To the Graduate Council:

I am submitting herewith a thesis written by Amy Spangler Reid entitled "The Effect of Time of Introduction and Amount of Mental Practice on the Performance of the Back Roll Extension." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Physical Education.

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THE EFFECT OF TIME OF INTRODUCTION AND AMOUNT OF MENTAL PRACTICE ON THE PERFORMANCE OF THE BACK ROLL EXTENSION

A Thesis

Presented for the

Master of Science

Degree

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Amy Spangler Reid

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ABSTRACT

The purpose of the study was to investigate the effect of the time of introduction and the amount of mental practice on the performance of the back roll extension. Performance was measured by the average from three judges' ratings of form and success in passing through the handstand position.

Thirty-two female college students enrolled in two elementary tumbling classes at The University of Tennessee, Knoxville, served as subjects for this study. The subjects were measured for body weight and shoulder strength and then were randomly assigned to one of four treatment groups. The treatment groups were: (a) early introduction and two minute periods of mental practice, (b) late introduction and two minute periods of mental practice, (c) early introduction and three minute periods of mental practice, and (d) late introduction and three minute periods of mental practice.

All physical practice trials of the back roll extension were videotaped. The judges evaluated the first three performances (pretest) and the three test performances (posttest) from the videotape recordings. The judges used a five-point scale to evaluate the form of the subjects' performance of the back roll extension. A Pearson correlation coefficient (r) was used to test the objectivity of the judges' ratings. A two-way ANOVA was used to analyze the rating scores. The judges used a dichotomous scale (yes or no) to evaluate the success of each subject to pass through the handstand position on performances of the back roll extension.

Crosstabulations were used to evaluate the scores on frequency of success and failure.

The analysis of variance indicated that there was no significant (a) effect of time of introduction of mental practice, (b) effect of amount of mental practice, or (c) interaction effect on the form of the back roll extension. Crosstabulations indicated more subjects who mentally practiced late were successful than subjects who mentally practiced early.

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CHAPTER I

INTRODUCTION

Adams (1971) stated learning was dependent upon two hypothetical memory states. One was termed the memory trace which was responsible for the initiation of a movement and the choice of its initial direction. The other was termed the perceptual trace which was dependent on feedback and was responsible for evaluating the response as initiated by the memory trace. Adams (1971) postulated that as performers practiced, the references from past movements became a hypothetical composite which consisted of the feedback qualities of the correct response (perceptual trace). Adams (1971) theorized that performance in a self-paced movement involved a comparison of the hypothetical perceptual trace with information from the position of limbs during the present movement, thus, providing a basis for the correction of any errors.

Adams (1971) theorized that the strength of the memory and perceptual trace developed as a function of practice trials on a task. Schmidt (1975) reasoned that mental practice served to entrench the traces by establishing or reinforcing appropriate strategies that were a part of the task. Mental practice allowed time to think about performance, errors, and the correction of errors (Schmidt, 1975).

Richardson (1976a) and Shick (1970) suggested three minutes of mental practice as a maximum amount of time. Singer and Witker (1970) attempted to determine the effect of the point of introduction of mental practice on a pursuit rotor task. No significant differences were found.

From a review of literature concerning the effect of mental practice on performance, Richardson (1967a) concluded that mental practice procedures were associated with improved performance on skills. Mental practice referred to the imaginary experience which mentally duplicated actual performance of a particular task. In a classic study, Vandell, Davis, and Clugston (1943) found that mental practice improved dart-throwing performance and performance on basketball free-throw shooting. Evidence existed to support the statement that mental practice was effective in improving performance on a juggling-type skill (Corbin, 1975) as well as on gross motor skills (Egstrom, 1964; Ulich, 1967). Wrisberg and Ragsdale (in press) found that mental practice was effective in the early stages of learning a cognitive task. Muscular endurance was also found to be improved through mental practice procedures (Kelsey, 1961).

A variety of studies have been conducted in the area of mental practice, but few involved tumbling skills. Tumbling appeared to be a worthwhild field for investigation of mental practice because it (a) involves complex closed skills with disorientations in space, (b) necessitates the development of a strong memory and perceptual trace, and (c) requires understanding of movement demands. Since it has been suggested that (a) practice improves the strength of the memory and perceptual trace, (b) strong memory and perceptual traces are needed in tumbling skills, and (c) mental practice facilitates strengthening the memory and perceptual traces, questions can be raised concerning the effects of mental practice on tumbling skills.

I. STATEMENT OF THE PROBLEM

The specific aim of this study was to investigate the effect of the time at which mental practice was introduced during the physical practice schedule and the amount of mental practice on the performance of the back roll extension.

The following hypotheses were tested:

1. There is no effect of time of introduction of mental practice on the performance of the back roll extension as measured (a) by judges' rating of form or (b) by success of passing through a handstand.
2. There is no effect of the relative amount of mental practice on the performance of the back roll extension as measured (a) by judges' rating of form or (b) by success of passing through a handstand.
3. There is no interaction effect of the time of introduction and the amount of mental practice on the performance of the back roll extension as measured (a) by judges' rating of form or (b) by success of passing through a handstand.

II. LIMITATIONS

This study was limited to females enrolled in two elementary tumbling classes at The University of Tennessee, Knoxville. The sample from which the subjects were drawn disallowed for use of males due to

the fluctuating and low ratio of males to females in beginning tumbling classes Spring Quarter, 1979.

III. DEFINITION OF TERMS

The following list of terms are defined as used in this study.

Amount of Mental Practice: The relative amount of mental practice, i.e., two minutes or three minutes, in each of the mental practice periods within the total practice schedule.

Augmented Knowledge of Results (KR): The information subjects received from the experimenter concerning the outcome of their performance; i.e., whether the timing of the leg thrust was too early, too late, or on time.

Back Roll Extension: A tucked backward roll with the legs snapped upward when the hands touch the mat and the body pressed into a handstand position by the hands and arms.

Mental Practice: Repeated imagining of the correct performance of the back roll extension with the absence of overt movements.

Performance: The behavior which resulted from subjects attempting the movements required in the execution of the back roll extension as measured by the average score of three gymnastic judges. The criterion for measurement was determined in two ways: (a) the rating of form on a five-point scale (Appendix A), and (b) the success or failure of the subject to pass through a handstand position.

Physical Practice Period: A one-minute session which consisted of physical practice of the back roll extension.

Physical Practice Trial: Each individual performance of the back roll extension within the physical practice and test period.

Previous Experience: Performance of the back roll extension that had occurred prior to participation in this study.

Test Period: Three performances of the back roll extension executed at the end of the practice schedule.

Time of Introduction of Mental Practice: When mental practice was introduced into the practice schedule. Early mental practice occurred after the first three of six physical periods. Late mental practice occurred after the last three of six physical practice periods.

IV. SIGNIFICANCE OF THE STUDY

The review of literature indicated that mental practice was effective in improving performance of skills. Shick (1970) indicated that three minute periods of mental practice were better than one minute periods of mental practice in the volleyball serve. A second study (Singer and Witker, 1970) in which pursuit rotor was used offered only a suggestion as to the most effective time of introduction of mental practice. This study extended the research on mental practice (a) to a new gross motor task, (b) to assess the time to introduce mental practice in a physical practice schedule, and (c) to evaluate two amounts of mental practice.

