5-1986

Effects of Internal Imagery & Experimental State on the Performance of Intercollegiate Smallbore Rifle Shooters

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1986

Effects Of Internal Imagery And Experiential State On The Performance Of Intercollegiate Smallbore Rifle Shooters

A Thesis

Presented To

The Faculty Of The Department Of

Physical Education And Recreation

Western Kentucky University

Bowling Green, Kentucky

In Partial Fulfillment

Of The Requirements For The Degree

Master Of Science In Education

by

Paul M. Whitworth

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Approved May 6, 1986

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Acknowledgements

I am deeply grateful:

To my wife Debbie for her understanding and patience throughout this project.

To my Thesis Committee, Dr. Burch Oglesby, Dr. Gary Ellis, Dr. William Kummer, Dr. Charles Crume, and Mr. Robert Cobb for their assistance, support, and encouragement.

To Dr. Doris Redfield who provided advice and assistance on statistical analysis.

To the coaches and rifle teams that made this study possible: Mr. Mike Owens, and the University Of Kentucky Rifle Team; Mr. Elvis Green, and the Murray State University Rifle Team; Mr. Bob Beard, and the University Of Tennesse At Martin Rifle Team; Mr. Newt Engle, and the University Of Akron Rifle Team; Mr. Paul Cuccarre, and the Miami University Rifle Team; Mr. Alan Joseph, and the Xavier University Rifle Team; and Mr. Milton Greenway, and the Ohio State University Rifle Team.

To Ltc. Lones W. Wigger, Jr., Mr. William Krilling, and the United States Army Marksmanship Unit for inspiring my interest in International Shooting.

And to Western Kentucky University for assistance in the form of a research grant.

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Effects Of Internal Imagery And Experiential State On The Performance Of Intercollegiate Smallbore Rifle Shooters

Paul M. Whitworth May 1986 89 pages

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This study was conducted to examine the effects of internal imagery and experiential state on the performance of intercollegiate smallbore rifle shooters. An interaction between internal imagery and experiential state was hypothesized. Subjects included 43 smallbore rifle shooters from 7 universities stratified into 2 groups. Group 1, composed of 23 shooters, received internal imagery instructions and practice time; group 2 received unrelated instructions and an equal amount of practice time. Following the instructional period, a posttest was administered to each group (the NRA/ISU Style 1/2 course on an indoor 50 foot range) and each shooter completed an experiential state measure. Analysis of Variance with repeated measures was utilized to examine Pretest to Posttest score differences. An Alpha level of .05 was chosen as the measure of significance.

Results of this study produced no evidence that internal imagery had a significant effect on shooters' composite performance scores. However, the control group's

score was significantly lower than that of the imagery group on posttest prone performance. No significant differences were found in the experiential state scores of those shooters who utilized internal imagery as opposed to those shooters who did not. No significant differences were found between scores of shooters classified into a high experiential state group and those classified into a low experiential state group. No significant interactions were evident between internal imagery and experiential state as measured by posttest composite performance scores.

CHAPTER I

INTRODUCTION

Researchers have studied mental imagery since the nineteenth century as demonstrated by Carpenter's (1894) Ideomotor principle. Numerous studies have been conducted in the area of mental imagery. Richardson (1967b) performed a review of the literature related to mental imagery and concluded that imagery rehearsal can result in an increase in performance and learning of a motor skill. Feltz and Landers' (1983) Meta-Analysis study supports Richardson's conclusions.

Internal imagery is a type of mental imagery. Internal imagery was defined by Mahoney and Avener (1977) as "requiring an approximation of the real life phenemonology such that a person actually images being inside his or her body and experiencing those sensations which might be expected in the actual situation" while external imagery was described as a situation in which "a person views himself from the perspective of an observer (much like in home movies)" (p. 137). In a study of elite gymnasts, Mahoney and Avener found that the more successful athletes principally utilized internal imagery. Davidson and Schwartz (1977) found that internal imagers display higher levels of physiological arousal than do individuals who

use external imagery. They also found that individuals who use internal imagery are more focused on their activity than are external imagers.

The effect of experiential state, which has been identified by Csikszentmihalyi (1975), is also related to the above findings. Experiential state involves dimensions "such as self consciousness, mood, motivation, sense of control, ability to concentrate, and perception of how much is at stake in an activity..." (Chalip, Csikszentmihalyi, Kleiber, and Larson, 1984, P.109). Such dimensions can contribute to, or detract from, the experience of an activity, and possibly increase or decrease performance.

Need Of The Study

A review of the literature, as evidenced by Feltz and Landers (1983), indicated that of the 100 plus research studies conducted on mental practice, the conclusions were contradictory. Schilling (1980) described psycho-training of marksmen, but his article was of a descriptive nature. Suinn (1972) conducted a mental rehearsal program with biathalon skiers, but it was conducted in an annecdotal nature. Relatively little research has been conducted concerning experiential state and internal imagery (Csikszentmihalyi, 1975); and research involving shooters in the area of mental rehearsal has not been conducted under experimental conditions.

