitations of this study and based upon the results, the following conclusion was drawn: For beginning swimmers, the use of guided mental practice as well as non-guided mental practice, when used in combination with physical practice, can be advantageously used in the acquisition of swimming skills, particularly the kip, a synchronized swimming task. Physical eductors should incorportate mental practice into their lesson plans to further motivate students during practice sessions.

Recommendations

The following are recommendations for further study in the area of mental practice:

1. A study should be conducted using a similar design as the study; however, the number of subjects should be increased.
2. A study should be conducted studying the effects of guided and non-guided mental practice with subjects of intermediate and advanced swimming ability.

3. Research should be conducted, dividing the beginner swimmers into high, average, and low skill groups, to determine the effects of guided and non-guided mental practice upon skill acquisition.
4. Research should be conducted in a variety of sport areas to determine if the effects of mental practice are more advantageous for some skills than for others.
5. A study should be conducted studying the effects of guided and non-guided mental practice upon both females and males.
6. A study similar to the design of the present study should be conducted. However, the subjects should be given three trails in the performance of the kip, in order to obtain a score representative of their "true" performance.

APPENDIX A

KIP STATEMENT

Prior to the instruction and demonstration seen today, I have never witnessed the performance of the kip.

_____
Name

APPENDIX B

TAPE RECORDING--GUIDED MENTAL PRACTICE

The guided mental-physical practice group was asked to mentally rehearse the kip as they witnessed the video-tape presentation of a highly skilled synchronized swimmer performing the kip. They also heard the following tape recorded presentation:

The Kip

The kip can kip can be divided into three phases:

Phase One

The kip is started from a back layout position. A tuck position is assumed as the knees are drawn toward the chest. During this move, a horizontal line must be held from the knees to the toes on the surface of the water.

Phase Two

A ½ back tuck somersault is executed by tucking the chin and pushing the water downward with the hands, until the legs from the knees to the toes are perpendicular to the water surface.

To hold this inverted position, overhead support skulling skill is very important. This is accomplished by extending your arms straight above the shoulders. Turn the

palms out so that they are facing directly toward the bottom of the pool. Push the water out and down. Now turn the water inward and down. Moving the hands and forearms continually, they make a figure 8 motion. The palms of the hands must face the bottom of the pool to support the feet and buttocks at the surface of the water.

Phase Three

The legs extend upward to establish a vertical line through the entire body. The skulling stops and the vertical body descends.

The underlined words in the above transcription of the taped session indicate the times when the video-tape recorder was placed on still as the words described the action being seen.

Within the 5 minute treatment session the entire presentation was given twice. On one, the performer, on the video-tape assumed a horizontal position, and on the other, the performer assumed a vertical position on the screen.

At the end of the tape, the guided mental practice group observed the kip in both the vertical and horizontal positions at their normal speed with no interruptions.

APPENDIX C

SCORE SHEET

EXPERIMENTAL DATA

Subject Number	Group Number	Judge 1	Judge 2	Judge 3
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				

APPENDIX D

SCORE SHEET

RELIABILITY JUDGES

Subject Number	Judge 1	Judge 2	Judge 3
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			

APPENDIX E

RELIABILITY TEST OF JUDGES'

RAW DATA

Subject Number	Judge 1	Judge 2	Judge 3
1	7.0	6.5	5.5
2	6.0	4.5	5.0
3	4.5	3.5	4.5
4	5.0	3.0	4.0
5	3.0	3.5	4.0
6	3.5	3.0	3.5
7	5.5	3.5	4.5
8	3.5	3.5	4.5
9	3.5	3.0	3.5
10	5.0	4.0	4.5
11	3.5	3.0	4.0
12	4.5	3.5	4.0
13	3.5	3.0	3.5
14	2.5	2.5	3.0
15	5.0	3.5	4.5
16	4.0	2.5	3.5
17	4.5	4.0	3.5
18	5.5	5.0	4.0
19	3.5	4.0	4.5
20	4.5	4.0	4.0
21	3.5	2.5	3.5
22	5.5	3.5	4.5
23	7.0	6.5	5.5
24	5.5	4.0	5.5
25	4.5	3.5	4.5
26	4.5	3.0	4.0
27	2.5	2.0	2.5

APPENDIX F

EXPERIMENTAL GROUPS

RAW DATA

Group Number	Judge 1	Judge 2	Judge 3
1	6.5	5.0	5.5
1	4.0	2.5	4.5
1	2.5	3.0	5.0
1	6.5	7.5	6.5
1	2.0	2.0	1.0
1	1.0	0.5	0.0
1	3.5	2.5	1.5
1	2.0	1.0	1.5
1	3.0	2.0	3.0
2	2.5	3.0	3.5
2	2.5	3.0	3.0
2	1.0	1.0	0.0
2	4.5	5.0	6.0
2	5.5	6.0	6.0
2	3.0	2.5	2.5
2	1.5	1.0	1.0
2	4.0	4.0	4.5
2	4.0	5.0	5.0
3	2.0	1.0	2.5
3	6.0	4.0	4.0
3	6.0	4.5	4.0
3	2.5	3.5	3.0
3	3.5	3.5	4.0
3	1.0	1.0	0.0
3	2.0	1.0	1.0
3	6.0	6.5	5.5
3	2.0	1.5	1.0

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