Many instructors have not introduced the method of mental practice to learners. Therefore, little is known about the effects of mental practice on improvement of skills. The back roll extension was chosen

as the skill to be measured because it was a novel task and more difficult for most college age females.

CHAPTER II

LITERATURE REVIEW

There has been concern about the effectiveness of mental practice in the performance of motor skills. Investigation of the literature revealed that relatively few studies pertained to the effect of mental practice on tumbling skills. This review of literature includes (a) the theoretical framework for the learning and performance of physical skills, (b) a survey of the mental practice research, and (c) a summary.

I. THEORETICAL FRAMEWORK

In his closed-loop theory of motor learning, Adams (1971) suggested that learning is dependent upon two mechanisms, the memory trace and the perceptual trace. He defined the memory trace as a learned capability for executing a response. This mechanism was postulated to be responsible for the initiation of a movement and the choice of its initial direction. The second mechanism, the perceptual trace (Adams, 1971), involved a reference of past movements and was a construct used to evaluate the response and explain how learners detected and corrected errors in their movements. Adams (1971) stated that three factors are required for moving a limb: (a) reference of past movements, (b) information concerning error in the previous movement (knowledge of results or KR), and (c) immediate data on the position of the responding limbs. Adams (1971) predicted that the extent of the movement was determined by comparing KR with feedback from the movement.

Schmidt and White (1972) stated that when learners were practicing with KR, they received from each practice trial a representation of how their responses looked, sounded, and felt. And, as the learners became proficient in their practices, all the representations formed a composite one consisting of the feedback qualities of the correct response (perceptual trace). Upon the withdrawal of KR, learners were able to compare feedback from the present response with the perceptual trace. This comparison provided the basis for the error detection mechanism.

Adams (1971) theorized that with continued practice the strength of the memroy and perceptual trace developed. Schmidt (1975) stated that mental practice aided in establishing strategies that were an important part of the task during practice and, thus, served to strengthen the traces and improve performance.

II. MENTAL PRACTICE

The majority of research efforts have indicated that mental practice had a positive effect on the performance and acquisition of physical skills. Vandell, Davis, and Clugston (1943) examined the effect of mental practice for junior high school students and college freshmen on acquiring and improving a dart throwing task and for senior high school students on acquiring and improving a basketball free throwing task. It was concluded that, for the junior high school subjects, mental practice for a period of thirty minutes with a one minute rest period between two fifteen minute bouts produced an improvement in later dart-throwing performance (Vandell et al., 1943). In the case of the college

freshmen, Vandell et al., (1943) concluded that mental practice tended to improve the later performance of the dart-throwing activity. For the senior high school subjects, fifteen minutes of mental practice daily produced an improvement in the number of successful free-throws from a possible thirty-five shots (Vandell, et al., 1943). The conclusions were not necessarily significant due to a small sample of subjects. Nevertheless, the study opened the field for investigation of the effect of mental practice.

Kelsey (1961) investigated the effect of mental practice on muscular endurance, with sit-ups selected as the test item. The measurement test was the "total number of sit-ups" that the subjects could do. All subjects were tested on the first and twenty-second day. The subjects were thirty-six male university students who were assigned to one of three groups on the basis of random selection. The groups were classified according to the conditions under which they were to practice on days between testing. The conditions were as follows: (a) Condition I, subjects had no practice, (b) Condition II, subjects had five minutes of physical practice of sit-ups, (c) Condition III, subjects had mental practice (five minutes practice). Improvement was measured between groups by using the difference between the mean scores on the twenty-second day. Significant differences were found between (a) the physical practice condition and the no practice condition and (b) the physical practice condition and the mental practice condition with a t ratio favoring the physical practice condition in both measures. No significant difference was found between the no practice condition and mental practice condition.

Improvement was also measured within groups by using the difference in mean scores between the first and twenty-second day, and the results indicated that mental practice was significantly effective in improving muscular endurance with $p < .05$ (Kelsey, 1961).

Egstrom (1964) studied the effect of varying emphasis of mental and manual practice on the early learning of a novel ballistic gross motor skill. Male college students were instructed to strike a small rubber ball toward a target with a wooden paddle in their nonpreferred hand. The nonpreferred hand was used to ensure novelty of the skill. The subjects were randomly assigned to one of six groups. The groups were (a) manual practice only, (b) early manual practice, (c) early mental practice, (d) alternate periods of manual and mental practice, (e) mental practice only, and (f) no practice. From the results of the data, Egstrom (1964) generalized that (a) mental practice was effective in acquiring and improving gross motor skills, and (b) that the use of manual and mental practice during learning was advantageous to the task (Egstrom, 1964).

Start and Richardson (1964) found that successful mental practice required the subjects to have a controlled and kinesthetic image of themselves performing. The subjects for their study were thirty-two males. The physical skill was a single leg upstart on the high bar. The subjects mentally practiced the skill for six days prior to a test of performance on the first trial of the skill. Tests of vividness and autonomy of imagery were compared with the performance score. The correlation of autonomy of imagery with the performance score was

significant ($p < .05$). Although not initially significant ($p < .05$), kinesthetic imagery after a second analysis appeared as a factor in successful performance of the physical skill (Start and Richardson, 1964).

Jones (1965) suggested that mental practice is effective without actual practice in a study comparing the acquisition of a motor skill under two conditions: (a) undirected mental practice, and (b) directed mental practice. The subjects consisted of seventy-one university males who were unfamiliar with the gymnastic skill, the hock-swing upstart. The criterion test was objective (i.e., pass or fail). The subjects were given a mental practice sheet with general directions on how to proceed and a mechanical analysis of the skill. Both groups received (a) one reading from the directions concerning how to get to the starting position, (b) one mental practice of getting to the starting position, and (c) one reading of the mechanical analysis of the skill. Three mental practices followed. For one group, the experimenter directed the first and third mental practices by reading the instructions aloud. For the second group, all three mental practices were undirected i.e., mental practice with no instructions. Both groups heard a reading of the mechanical analysis of the skill and then were tested on the skill. The results showed that more than half of the subjects were able to perform the skill without previous physical practice or demonstration. The undirected mental practice group scored significantly better ($p = .02$) than the directed mental practice group (Jones, 1965).

Richardson (1967a) concluded from a review of literature that mental practice procedures usually produced improved performance of the motor

tasks. Richardson (1967b) reported that (a) a learner gains something from initial physical performance of an unfamiliar skill, and (b) as a result of mental practice, the elements become more familiar resulting in a reduction in performance errors.

Corbin (1967) tested the effect of mental practice on a novel juggling-type skill. The subjects were thirty high school males. All subjects were exposed to physical practice of the skill for five days and then were randomly assigned to controlled practice groups for further practice. A control group was not allowed any practice for thirteen days after the five day introduction to the skill. A mental practice group mentally practiced without observation of the task for thirteen days. A physical practice group physically practiced for thirteen days. Results from a criterion test administered the last day of the experiment indicated that the mental practice group was significantly better ($p < .01$) than the control group. The physical practice group was significantly better ($p < .01$) than both the mental practice and control group. A paired t-test used to determine within group improvement revealed that the mental practice group showed significant improvement ($p < .01$) on performance of the skill (Corbin, 1967).