Purpose

The purpose of this study was to investigate the effects of internal imagery and experiential state on the performance of intercollegiate smallbore rifle shooters.

Statement Of The Problem

The problems stated in question form are

1. Does internal imagery increase the performance of collegiate smallbore rifle shooters?
2. Is there a significant difference between the experiential state scores of shooters who use internal imagery and those shooters who do not?
3. Is there a significant difference between the scores of shooters classified into a high experiential state and those shooters classified into a low experiential state group?
4. Is there a significant interaction between internal imagery and experiential state on the performance of collegiate smallbore rifle shooters?

Hypotheses

The following Null hypotheses were tested in this study:

1. HOl-There will be no significant difference between the composite scores of shooters who receive the internal imagery treatment and shooters who receive non-related instructions.
2. HOla-There will be no significant difference betweeen the mean prone shooting scores of shooters who receive the internal imagery treatment and those shooters who do not.

3. HO1b-There will be no significant difference between the mean standing scores of shooters who receive the internal imagery treatment and those shooters who do not.
4. HO1c-There will be no significant difference between the mean kneeling scores of shooters who receive the internal imagery treatment and those who do not.
5. HO2-There will be no significant differences in the experiential state scores of shooters who receive the internal imagery treatment and those shooters who do not.
6. HO3-There will be no significant difference between the composite scores of shooters classified into the high experiential state group and those shooters classified into the low experiential state group.
7. HO3a-There will be no significant difference between the high and low state group's posttest prone shooting performance.
8. HO3b-There will be no significant difference between the high and low state group's posttest standing performance.
9. HO3c-There will be no significant difference between the high and low state group's posttest kneeling performance.
10. HO4-There will be no significant interaction effects between internal imagery and experiential state on composite shooting scores.

Limitations

The following is a listing of the limitations of this study:

1. Internal imagery is difficult to quantify. Whether or not subjects actually practice internal imagery cannot be determined with any certainty. Vandell (et. al., 1943) described mental practice as an uncontrollable variable.
2. Subjects may have been exposed to mental imagery techniques prior to the study (Ryan & Simons, 1982).
3. Subjects may differ in amount and quality of their imagery (Ryan & Simons, 1982).
4. Although randomization is required in experimental designs, each school was matched according to performance levels. According to Kerlinger (1973) "... matching as a form of variance control can be profitable and desirable" (p. 311).
5. The number of subjects meet minimum requirements per group according to Borg And Gall (1983), however, a larger sample would have been desirable.
6. Experiential state at this time is best measured by self report measures. However, self report measures have inherrent problems as stated by Borg and Gall (1983) state that "... they are only accurate to the degree that the person is willing to express them honestly" (p. 336).

Delimitations

This study was delimited to and consisted of undergraduate intercollegiate smallbore rifle shooters who shot on a fifty foot indoor rifle range during the Spring of 1985. Generalizations of results should be limited to a similar population.

Definition Of Terms

1. Mental Imagery-"the symbolic rehearsal of a physical activity in the absence of any gross motor movement" (Richardson, 1967, p. 95).
2. Internal Imagery- "...an approximation of the real life phenemenology such that a person actually images being inside his or her body and experiencing those sensations which might be expected in the actual situation" (Mahoney & Avener, 1977, p. 137).
3. Physical Rehearsal-repetition of an activity accomplished by gross motor movement.
4. International Shooting Union-National Rifle Association Smallbore Three Position One-Half Course (ISU-NRA 1/2 course)-a three position course of fire in which the competitor fires 20 shots for score in each position (prone, standing, and kneeling). There are two targets per position with 100 points per target, or 600 points possible for the composite score. The time limits are 20 minutes for prone, 40 minutes for standing, and 30 minutes for kneeling.

5. External Imagery-a situation in which "a person views himself from the perspective of an observer (much like in home movies)" (Mahoney & Avener, 1977, p. 137).
6. Ideo-motor Principle-any ideal that dominates the mind finds its expression in the muscles.
7. Meta-analysis-the "... combination of results of independent studies for the purpose of integrating their findings" (Feltz & Landers, 1983, p. 27).
8. Elite-a generally accepted term for athletes whose performance is world class or at the top of the performance spectrum.
9. Experiential State-the sum total mood of the individual based on dimensions such as "self-consciousness, mood, motivation, sense of control, ability to concentrate, and perception of how much is at stake in an activity..." (Chalip, Csikszentmihalyi, Kleiber, & Larson, 1984, p.109).

CHAPTER II

REVIEW OF RELATED LITERATURE

Background: The Study Of Mental Rehearsal

Performance in any athletic sport is determined by many factors. Physical conformation, diet, developmental environment, exercise, and mental preparation are among those factors which are often assumed to contribute to performance. Among highly skilled "elite" athletes, mental rehearsal is the factor usually stressed as contributing the most to successful performance (Mahoney, 1979; Gallwey & Kriegel, 1977).