Phipps and Morehouse (1969) looked at the effect of mental practice on the acquisition of gymnastic skills with varied difficulty. The skills, varying from simple to complex, were: (a) a hock swing to a horizontal bar, (b) a jump-foot testing motor ability, and (c) a soccer hitch kick. The subjects had had no previous experience in the skills. Five days prior to testing of the skills, subjects were introduced to physical

practice and had five periods of directed mental practice. It was found that the mental practice group required significantly fewer trials ($p < .05$) to succeed in the hock swing to a horizontal bar and the jump-toot. Phipps and Morehouse (1969) concluded that the effectiveness of mental practice was specific to skill and more pronounced in the simpler skills.

Shick (1970), using a sample of college women, studied the effect of mental practice on the improvement of volleyball serving and volleying skills. The study compared a mental practice group with a no practice group. The mental practice group mentally practiced three minutes daily on both volleying and serving for a period of two weeks. No significant results ($p < .025$) were found on volleying. On serving, the mental practice group produced significant improvement ($p < .025$) over the no practice group. A substudy indicated that for the serving skill, three minutes of mental practice was significantly superior ($p < .05$) to one minute of mental practice.

A study was made by Singer and Witker (1970) to determine the effect of time of introduction of mental rehearsal on the acquisition of skill on the pursuit rotor. Sixty-five college women were the subjects for the study, and they were placed randomly into five groups. Four of the groups mentally practiced at various times within actual practice, and the fifth group served as a control group receiving only overt practice. During mental practice, the subjects were instructed to close their eyes and concentrate on mentally performing the task. Two practice sessions were conducted each week for a period of four weeks with one day of rest

in between the two practice sessions. The sessions consisted of five trials of either physical or mental practice lasting fifteen seconds per trial with a rest period of ten seconds between each trial. Each group mentally practiced within the context of overt practice according to the following schedule: (a) Group I—mentally practiced during sessions 1 and 2, (b) Group II—mentally practiced during sessions 3 and 4, (c) Group III—mentally practiced during sessions 5 and 6, and (d) Group IV—mentally practiced during sessions 7 and 8. Posttest (at the end of the four week period), post-mental practice, and pre-mental practice time-on-target scores were obtained. From the results of various statistical analyses, it appeared that some overt practice was necessary before the introduction of mental practice. Overt practice and combination of overt and mental practice were not significantly different ($p < .01$) in the acquisition of the task. Singer and Witker (1970) concluded that although no significant differences were found between the groups concerning the point of introduction of mental rehearsal ($p < .01$), a trend in scores indicated that earlier mental rehearsals in the pursuit rotor task might be more beneficial than later mental rehearsals.

Rawlings, Rawlings, Chen, and Yilk (1972) conducted two experiments to test the hypothesis of Singer and Witker (1970). In the first experiment, improvement in a rotary pursuit task was compared between three groups: (a) physical practice, (b) mental practice, and (c) no practice. Subjects for the study were eight female undergraduate students per group. Practice sessions consisted of twenty-five trials

on the pursuit rotor lasting thirty seconds, with thirty second rest intervals in between each trial. Each subject was tested once per day for a period of ten days. On the first day, all subjects were instructed to practice physically for twenty-five trials. During the rest period, all subjects were instructed to read aloud from a list of colors to prevent any active mental rehearsal. From the second through the ninth day the physical practice group repeated the same schedule as they did on the first day. During the same time period the mental practice group was instructed (a) to mentally picture the apparatus and imagine themselves performing the task without making the motor responses for thirty seconds, (b) to name colors for thirty seconds, and (c) to rest for thirty seconds. On the tenth day, all groups were retested. The results of the study confirmed the hypothesis that mental rehearsal facilitated learning of rotary pursuit tracking. The physical and mental practice groups were equally proficient and both groups were superior to the control (no-practice) group ($p < .05$).

In the second experiment (Rawlings et al., 1972), twenty male college freshmen were used as subjects and were assigned randomly to groups: (a) motor practice and mental rehearsal, during the rest period, or (b) motor practice and color naming during the rest period. The rate of learning was singificantly faster ($p < .001$) for the group receiving motor and mental practice (Rawlings, et al., 1972).

In the first part of a two part experiment, Smyth (1975) studied the effects of mental practice on performance of a mirror drawing task. Tim and error scores were recorded as a measure of performance.

Twenty-nine female and forty-one male undergraduate and postgraduate university students with no prior experience in the task were used as subjects. The subjects were randomly assigned to seven groups of ten subjects each; one group consisted of five females and five males, the other groups consisted of four females and six males. Four of the seven groups were shown and given an explanation of the test equipment and then were grouped respectively as: (a) active practice with five practice trials, (b) no practice, (c) mental practice of the same time duration of the group who actively practiced five trials, and (d) mental practice with five mental practice trials. The remaining three groups were shown an interference task, which was the same as the test task except for the addition of a second mirror, and then were grouped as: (a) timed active interference practice, (b) timed mental interference practice, and (c) mental interference practice with five practice trials. The mental practice subjects were instructed to attempt to formulate the principles of displacement involved in mirror drawing and to imagine as clearly as possible actually drawing the task as it was explained. It was recommended that the subjects close their eyes, and make no overt movements. All subjects were tested on the test task after their respective practice. Analysis of data indicated that the active practice group with five practice trials was significantly better than the other groups, ($p < .01$) and, that the mental practice group with five mental practice trials was significantly better than the no practice group ($p < .05$). Although in this study mental practice was not shown to be effective in the initial learning of a mirror-drawing task, Smyth (1975)

did not rule out mental practice as a factor in skill learning because no active trials were allowed before the use of mental practice. Smyth concluded that if the subjects had been allowed one active practice trial before mentally practicing, the results might have been consistent with the majority of studies that reported mental practice as effective in the initial learning of a task. Step-by-step instructions or experience of the task might be necessary for mental practice to be more effective (Smyth, 1975).

The hypothesis that mental practice alternated with physical practice was more effective for the acquisition of a skill than physical practice alternated with rest was rejected ($p < .05$) by Smyth (1975) in the second part of her experiment which investigated the use of mental practice with varying amounts of active practice on the rotary pursuit task. It was suggested that lack of familiarity with mental practice contributed to the rejection of the hypothesis since the subjects reported difficulty in practicing mentally (Smyth, 1975).

Minas (1978) trained subjects to use their nondominant hand to promote novelty on a perceptual-motor ball throwing task. Sixteen male and sixteen female undergraduate students served as subjects and were randomly assigned to four groups. Following two initial training trials (pre-treatment phase), treatment was as follows: (a) physical practice, (b) mental practice, (c) mental practice with feedback, and (d) no practice. The mental practice groups were instructed to imagine performing the initial task; the physical practice group continued training as in the initial trials. The final phase of the experiment

involved a test for all groups on the initial task. The results showed no significant improvement ($p < .01$) in the act of the motor skill for any of the groups. However, in the measurement of sequence learning, the mental practice with feedback group was significantly superior ($p < .05$) to the other groups (Minas, 1978).

Wrisberg and Ragsdale (in press) studied the effect of mental practice on motor and cognitive skills. They randomly assigned subjects to one of three groups including: (a) a mental practice group, (b) a physical practice group, and (c) a control group (no practice). The mental practice group was instructed to imagine physical performance of the skill. The primarily motor task selected was the stabilometer. The McCloy Block Test was selected and used as the primarily cognitive task. It was found that for performance on the cognitive task, (a) the physical practice group was not significantly different from the mental practice group ($p < .05$) and (b) both the mental and the physical practice groups were significantly better ($p < .05$) than the control group. For performance on the primarily motor task, it was found that (a) the physical practice group was significantly better ($p < .05$) than the mental practice and control group, and (b) the mental practice group was not significantly different ($p \leq .05$) from the control group. It was concluded that mental practice could be a valuable tool for the practitioner in the teaching and coaching of students in the early stages of learning a cognitive task (Wrisberg and Ragsdale, 1979).

III. SUMMARY

Adams (1971) stated that the perceptual trace becomes more specified or stronger with practice with the possible result that mental practice might be more specifically directed. The majority of researchers have established that mental practice facilitated performance and acquisition of motor skills (Corbin, 1967; Egstrom, 1964; Phipps and Morehouse, 1969; Rawlings et al., 1972; and Vandell, 1943). Others have established that mental practice improved performance (Shick, 1970) as well as muscular endurance (Kelsey, 1961). Mental practice facilitated acquisition of the sequential component of a complex motor skill (Minas, 1978). Singer and Witker (1970) and Smyth (1975) suggested that an initial trial or overt practice as well as step-by-step instructions or an explanation of the task were necessary before the introduction of mental practice.

However, there were conflicting results in the literature concerning the effect of the amount of mental practice (Richardson, 1967 and Shick, 1970) and there was only one study concerning the time of introduction of mental practice (Singer and Witker, 1970). Therefore, research could be extended to attempt to resolve the conflicts and provide more information concerning the effects of amount and time of introduction of mental practice on the performance of specific sport skills.

CHAPTER III

METHODS AND PROCEDURES

This study was designed to investigate the relative effects of the time at which mental practice was introduced during the physical practice schedule and the amount of mental practice on the performance of the back roll extension. Form and success of the back roll extension were evaluated by judges' objective evaluation of the videotaped performances.

I. SUBJECTS

This study involved a sample of thirty-two females who were enrolled in elementary tumbling service courses during the Spring Quarter of 1979 at The University of Tennessee, Knoxville. As a prerequisite, all of the subjects could perform a backward roll. Prior to participation in the study, the subjects received a letter explaining the procedures and completed a consent form (Appendix B).

II. STRENGTH TEST

DiGiovanna (1932) and Wettstone (1938) studied gymnasts and found that arm and shoulder strength was an ability factor in the performance of the back roll extension. Therefore, each subject in the present study was weighed to the nearest one quarter pound. Then, each was tested for shoulder flexor and elbow extensor strength as measured by a maximal weight bench press test using a universal gym, The Circuit Trainer, model number CT-12-M. The subjects were ranked according to

the ratio of strength (maximum amount of weight to the nearest ten pounds that the subject could press) to body weight (in pounds). Four groups of eight successive ranks were established. Subjects from each of the four ranked groups were randomly assigned to each of the four treatment groups. This procedure resulted in the formulation of eight females per treatment group with balancing for the strength/weight ratio and previous experience with the back roll extension. The strength test was given in the weight training room in the Health, Physical Education and Recreation Building on The University of Tennessee campus.

III. PRACTICE SCHEDULE

Within a week following the strength test, the subjects individually appeared for their respective practice schedule. The testing/practice procedure lasted a total of thirty minutes. The subjects received: (a) directions (Appendix C); (b) three initial demonstrations via a motion picture; (c) six one-minute physical practice periods of the back roll extension each followed by three minutes of physical rest with a puzzle solution, mental practice, or a combination of mental practice and physical rest; (d) knowledge of results (KR) on each physical practice trial; and (e) one test period consisting of three performances of the back roll extension with KR on each trial. The mental practice (MP), physical rest with puzzle solution (X), and physical practice (P) schedules were specific for the four treatment groups (Table 1).

TABLE I

PRACTICE SCHEDULES FOR THE FOUR TREATMENT GROUPS

Group	Practice Period 1	2	3	4	5	6	Test
1.	$P_1MP_1X_1MP_1$	$P_1MP_1X_1MP_1$	$P_1MP_1X_1MP_1$	P_1X_3	P_1X_3	P_1X_3	Test
2.	P_1X_3	P_1X_3	P_1X_3	$P_1MP_1X_1MP_1$	$P_1MP_1X_1MP_1$	$P_1MP_1X_1MP_1$	Test
3.	P_1MP_3	P_1MP_3	P_1MP_3	P_1X_3	P_1X_3	P_1X_3	Test
4.	P_1X_3	P_1X_3	P_1X_3	P_1MP_3	P_1MP_3	P_1MP_3	Test

[1]The subscript equals number of minutes of subsequent activity.

Physical practice periods were equal in length for all groups. All subjects participated in six one-minute physical practice periods and one test period of three performances of the back roll extension (Table II). Between the physical practice periods and test period subjects were limited to three minutes of either physical rest, mental practice, or a combination of both rest and mental practice. During all physical rest periods (X), subjects worked a puzzle solution which required them to find andd circle a list of words among a block of letters. The words could be found horizontally, vertically, or diagonally and were printed forward or backward. The puzzle solution was provided to prevent active mental rehearsal.

Mental practice was manipulated by time introduced and amount. For two of the four treatment groups, mental practice was introduced after each of the first three of the six physical practice periods or, in other words, early in the physical practice schedule. For the other two groups, mental practice was introduced after each of the last three of the six physical practice periods, or late in the physical practice schedule. For two groups one in which mental practice was introduced early and one in which mental practice was introduced late, mental practice periods were limited to two minutes. For the remaining two groups in which mental practice was introduced respectively early and late, mental practice periods were limited to three minutes.

Practices were conducted in the Motor Behavior Laboratory in the Health, Physical Education and Recreation Building on The University of Tennessee campus. A spotter was available for all physical practice

TABLE II

SUMMARY TABLE FOR ANALYSIS OF VARIANCE
OF POSTTEST RATING SCORES

Source of Variation	df	MS	F	p
Time	1	3.52	3.73	0.06
Amount	1	0.38	0.41	0.52
Time * Amount	1	0.29	0.31	0.58
Error	28	0.94		
Total	31			

trials. Following the practice and test periods, a questionnaire was answered by each of the subjects (Appendix D).

IV. VIDEOTAPE RECORDING

The subjects were videotaped during all physical practice periods and the test period using a Sony Portapak camera, model number AVC-3400, black and white videotape recorder, model number AV-3400, and large screen monitor. Displayed within the camera range were group and subject number, practice period and/or test period number, and practice trial and/or test trial number. The camera was positioned on a tripod twenty-five feet from the twelve-foot Nissen folding floor exercicse mat on which the subjects performed (Appendix E).

V. JUDGING PERFORMANCE

By viewing the videotape recording on the large screen monitor, three experienced gymnastic judges and tumbling instructors evaluated the subject's back roll extensions on the first three trials (pretest ratings) and the three test performances (posttest ratings) using a rating form (Appendix A). The performance was evaluated in two ways: (a) rating of form (0-5 points), and (b) judging of pass or failure to pass through a handstand position. The evaluators were not informed of any treatment differences. Their viewing of the order of the subjects' trials was constant but the order of subjects and groups was random.