Mental imagery has been defined as "the symbolic rehearsal of a physical activity in the absence of any gross motor movement" (Richardson, 1967a, p. 95). This phenomenon has been studied since the nineteenth century as illustrated by Carpenter's (1894) work on the Ideo-Motor Principle. Carpenter's theory was similar to Richardsons' (1967a) definition in his belief that any ideal that dominates the mind also finds its expression in the muscles.

Mental Rehearsal Theories

Block (1981) describes two theories of image formation in the mind. His description of the Pictoralist viewpoint holds that when we imagine a scene in our "minds eye" we

are scanning an actual image that has formed in our brain. The second position, that of the Descriptionists, holds that images do not exist. In the Descriptionists' view when we imagine a physical scene we are not seeing a mental image but the graphic and detailed nature of our language makes it appear so.

A related concept is Lang's (1979) Bio-Informational Theory of emotional imagery which assumes that images in the brain are organized, finite sets of propositions about relationships, descriptions, etc., which function as a prepatory set to response. According to this theory, an emotional image contains stimulus and response propositions. Stimulus propositions are descriptors about stimuli, while response propositions are assertions concerning behavior.

Evidence indicates that mental images can be scanned like physical objects (Kosslyn, Pinker, Smith, & Schwartz, 1981; Kosslyn, 1973,1975). Kosslyn, Pinker, Smith & Schwartz (1981) have conducted research in the area of image formation and have found that small images are hard to see, and when they expand they eventually overflow in an eliptical shape. Also, Images vary in vividness, amount, and quality (Ryan & Simons, 1982).

The effectiveness of imagery on skill acquisition and performance has been explained in several ways. One explanation of the effectiveness of imagery suggests that it is beneficial because it results in minute innervation

of muscles that would be used during actual performance of an activity (Carpenter, 1894; Richardson, 1967; Corbin, 1972; Hale, 1982; Arnold, 1946; Jacobson, 1932; Freeman, 1931). Reviews by Richardson (1967b) and Corbin (1972) have termed this muscle innervation explanation as the Neuro Muscular Feedback Theory which explains imagery as producing identical minute innervations in localized muscles which provides kinesthetic feedback for future movement corrections.

Adams (1971) proposed the Closed Loop Theory Of Perceptual Trace which involves kinesthetic feedback as an internal model of the correct movement: a feeling or memory of how the movement ought to be performed. In Adams' (1971) theory, stimulations from cues are compared to the perceptual trace. This perceptual trace theory poses that mental imagery acts as a mental template or reference for actual performance of the activity.

Another explanation for the effectiveness of imagery (Corbin, 1972; Minas, 1978; Morrisett, 1956; Ryan & Simons, 1981; Sackett, 1934,1935; Sage, 1977; Wrisberg & Ragsdale, 1979) is that the function of imagery is to reinforce the symbolic and or cognitive aspects of movement patterns, and that benefits derived from this reinforcement increases with the greater number of symbolic components that can be identified with the performance of a motor skill. Schmidt (1982) explained imagery as being effective because the imaging subject "can think about what kinds of

things might be tried, the consequences of each action can be predicted to some extent based on previous experiences with similar skill, and the learner can perhaps rule out inappropriate courses of action" (p. 520). Rosenthal and Jacobson (1968) refute theories of imagery effectiveness and attribute reports of increased performance to experimental demand or self-fulfilling prophecy. This Self-fulfilling prophecy is similar to a statement made by William Krilling (personal communication, March 20, 1986), who is the International Rifle Coach of the United States Army Marksmanship Unit. According to Krilling (when discussing psychological technique or equiptment changes) "...the change is not as important as the perception of the change..." and "...if the change is perceived as beneficial to performance, it will be."

Types Of Imagery

The type of imagery utilized appears to determine the effectiveness of imagery in facilitating performance. Two types of imagery have been identified: (1) internal (or kinesthetic) and (2) external. Internal imagery is defined as "requiring an approximation of the real life phenomenology such that a person actually images being inside his or her body and experiencing those sensations which might be expected in the actual situation" (Mahoney & Avener, 1977, p.137). External imagery is defined as a situation in which "a person views himself from the perspective of an observer (much like home movies)"

(Mahoney & Avener, 1977, p. 137). In a study of elite gymnists, Mahoney and Avener found that the more successful athletes principally practiced internal imagery while less successful athletes practiced external imagery. According to Epstein (1980), external imagery relates negatively to motor performance and can produce a performance decrement.

Studies Supporting The Use Of Mental Rehearsal

Numerous studies have been conducted on the relationship between imagery and performance. Studies have been made on such motor skills as juggling, (Trussell, 1952); basketball free throwing,(Russell & Branch, 1979; Vandell, Davis, & Clugston, 1943); track, (Fosbury,1974); ring tossing, (Twining, 1949); dart throwing, (Mendoza & Wickman, 1978); tennis, (Gallwey, 1974; Noel, 1980); karate, (Weinberg, Seabourne, & Jackson, 1981); gymnastics, (Start & Richardson, 1964); skiing (Suin, 1972); and utilization of a pursuit rotor, (Rawlings, Rawlings, Chen, & Yilk, 1972). The above studies support the use of mental rehearsal as a technique for improving performance.

Among those studies reviewed, the typical design involves a mental rehearsal group who has received mental practice instructions and a control group who received unrelated instructions. Occassionaly these groups were compared to a physical practice group and or a group receiving mental and physical rehearsal. Practice periods of varying lengths were conducted for both the experimental and control groups. After a certain number of practice

sessions, the skills were normally tested under standardized conditions to determine the effects of the treatment.

Jacobson (1932) and Shaw (1938) showed electromyographical evidence of increased muscle activity during mental practice. Jacobson reported that the subjects in his experiment, after having been trained to relax, exhibited action potentials only in the muscles involved in the particular imagined activity. This study exhibited an inherrent problem in that electronic probes were located only in the right arm, which cannot conclusively support localization of stimuli. Hale (1981) found that action potentials were demonstrated in a more general area instead of an immediate locality. Shaw (1938) noted that localization of the action potentials was not obtained in his study. However in a later study, Shaw reported that amplified muscle activity potentials from imaginal lifting of a weight showed muscular activity during imaginal lifting, and that the activity increased linearly with increased weight.

In 1943, Vandell, Davis, and Clugston reported on dart throwing and basketball freethrowing in a three week experiment involving junior high school and college groups. The study utilized a small number of subjects and did not utilize a true statistical analysis. However, under the conditions of the experiment the researchers concluded that

mental practice was almost as effective as physical practice.

Twining (1949) divided 36 college men into three groups. The experiment involved ring tossing for 21 days of mental and physical practice. It was concluded that covert rehearsal (mental rehearsal) was statistically significant ($p<.01$) in developing skilled performance when compared to a no practice group.

In 1952, Steel conducted a similar study. Steel used a basketball throw as the required task. Although differences between the control and cognitive rehearsal groups were not significant, he concluded that covert rehearsal did increase performance.

Eggstrom (1964) conducted a study involving 20 male college students performing a novel ballistic gross motor skill involving a wooden paddle and a rubber ball. Analysis of Variance and an examination of a learning curve indicated that five conceptualizing and manual practice methods were more effective than practice given to the control group. It was concluded also that alternating periods of emphasis on conceptualizing and manual practices were as effective as successive periods of manual practice. Clark (1960), in a similar study, found that mental practice was nearly as effective as physical practice.

Corbin (1967b) conducted a study involving a wand juggling task. Subjects participated in physical practice for one week and were then separated into control, mental

practice, and physical practice groups; subjects then practiced in their respective groups for three weeks. Results indicated mental practice to be more effective in subjects having experienced controlled actual practice. In all cases however, the physical practice group significantly outperformed the control and mental practice groups.

Ammons (1951) conducted a study in symbolic content utilizing rotary pursuit tracking. Groups included manual practice, control, and imagery treatments. Analysis of variance showed no significant differences among treatments. This is consistent with the findings of Ryan and Simons (1983), and Barnes (1982).

Reviews by Richardson (1967a) and Corbin (1972) included from 22 and 56 studies respectively, and indicated contradictory conclusions. According to Richardson (1967a) mental practice was associated with improved performance in a majority of the studies. Corbin (1972) held that the studies were inconclusive and that many factors contribute to different results involving mental practice. Feltz and Landers (1983) cite problems with these reviews which include too few studies; only a subset of the total studies were included; the style of the reviews were narrative and rhetorical more so than technical and statistical; and the reviews ignored the issue of relationship strength which may have allowed the equal

weighting of the conclusions from single studies to the conclusions of several studies.

Feltz and Landers (1983) conducted a meta-analysis of the mental rehearsal studies that have been carried out since the 1930's. Of these studies, 60 were included in the meta-analysis. These studies consisted of single group studies for which pre and posttest scores existed, and multiple group studies having at least one comparison between mental practice and control groups. Feltz and Landers (1983) describe the meta-analysis procedure (used in over 15 published studies as of the publishing of their article) as one which is conducted on a group of studies that have common conceptual hypothesis or common operational definitions of independent or dependent variables. According to the authors, this is a way of statistically analyzing the findings of many studies which "usually produces a significance level that gives the probability that a set of studies exhibiting the obtained results could have generated if no actual relationship existed" (Feltz & Landers, 1983, p. 27). The 60 studies in the meta-analysis yielded 146 effect sizes with an overall effect size of .48 which suggests that mental practice of a motor skill is better than no practice at all. Studies involving cognitive tasks had a larger average effect size (M=1.44) than motor tasks (M=.43) or tasks involving strength (M=.20). The authors also mention that published studies had an effect size of .74.