CHAPTER IV

RESULTS

This investigation was designed to study the relative effects of time of introduction and amount of mental practice on the performance of the back roll extension. Data from the performance of thirty-two female undergraduate students enrolled in elementary tumbling courses during the Spring Quarter of 1979 were used. Results were organized in four categories: (a) objectivity-reliability of the judges' ratings, (b) questionnaire, (c) data analysis, and (d) discussion.

I. OBJECTIVITY-RELIABILITY

The objectivity-reliability of the three judges' pretest and posttest ratings were tested by using a Pearson correlation coefficient. The pretest correlations were: (a) $r_{1,2} = .71$, $p = .0001$, (b) $r_{1,3} = .65$, $p = .0001$, and (c) $r_{2,3} = .69$, $p = .0001$ with the number of the judge referred to by the subscript. The posttest correlations were: (a) $r_{1,2} = .71$, $p = .0001$, (b) $r_{1,3} = .59$, $p = .0004$, and (c) $r_{2,3} = .59$, $p = .0004$. Findings of the calculation revealed that the judges' ratings had significance levels of objectivity-reliability with $p < .05$.

II. QUESTIONNNAIRE

The subjects via a questionnaire were asked to describe how they mentally practiced. The questionnaire required the subjects to first write a description of how they mentally practiced and then to turn the

questionnaire over and circle answers which applied to their mental practice procedure (Appendix D).

The descriptions from the questionnaire revealed that all of the subjects imagined themselves performing the back roll extension skill. Many of the subjects reviewed the instructions on the performance of the back roll extension and used the film demonstration as a reference of the correct performance. They concentrated primarily on the correct timing of the leg thrust and arm push as well as on correcting errors. No major problems in mentally practicing were reported by the subjects. One subject did mention difficulty in imagining the leg thrust, and another mentioned that her thoughts occasionally wandered during the mental practice periods. The forced answers from the questionnaire revealed that (a) nineteen subjects both felt and visualized performance of the skill; (b) seven subjects felt, visualized, and verbally reviewed performance of the skill; and (c) six subjects verbally reviewed and visualized performance.

III. DATA ANALYSIS

The experimental design was a 2 × 2 factorial design with two dependent variables. The independent variables were: (a) time of introduction of mental practice, early or late, and (b) amount of mental practice per period, two or three minutes. The dependent variables were: (a) the average of the three judges' ratings ranging from 0-5 points, and (b) an assessment on whether the subject passed through a handstand position (yes—no).

Ratings

A two-way ANOVA was used to determine if the groups were significantly different on the pretest rating scores (0-5 points). With no significant differences found, $p < .05$, a two-way ANOVA was used to analyze the posttest rating scores (Table III).

The posttest rating scores were calculated as the average of scores from the judges on the back roll extension test performances. The factor of time of introduction of mental practice (early or late) was not significant at the .05 level, $F(1,28) = 3.73$, $p = .06$. The effect of amount of mental practice (two or three minutes) was not significant at the .05 level, $F(1,28) = 0.41$, $p = .52$. The interaction effect of time of introduction by amount of mental practice also failed to reach significance at the .05 level, $F(1,28) = 0.31$, $p = .58$. The null hypotheses that there is no difference in form of the back roll extension performance as a function of: (a) time of introduction of mental practice, (b) amount of mental practice, and (c) interaction of time of introduction and amount of mental practice could not be rejected with $p \leq .05$.

Crosstabulations

The frequency of success or failure to pass through the handstand position by time of introduction of mental practice by amount of mental practice was analyzed using crosstabulations of success and failure scores on the data. If the subject passed through the handstand position, 1 point was received; if not, 2 points were received. A total score of 3 or 4 indicated that the subject passed through the handstand position on the majority of the three posttest performances. A score of

TABLE III

CROSSTABULATIONS OF TIME OF INTRODUCTION AND AMOUNT OF MENTAL PRACTICE WITH HANDSTAND SUCCESS IN POSTTEST DATA

	Time of Introduction of Mental Practice							
	Early				Late			
	Success		Failure		Success		Failure	
Score:	3	4	5	6	3	4	5	6
Amount of Mental Practice								
2 minutes								
Cell frequency	0	0	0	8	0	1	2	5
Cell percent	0%	0%	0%	25%	0%	3.1%	6.25%	15.63%
3 minutes								
Cell frequency	0	0	0	8	2	1	0	5
Cell percent	0%	0%	0%	25%	6.25%	3.1%	0%	15.63%

5 or 6 indicated that the subject failed to pass through the handstand position on the majority of the posttest performances.

Crosstabulation was used to evaluate the frequency of successes and failures. Fisher's Exact Test was used on the 2 × 2 (time of introduction by amount of mental practice) crosstabulations on pretest failures. There was no significant difference between groups on pretest scores with $p = .85$.

A three-way crosstabulation was used to analyze the 4 × 2 × 2, handstand success by time by amount of mental practice. The frequencies and percent of frequency were calculated by crosstabulations (Table II). The results were not statistically analyzed because the Chi square restrictions could not be met. However, percentages were calculated and patterns were observed.

In the time of introduction by amount of mental practice crosstabulations, the most successes occurred in the group which received a late introduction to mental practice and three minute periods of mental practice (Table III). Of the subjects in this group, 9.35% received scores indicating success and 15.63% received scores indicating failure in passing through the handstand position on the posttest evaluation. The only other group that showed successes was the one which received late mental practice with two minute periods (Table III) Within this group, one subject was successful in passing through the handstand position.

Of the subjects in the groups which received late mental practice, 25% were successful in passing through the handstand position (Table IV).

TABLE IV

SUMMARY OF CROSSTABULATION BY TIME OF INTRODUCTION OF MENTAL PRACTICE AND HANDSTAND SUCCESS

Cell Frequency Cell Percent Row Percent	Success		Failure	
	3	4	5	6
Time of Introduction				
Early	0 0% 0%	0 0% 0%	0 0% 0%	16 50% 100%
Late	2 6.25% 12.50%	2 6.25% 12.50%	2 6.25% 12.50%	10 31.25% 62.50%

N = 32

In contrast, none of the subjects in the early mental practice groups was successful in passing through the handstand position (Table III and Table IV).

When considering the factor of amount of mental practice, crosstabulations revealed that of the subjects who received three minutes of mental practice per period, 18.7% were successful in passing through the handstand position (Table V). Of the subjects who received two minutes of mental practice per period, 6.2% were successful in the handstand evaluation (Table V).

IV. DISCUSSION

Richardson (1967a) suggested three minutes as a maximum amount of time to mentally practice in one period. Shick (1970) found three minutes of mental practice was significantly better ($p < .05$) than one minute of mental practice on a volleyball serve. The present study did not support a difference in the effect of two and three minute practice periods. This suggests that the differences in the amounts of time spent mentally practicing need to be greater than one minute in order to significantly effect performance of closed gross motor tasks.

Adams (1971) stated that the memory and perceptual traces become more definite with practice. The crosstabulations analysis revealed that the factor producing the greatest number of successes in passing through the handstand position was the time of introduction of mental practice. From the evidence in the crosstabulations, the data in the present study suggested that subjects which received a late introduction

TABLE V

SUMMARY OF CROSSTABULATION BY AMOUNT OF MENTAL PRACTICE AND HANDSTAND SUCCESS

Cell Frequency Cell Percent Row Percent	Success		Failure	
	3	4	5	6
Amount				
2 Minutes	0 0% 0%	1 3.1% 6.2%	2 6.25% 12.5%	13 40.63% 81.26%
3 Minutes	2 6.25% 12.5%	1 3.1% 6.2%	0 0% 0%	13 40.63% 81.26%

N = 32

to mental practice were more successful in performing the back roll extension. Adams (1971) believed that a representation of the correct response developed from increased experience with the task. If a composite representation was beginning to formulate during the early periods of physical practice alternated with rest, then it could be that the later introduction of mental practice resulted in more specifically directed mental practice which led to the greater successes in performance. Adams (1971) also believed that the memory and perceptual trace became defined over practice trials. With early physical practices of the back roll extension, the memory and perceptual trace could have become more specifically defined and the major errors in performance eliminated so that late mental practice was directed toward improvement on what became a more familiar skill with emphasis on the correction of minor errors. As Adams (1971) believed that verbal or cognitive activity was dominant during early practice, mental practice during early periods of physical practice could have either interfered with or confounded the formulation of references from the movements.

Smyth (1975) and Richardson (1967b) suggested that overt practices were needed before the introduction of mental practice. The present study provided at least one physical practice period prior to the introduction of mental practice. Results of the present study imply that more than four overt practice periods might be necessary for mental practice to have an effect on complex tasks.

A plausible reason for lack of statistical significance on form of performance at the .05 level was that the amount of physical practice

totaled only six minutes. It is possible that the results might have revealed significant differences had there been more physical practice. More practice periods might have resulted in a more pronounced effect of time of introduction of mental practice as the memory and/or perceptual traces might have been more definite allowing more specifically directed mental practice.

Singer and Witker (1970) attempted to show the effect of time of introduction of mental practice with a pursuit rotor task. A significant effect was not found in the study but a trend in scores indicated that an earlier introduction to mental practice might be more beneficial on this open task (Singer and Witker, 1970). Wrisberg and Ragsdale (in press) found that early periods of mental practice were effective in the early stages of performance on a highly cognitive task. Crosstabulations from the present study suggested late mental practice were more beneficial for performance on the back roll extension, a closed task. The contrast of results of the studies by Singer and Witker (1970), Wrisberg and Ragsdale (in press) and the present study suggest that the time of introduction of mental practice might be specific to the classification of the task. Phipps and Morehouse (1969) concluded that mental practice effects were specific to the difficulty of the skill and were more pronounced in the simpler of three tested skills. Early mental practice may be more effective when there are more environmental controls (open task) while late mental practice may be more effective when there are only internal controls (closed task).

Smyth (1975) suggested that the factor of reported difficulty in mentally practicing might have contributed to the rejection of the hypothesis that mental practice alternated with physical practice was more beneficial than physical practice alternated with rest. In the present study, the questionnaire results indicated that the subjects were able to mentally practice without any reported difficulty. Start and Richardson (1964) suggested that mental practice was effective when the subjects had a controlled kinesthetic image of themselves performing. The questionnaire results from the present study revealed than nineteen of the subjects both felt and visualized performance of the back roll extension skill.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The purpose of the study was to investigate the effect of the time of introduction and the amount of mental practice on the performance of the back roll extension. Performance was measured by the average from three judges' ratings of form and success in passing through the handstand position.

Thirty-two female college students enrolled in two elementary tumbling classes at The University of Tennessee, Knoxville, served as subjects for this study. The subjects were measured by body weight and shoulder strength and then were randomly assigned to one of four treatment groups. The treatment groups were: (a) early introduction and two minute periods of mental practice, (b) late introduction and two minute periods of mental practice, (c) early introduction and three minute periods of mental practice, and (d) late introduction and three minute periods of mental practice.

All physical practice trials of the back roll extension were videotaped. The judges evaluated the first three performances (pretest) and the three test performances (posttest) from the videotape recordings. The judges used a five-point scale to evaluate the form of the subjects' performance of the back roll extension. A Pearson correlation coefficient (r) was used to test the objectivity of the judges' ratings. There were

no significant differences in the groups based on analysis of the pretest scores of form and success. A two-way ANOVA was used to analyze the rating scores. The judges used a dichotomous scale (yes or no) to evaluate the success of each subject to pass through the handstand position on performances of the back roll extension. Crosstabulations were used to evaluate the scores on frequency of success and failure.

The analysis of variance indicated that there was no significant (a) effect of time introduction of mental practice, (b) effect of amount of mental practice, or (c) interaction effect on the form of the back roll extension. Crosstabulations indicated more subjects who mentally practiced late were successful than subjects who mentally practiced early.

II. CONCLUSIONS

Based on this study the following conclusions were drawn:

1. There is an implication that late introduction to mental practice produces more successful performances of the back roll extension.

2. There is no effect of amount, i.e., 2 or 3 minutes, of mental practice on the form or the success of performance of the back roll extension.

3. There is no interaction effect of time of introduction and amount of mental practice on the form or the success of performance of the back roll extension.

III. RECOMMENDATIONS

1. Studies should be conducted using more and/or longer physical practice periods with varied introduction of mental practice.

2. Further studies should be conducted to investigate the effect of more variation in time of introduction to mental practice on performance of gross motor tumbling skills as well as on performance of closed and open tasks.

3. Studies should be conducted to investigate effects on performance over trials when mental practice is used between trials.

4. Studies using gymnasts with varied ability levels should be conducted to investigate the effect of mental practice.

5. Studies should be conducted to investigate the effect of more varied amounts of mental practice.

6. Studies should be conducted to measure the effect of time of introduction to mental practice on performance of tumbling skills which vary on levels of complexity and difficulty.

LIST OF REFERENCES

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Adams, J. A. A closed-loop theory of motor learning, Journal of Motor Behavior, 1971, 3 (2), 111-149.

Corbin, C. B. The effect of mental practice on skill development after controlled practice, Research Quarterly, 1967, 38, 534-538.

DiGiovanna, V. The relation of selected structural and functional measures to success in college athletics, Research Quarterly, 1943, 14, 207-216.

Egstrom, C. H. Effect of emphasis on conceptualizing techniques during early learning of a gross motor skill, Research Quarterly, 1964, 35, 472-481.

Jones, J. Motor learning without demonstration of physical practice under two conditions of mental practice, Research Quarterly, 1965, 36, 270-276.

Kelsey, I. B. Effects of mental practice upon muscular endurance, Research Quarterly, 1961, 32, 47-54.

Minas, S. C. Mental practice of a complex perceptual-motor skill, Journal of Human Movement Studies, 1978, 4, 102-107.

Phipps, S. J. and Morehouse, C. A. Effects of mental practice on the acquisition of motor skills of varied difficulty, Research Quarterly, 1969, 40, 773-778.

Rawlings, E. I., Rawling, I. L., Chen, S. S., and Yilk, N. D. The facilitating effects of mental rehearsal in the acquisition of rotary pursuit tracking, Psychonomic Science, 1972, 26, 71-73.