The previous reviews, along with the existing literature, lead to the conclusion that research in mental practice has yielded contradictory results. According to Feltz and Landers (1983), based strictly on statistical signifance of the 60 studies included in the meta-analysis, "50% of them would show mental practice effects and 50% would not" (p. 27). Few of the studies conducted have included internal imagery (or they do not define precisely the type of imagery treatment applied). Many of the studies that have been conducted also are limited due to the use of tasks that involved motor or strength components. The efficacy of mental practice tasks that are predominantly motor or strength based with little symbolic content have been questioned in many studies (Morrisett, 1956; Richardson, 1967b; Ryan & Simons, 1981; Sackett, 1934).

There is some evidence that kinesthetic (internal) imagery produces more muscle innervation than external imagery (Hale, 1981; Jacobson, 1932; Lang, 1979). Davidson and Schwartz (1977) found that subjects who engaged in kinesthetic imagery evidenced greater somatic arousal and less visual activity than subjects who engaged in visual attention and imagery. Evidence also indicates that internal imagers are more focused on their activity than external imagers (Davidson, Schwartz, & Rothman, 1976; Davidson & Schwartz, 1977).

Effects Of Task Type And Practice Time

Studies examining the effectiveness of mental rehearsal have shown improvements of cognitive components (Minas, 1978; Morrisett, 1956; Ryan & Simons, 1981; Smyth, 1975; Wrisberg & Ragsdale, 1979). Beneficial effects of mental practice have been observed in tasks high in symbolic content (tasks that require cognitive processes) (Sackett, 1934; Morrisett, 1956). Sackett (1934) stated that mental rehearsal might well be limited to "those skills in which there is ideational representation of the movement involved" (p. 113). According to Feltz and Landers (1983):

> ... the symbolic or cognitive elements of an unfamiliar task can be learned from task instructions, observational learning, or initial physical performance. Mental practice of these elements fosters subject's retention of symbolized elements and their connections more so than for subjects denied the opportunity for mental rehearsal (p. 46).

The above statements by Felt and Landers (1983) could lead one to the conclusion that mental practice facilitates and improves the subject's perceptions of the symbolic components of a task. Zecker (1982) made a related statement (in description of the Symbolic and Perceptual Trace Hypothesis) that "the greater the number of symbolic components, the greater the benefits of mental practice should be" (p. 54). It has also been suggested that the

greater the number of mental rehearsals the greater the benefits to performance (Sackett, 1935; Smyth, 1975; Smyth & Harrison, 1962). Corbin (1972) and Twining (1949), based on their studies, concluded that there may be an optimal number and length of practice sessions which have the greatest effects on the learning of a skill. According to Feltz and Landers (1983) the "length of practice sessions that were 1 minute or between 15 or 25 minutes produced the largest mental practice effects" and that "it appears that studies that employed either less than 6 trials, or between 36 and 46 trials per practice session, demonstrated the largest effect sizes" (p. 42). Feltz and Landers also concluded that the type of task (physical or cognitive) moderates the amount of mental practice and that the cognitive tasks were associated with relatively few trials (less than six). This indicated that mental rehearsal of tasks high in cognitive content should exhibit effects in relatively few practice sessions. In a study with many trials, Barnes (1982) noted that subjects involvement (interest) decreased with time. Consistent with Barnes' study, Ryan and Simons (1981) concluded that greater numbers of mental rehearsal executions lead to a decrement in performance.

The time at which mental rehearsal is utilized may determine its effectiveness. Oxendine (1968) noted that mental rehearsal may be used before, during, or after

performance of a task. According to Feltz and Landers (1983) mental rehearsal may be most effective when done immediately prior to performance. In their meta-analysis, although not statistically significant at the $p<.01$ level according to the authors, $P<.02$), the effects of mental rehearsal tend to be greater when the posttest is administered later than immediately following mental rehearsal.

The Effects Of Skill Level

The effectiveness of mental rehearsal appears to be determined by the experience level and skill level of the imaging subject. Fitts and Possner (1967) proposed that skill learning can be divided into three phases: cognitive phase, associative phase, and the autonomous phase. According to Fitts and Possner mental rehearsal should be most beneficial during the cognitive phase (or early learning phase) when learning is dependent upon cognitive activity. This conclusions was consistent with the conclusions of Schmidt (1982), and Wrisberg and Ragsdale (1979) that mental rehearsal works best with beginners. Several studies lead to the conclusion that the effects of mental rehearsal are greater for experienced subjects versus novices (Clark, 1960; Corbin, 1967; Egstrom, 1964; Kuhn, 1971; Start, 1962; Zecker, 1982) as exemplified by Decaria's (1977) finding that cognitive rehearsal enhanced the performance of intermediate skill level subjects. The improvement at this skill level may be explained by the

necessity of some prior knowledge, experience, and ability required to be able to perform a task.

Smyth (1975) wrote that a "familiar task would have greater gains after mental practice since a clearer model of what constitutes good performance would have been internalized" (p. 199-200), however, mental rehearsal may be effective with unfamiliar tasks as well. Some researchers such as Jones (1964) have suggested that mental practice is effective without actual physical practice of a task. Phipps and Morehouse (1969) concluded on the basis of their study that the benefits of mental rehearsal without physical practice is specific to the skill and is more pronounced in simpler skills. According to Ryan and Simons (1981) the cognitive components of a task could be learned through mental rehearsal, however there would be a problem concerning correct performance due to lack of feedback or knowledge of results to know whether or not the task was being performed properly. Although Zecker (1982) concluded that knowledge of results is not always necessary for improved performance; Ryan and Simons (1981) stated that "practice does not make perfect, it makes consistent, and if the mental rehearsal was performed improperly no improvement would take place" (p. 43). It was Zecker's (1982) contention that utilization of the objects involved in a task allows proprioceptive cues which facilitate actual performance of the task. Ryan and Simons (1981) posit that mental rehearsal could permit the learning of

the cognitive elements to the point that when actual performance occurs that it would take less time to perfect the skill than without mental rehearsal.

Mental rehearsal effects appear to vary with the proficiency of performers. Corbin (1967) found that most proficient performers did not show any more additional gains than moderately experienced groups when each utilized mental rehearsal. This lack of improvement while utilizing mental rehearsal is most likely due to proficient performers and elite performers being so skilled that mental rehearsal would show very little performance increase. A possible explanation may be Fitts and Possner's (1967) conclusion that as the proficiency of skill increases, the cognitive and conscious involvement required decreases. Another explanation for the lack of improvement may be that highly skilled and elite performers may already utilize mental rehearsal techniques (Ryan & Simons, 1982). Feltz and Landers (1983) recommend the use of secondary tasks (decision making, effort expenditure, etc.) in working with high level performers since scores may be insensitive to the effects of mental rehearsal.

Detrimental Effects Of Mental Rehearsal

The study of internal imagery and mental practice has several complicating factors that can influence outcomes of studies. According to studies by Davis (1932) and Short (1953), images are often multimodal. Meyers, Cook, Cullen, and Liles (1979) found no relation between image

perspective and skill level. Marks (1977) study identified "...the role of individual differences in imagery vividness in the mental practice of physically demanding psychomotor skills" (p. 287). Furthermore, Epstein (1980) found that it is virtually impossible to categorize subjects as strictly internal or external imagers because individuals' images vary both within and between images. Start and Richardson (1964) found that subjects utilizing vivid, controllable imagery exhibited increased performance.

In their study of mental rehearsal, Ryan and Simons (1982) noted that it was difficult to find subjects who had not used imagery. Ryan and Simons also noted that

> ...those who rarely or never use mental imagery may mentally rehearse best without it, whereas those who often use imagery may attain best results by using it in mental rehearsal (p. 42).

Research in some cases supports the notion of the possible detrimental effects of mental rehearsal as evidenced by Ammons (1951) study which showed a performance decrement on a rotary pursuit task after mental practice. Epstein (1980) noted a similar performance decrement in dart throwing which she concluded as being due to mental rehearsal being distracting to some subjects. Clark (1960), in his study, reported that some subjects had hallucinations during imagery rehearsal which adds further support to the possible detrimental effects of mental rehearsal.

The Effects Of Experiential State

In a study by Corbin (1967a) subjects reported on a questionaire that they felt that covert rehearsal improved their ability, helped them relax, concentrate, and analyze the task to be performed. This finding was consistent with a study by Weinberg, Seabourne, and Jackson (1981) who concluded on the basis of their study that VMBR (Visou-Motor Behavior Rehearsal which is a combination of imagery and relaxation) and relaxation groups exhibited significantly less precompetitive state anxiety allowing athletes to develop a relaxed concentration and focus on the relevant cues involved in the sports environment. Knapp (1966) found that anxiety was detrimental to novice collegiate gymnasts. It follows, based on Knapp's study, that if subject's anxieties were decreased then performance would be enhanced. According to Decaria (1977), cognitive rehearsal (progressive relaxation training and mental rehearsal) produced an immediate, but not cumulative, decrease in self-report of anxiety in intermediate subjects and a significant cumulative, but not immediate decrease in the self-report of performance anxiety in novice subjects. These above cited studies support the conclusion that mental rehearsal may reduce perceived anxiety and allow greater focus on the activity which might ultimately increase performance.