Richardson, A. Mental practice: A review and discussion, Part I, Research Quarterly, 1967a, 38, 95-107.

Richardson, A. Mental practice: A reveiw and discussion, Part II, Research Quarterly, 1967b, 38 (2), 263-273.

Schmidt, R. A. Motor Skills, New York, Evanston, San Francisco, London: Harper and Row, Publishers, 1975.

Schmidt, R. A. and White, J. L. Evidence for an error detection mechanism in motor skills: A test of Adams' closed-loop theory, Journal of Motor Behavior, 1972, 4 (3), 143-153.

Shick, J. Effects of mental practice on selected volleyball skills for college women, Research Quarterly, 1970, 41, 88-94.

Singer, R. N., and Witker, J. Mental rehearsal and point of introduction within the context of overt practice, Perceptual and Motor Skills, 1970, 31, 169-170.

Smyth, M. M. The role of mental practice in skill acquisition, Journal of Motor Behavior, 1975, 7 (3), 199-206.

Start, K. B., and Richardson, A. Imagery and mental practice, British Journal of Educational Psychology, 1964, 34, 280-284.

Ulich, E. Some experiments on the function of mental training in the acquisition of motor skills, Ergonomics, 1967, 10 (4), 411-419.

Vandell, R. A., Davis, R. A., and Clugston, H. A. The function of mental practice in the acquisition of a motor skill, Journal of General Psychology, 1943, 29, 243-250.

Wettstone, E. Tests for predicting potential ability in gymnastics and tumbling, Research Quarterly, 1938, 9, 114-127.

Wrisberg, C. A., and Ragsdale, M. R. Cognitive demand and practice level: Factors in the mental rehearsal of motor skills, Journal of Human Movement Studies, in press.

APPENDICES

APPENDIX A

RATING FORM

RATING FORM

Judge

Subjects	Trials	Timing	Vertical Thrust	Hands/ Arms	Inverted	Balance	Passed Through Handstand Position Yes	Passed Through Handstand Position No	Total	Average
Pre-Test	1 1									
	1 2									
	1 3									
Post-Test	7 1									
	7 2									
	7 3									

Rating Form Points:

1. Proper Timing in Thrust of Legs
2. Success in Thrusting the Legs Vertically
3. Success in Pushing with Hands/Arms
4. Attainment of the Inverted Position Feet above Knees, Knees Above Hips, Hips Above Shoulders
5. Balance Point Attained

APPENDIX B

LETTER/INFORMED CONSENT

The University of Tennessee
School of Health, Physical Education and Recreation
Knoxville 37916

Division of Physical Education

May, 1979

You have been selected to participate in a study concerned with types of practice of a tumbling skill. The study will be conducted by Amy Reid and is the thesis project required to complete the requirements for a Masters of Science degree in physical education.

The study will consist of a strength test, body weight measure, and a session to practice the tumbling skill. The strength test is designed to measure your shoulder/upper arm strength and will be related to your body weight. The practice session is designed to provide a series of types of practice. Different groups of subjects will receive different types of practice at different times. You will be randomly assigned to one of these groups. Each practice trial will be videotaped as a record of the event. The tapes will be viewed only by the research team and 3 tumbling teachers who will determine performance scores for use in the analysis of data. The tapes will be erased at the conclusion of the study. No names will be recorded on score sheets or tapes and your scores will be considered confidential information.

If you are willing to participate, the following total time committment of 35 minutes will be expected. The strength test will take a maximum of 5 minutes and will be given on a day preceding the practice session which will take a maximum of 30 minutes. The strength test will occur one afternoon or evening and a few days later the practice session will occur. Scheduling will be made at times convenient to you.

This study can be accomplished only with your help. Your contribution is very important, and you are doing me a real favor if you agree to participate. No portion of your grades or academic standing are dependent upon participation in this experiment.

Please complete the attached form and sign up on the master schedule for times you can come. Come to Room 135 in HPER Building for the strength test. Come to Room 144 HPER for the practice session.

Thank you very much for your assistance.

Sincerely,

Amy S. Reid

Amy S. Reid
522-2562 Home Phone
974-2160 or 974-5111 Office Phone
Alumni Gym or HPER Building (Mailbox)

Strength Test, Room 135
Date_____ ____
M T W T F Time

Practice Session, Room 144
Date_____ ____
M T W T F Time

INFORMED CONSENT

I understand that the purpose of this study is to learn more about types of practice for the back roll extension.

I confirm that my participation as a subject is entirely voluntary. No coercion of any kind has been used to obtain my cooperation. I confirm that no portion of my grades or academic standing are dependent upon participation in this experiment.

I understand that I may withdraw my consent and terminate my participation at any time during the investigation.

I have read the letter explaining the procedures that will be used in the study and understand what will be required of me as a subject. I know that I may ask any questions for clarification and understanding at anytime.

I understand that all of my responses and scores will remain completely confidential and that all tapes will be erased at the conclusion of the study.

I wish to give my cooperation as a subject.

Date_____ Signed_____

Witness_____

_____

Campus address_____

Local Phone Number_____

Do you have any physical limitations? yes no
If yes, please describe_____

Do you wear glasses? yes no During physical activity? yes no

Do you wear contacts? yes no During physical activity? yes no

Other explanation_____

Strength Test
M T W Th F
Date_____ Time_____

Practice Sessions
M T W Th F
Date_____ Time_____

APPENDIX C

DIRECTIONS

Initial Directions for All Groups:

You are here to perform and practice the back roll extension tumbling skill. The back roll extension is a backward roll which finishes in a handstand. You will physically practice the skill, and mentally practice the skill, and rest at various times during the total time you are here.

On the verbal signal "Practice," you are to move to the mat and actually physically practice the back roll extension. On the signal "Mentally Practice," move to the chair, or remain in it, and mentally practice the back roll extension. Mental practice requires you to imagine yourself correctly performing the skill and the instructions to mental practice are as follows:

Close your eyes and imagine that you are performing that back roll extension. Do this without making any observable or overt movements. Think about, see, and feel yourself correctly performing the skill. Concentrate, and continue to mentally practice from instruction to "Mentally Practice" until next instruction.

On the signal "Rest," move to the chair, or remain in it and work on the puzzle provided for you. Here is a sample similar to the one you will work on (show it). In the puzzle of letters you are to find, circle, and check-off as many words as you can in the amount of time allotted to you. Correctly circled words are worth one point each. The words circled and checked-off will be counted and scored, so find as many as you can. If you complete the puzzle, another one will be provided.

On the signal "Test," move to the mat and perform the back roll extension a total of three (3) times.

Group 1

Your individual schedule will consist of six physical practices, each lasting for one minute. Practice during these times at your own pace; in other words, don't feel rushed. Start each skill from the X-mark on the mat. A three-minute rest period will occur between your six practices.

You will physically practice the back roll extension for one minute; mentally practice the back roll extension for one minute; rest for one minute; mentally practice for one minute and then repeat the sequence twice. You will then physically practice the back roll extension for one minute; rest for three minutes and then repeat the sequence twice. Then you will test.

Remember, the verbal cues are "Practice," "Mentally Practice," "Rest," and "Test."

Do you have any questions?