Performance seems to be affected by arousal. Arousal has to do with an individual's degree of alertness at a particular time. Arousal is reflected in such physiological responses as heart rate, blood pressure, galvonic skin response, and muscle tension. Excessive degrees of arousal, due to high demand for performance of a complex skill, is thought to be a factor which often leads to less than optimal skill performance. Fiske and Maddi (1961) have suggested that simple skills have a broad range of optimal arousal while difficult tasks have a narrow optimal range of arousal. It may well be that mental rehearsal such as internal imagery moves the subject's arousal toward an optimal level (depending on the type of mental rehearsal, type of sport or skill, and the complexity involved). Courtney (1984) found that successful performance in golf was related to a positive affective response toward the experience, low levels of concern regarding negative performance outcomes and negative self evaluations, and a high degree of self efficacy (self confidence) for the task. When used in conjunction with measures of arousal and self confidence these variables accounted for 58 percent of the variance in golf scores. Courtney (1984) also found that changes in the above described variables preceeded actual improvement in performance.

Bandura (1977) labels situational specific self-confidence as self efficacy and suggests it to be the

cognitive mechanism that commonly induces behavioral change. Self efficacy influences persistence, thought patterns, arousal and behavior (Bandura, 1977; Bandura, Adams, & Beyer, 1977; Bandura & Schank, 1981). Chalip, Csikszentmihalyi, Kleiber, and Larson (1984) have posited that the feelings, moods, and motivations associated with the "sum of discrete, immediate experiences is as important, or more so, than the long-term 'effects' Sports Psychology has been attempting to identify" (p. 109).

Bandura (1977) states that among performers, "...those who acquire maximal efficacy expectations should attain terminal performances, whereas those holding lower expectations should not" (p. 207). Both arousal and self efficacy are components of individuals' experiential states (Csikszentmihalyi, 1975). According to Chalip, Csikszentmihalyi, Kleiber, and Larson (1984, p.109):

> Anxiety is defined as an imbalance between challenges and skills such that perceived challenges are greater than one's sense of skill. Boredom sets in when one's skills are greater than the challenges of an activity. When challenges and skills are equal and greater than zero, experience is optimal, and is called Flow.

In a description of flow, Csikszentmihalyi and Figurski (1982) write:

> The first two aspects of this state are a centering of attention on a limited stimulus field and an intense concentration that produces a merging of action and

> awareness. Also, feedback is clear and unambiguous and the person is not concerned over his control of the situation, feeling quite competent within the interaction. Finally, contingent on the focused attention and intense concentration is the Fifth element: Lack of self awareness (p. 27).

The experiential state of an individual would appear to have a significant effect on the performance outcome of a task.

Motivation Effects

It appears that subject's motivation influences performance. Chalip, Csikszentmihalyi, Kleiber, and Larson (1984) found that more is to be perceived at stake in organized sport, and that the higher motivation associated with organized sport is associated with a lower sense of skill as compared to informal sport. The reason for this could be explained by the findings of Graef, Csikszentmihalyi, and Gianinno (1983) that psychological well being and competence are higher in intrinsically rewarding experiences. Many organized sports utilize extrinsic motivators (varsity letters, trophies, scholarships, etc.) which may decrease intrinsic motivation. The findings by Chalip, Csikszentmihalyi, Kleiber, and Larson and Graef, Csikszentmihalyi, and Gianinno indicate that if involvement in organized sport could be continually intrinsically rewarding and that if the indiviual's perception of how much is at stake could be

lowered then the sense of skill might increase which possibly would lead to an eventual increase in performance.

Chalip, Csikszentmihalyi, Kleiber, and Larson (1984) state that

> Within the context of the flow model, a number of subjective dimensions such as self-consciousness, mood, motivation, sense of control, ability to concentrate, and perception of how much is at stake in an activity are considered to be complementary determiners of the quality of immediate experience (p. 109).

Csikszentmihalyi (1975) has determined that competence can be measured by the balance of challenges and skills. Furthermore, Graef, Csikszentmihalyi, and Gianinno (1983) state "... that it is possible to assess not only a person's initial decision to become engaged in an activity but also his or her ongoing desire to remain involved in the activity or to become involved in something else" (p. 156). In summation of several findings related to experiential state, studies support that when subjects feel skilled in an activity they will enjoy participating in it (Roberts, Kleiber, Duda, 1981), will expect success (Scanlan & Passer, 1981), will expend effort (Korman, 1970), and eventually will attain success (Dalton, Maier, & Posavac, 1977; Muller & Spuhler, 1976).

Experiential State Measurement Methodology

In their study, Chalip, Csikszentmihalyi, Kleiber, & Larson (1984) describe how experiential state can be measured:

1. Self-consciousness was measured by response to a ten-point Likert scale item: 'How self conscious were you?' Responses ranged from 'not at all' (scored zero) to 'very' (scored nine).
2. Skills were rated on a ten-point Likert scale item: 'your skills in the activity', from 'low' (scored zero) to 'high' (scored nine).
3. Challenges were rated on a ten-point Likert scale item: 'challenges of the activity', from 'low' (scored zero) to 'high' (scored nine).
4. Mood was a second order factor combining two oblique First order Factors: affect and activation. The affect dimension was made up of four Seven-point semantic differential items: happy-sad, irritable-cheerful, angry-friendly, and lonely-sociable. The activation dimension was made up of Five seven-point semantic differential items: alert-drowsy, strong-weak, active-passive, involved-detached, and excited-bored. The Factor was scored such that the higher the score, the better the aggregate mood.
5. Motivation was measured by a ten-point Likert scale item: 'Do you wish you had been doing

something else?' The lower the desire to be doing something else, the higher the motivation. In analyses here, the higher the score, the higher the motivation.