Group 2

Your individual schedule will consist of six physical practices, each lasting for one minute. Practice during these times at your own pace; in other words, don't feel rushed. Start each skill from the X-mark on the mat. A three-minute rest period will occur between your six practices.

You will physically practice the back roll extension for one minute; rest for three minutes and then repeat the sequence twice. You will then physically practice for one minute; mentally practice the back roll extension for one minute; rest for one minute; mentally practice for one minute and then repeat the sequence twice. Then you will test.

Remember the verbal cues are "Practice," "Mentally Practice," "Rest," and "Test."

Do you have any questions?

Group 3

Your individual schedule will consist of six physical practices, each lasting for one minute. Practice during these times at your own pace; in other words, don't feel rushed. Start each skill from the X-mark on the mat. A three-minute rest period will occur between you six practices.

You will physically practice the back roll extension for one minute; mentally practice the back roll extension for three minutes and then repeat the sequence twice. You will then physically practice for one minute; rest for three minutes and then repeat the sequence twice. Then you will test.

Remember the verbal cues are "Practice," "Mentally Practice," "Rest," and "Test."

Do you have any questions?

Group 4

Your individual schedule will consist of six physical practices, each lasting for one minute. Practice during these times at your own pace; in other words, don't feel rushed. Start each skill from the X-mark on the mat. A three-minute rest period will occur between your six practices.

You will physically practice the back roll extension for one minute; rest for three minutes and then repeat the sequence twice. You will then physically practice for one minute; mentally practice the back roll extension for three minutes and then repeat the sequence twice. Then you will test.

Remember, the verbal cues are "Practice," "Mentally Practice," "Rest," and "Test."

Do you have any questions?

All Groups

Now I will give you instructions on how to perform the back roll extension.

You begin the roll extension as you would the backward roll tuck: Stretch, squat (heels leave floor), place hands (palm up) beside ears, tuck head, drop heels and roll. There is no exception. As your hand touchs the mat, thrust or snap your legs upward (extending your toes toward the ceiling) and immediately push with your hands and arms into a handstand position. On each of your practice trials, I will tell you whether you thrusted your legs too early, too late, or on time.

Now I will show you a performance of the back roll extension.

I will spot you when or if you feel it necessary, so let me know.

Questions?

Okay, "Practice."

After Test

Answer this questionnaire.

Keep practice confidential.

Don't mention or practice the skill in class.

Thank you.

APPENDIX D

QUESTIONNAIRE

QUESTIONNAIRE

How did you mentally practice?

(turn over)

How did you mentally practice: (circle numbers)

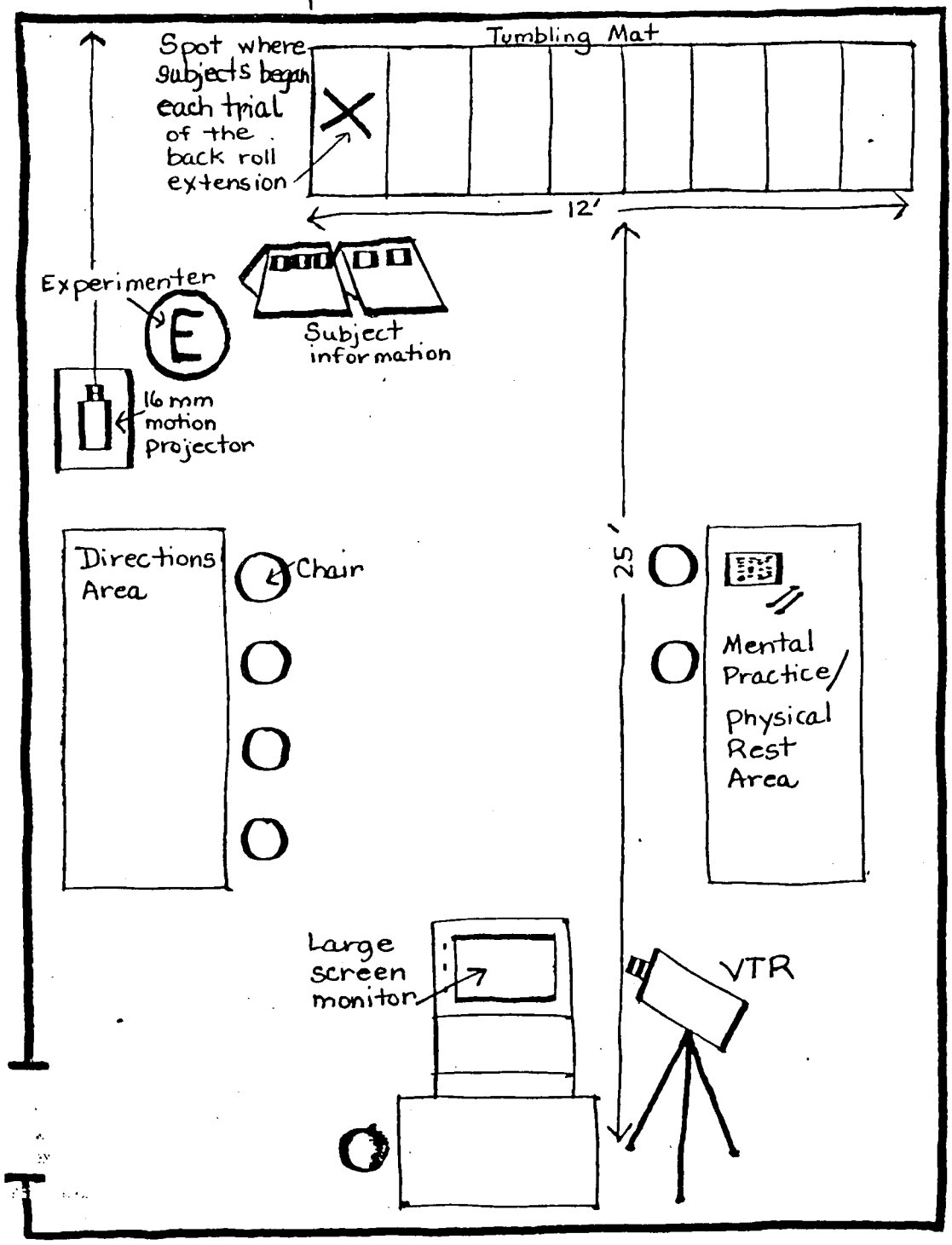
1. Verbally reviewed performance of skill
2. Felt the movement of performing the skill
3. Visualized performance of the skill
4. Verbal and felt
5. Verbal and visualized
6. Felt and visualized
7. Verbal, felt, and visualized

Note: Questionnaire was folded along dotted line. The first question was answered before subjects read and answered the second.

APPENDIX E

EXPERIMENTAL SETTING

Experimental Setting



VITA

Amy Spangler Reid was born in Bristol, Tennessee on November 18, 1956. She attended elementary schools in that city and was graduated from Bristol Tennessee High School in June 1974. The following September she entered The University of Tennessee, Knoxville, and in June 1978 she received a Bachelor of Science degree with a major in Secondary Physical Education and a minor in Elementary Physical Education. In the fall of 1978 she accepted a graduate teaching assistantship at The University of Tennessee and began study toward a Master of Science degree in Physical Education. This degree was awarded in December 1979.