6. The sense of control was measured by a ten-point Likert scale item: 'Were you in control of the situation?' Responses ranged from 'not at all' (scored zero) to 'very' (scored nine).
7. How much was at stake in the activity was measured by a ten-point Likert scale item: 'Was anything at stake for you in the activity?' Responses ranged from 'nothing' (scored zero) to 'very much' (scored nine).
8. Difficulty in concentrating was measured by the item: 'Was it hard to concentrate?' Responses on a ten-point Likert scale ranged from 'not at all' (scored zero) to 'very' (scored nine). The higher the score, the more difficult it was for the subject to concentrate (p. 111-112).

According to the authors, this instrument has been used in thousands of observations. The original manner in which this instrument was utilized is called the Experience Sampling Method. Each subject studied under this measure carried a pager that signalled them at random times at which they would fill out a self report form. Validity and reliability of this instrument were not given. However, in an unpublished study by Ellis, Oglesby, and Whitworth

(1986), face validity was assumed in an experiment involving imaging bowlers and the experiential state measure described. Ellis, Oglesby, and Whitworth reported an Alpha reliability of .90 for an instrument that used the above described format for measuring experiential state.

Self-report measures have various problems in their utilization in research. Nisbett and Wilson (1977) state that

> ...when people attempt to report on their cognitive processes, that is, on the processes mediating the effects of a stimulus on a response, they do not do so so on the basis of any true introspection. Instead, their reports are based on a priori implicit causal theories or judgements about the extent to which a particular stimulus is a plausible cause of a given response (P. 231).

Csikszentihalyi and Figurski (1982) in a study on self-awareness (which is necessary to fill out a self-report measure) found that results indicated that self-awareness is associated with lower affect, activation, and personal involvement in voluntary activities. Further discussion of self awareness can be found in Csikszentimihalyi's and Figurski's (1982) article as to self-awareness being aversive (detrimental) except when one has the opportunity to change one's performance.

Conclusions

After a review of the literature, it was evident that findings concerning mental rehearsal are inconsistent across studies due to varied findings and ambiguity in imagery instructions (often difficult to differentiate the type of imagery), skill levels, populations, and methods. However, internal imagery does seem to slightly improve performance while external imagery appears to cause a performance decrement. Even if internal imagery does not improve performance in the short term, utilization of this cognitive rehearsal technique might initiate the cognitive changes that precede performance improvement (Courtney, 1984). As discussed earlier, (Davidson & Schwartz, 1977) internal imagery exhibits higher levels of physiological arousal and greater focus of attention than external imagery. Because both arousal and focusing of attention are characteristics of an optimal experiential state, it follows that the use of internal imagery may increase athlete's performance.

Evidence (presented in the section entitled The Effects Of Experiential State) suggested that internal imagery can improve performance by moving the athlete's experiential state toward an optimal level and allowing focus on cognitive aspects of the activity to be performed. Smallbore rifle shooting was a relatively fine motor skill which utilizes cognitive ability and may be affected by experiential states. Research on the effects of imagery

and experiential states on performance, however, is lacking. Therefore, a study investigating the effects of internal imagery and experiential states on performance is justified.

CHAPTER III

METHODS AND PROCEDURES

Subjects

Subjects for this study were composed of 43 intercollegiate smallbore rifle shooters. The internal imagery treatment group consisted of six females and seventeen males from four universities. The control group consisted of four females and sixteen males from three universities. The composition of subjects skill and experience level are shown in Tables 1 and 2.

Table 1

Years Of Experience Shooting By Treatment

	Number of Subjects		
Years of Shooting	Imagery Group	Control Group	Total
1	4	3	7
2	6	4	10
3	5	4	9
4	2	3	5
5	2	4	6
6	0	1	1
7	1	1	2
8	1	0	1
9	1	0	1
10	1	0	1
Total	23	20	43

Table 2

NRA International Rifle Skill Level By Treatment

Skill Classification	Number of Subjects		
	Imagery	Control	Total
Unclassified	1	3	4
Marksman	9	9	18
Sharpshooter	6	4	10
Expert	4	3	7
Master	3	1	4
Total	23	20	43

Apparatus

The National Rifle Association-International Shooting Union style Smallbore Rifle, Three Positon 1/2 course of fire was utilized as the pre and posttest performance measures. This course of fire was performed on a 50 foot indoor range using the NRA A-36 target. Two NRA A-36 targets were fired in each position (prone, standing, and kneeling). Scores were recorded by position and totaled to yield a composite score of all positions. Time allotments for the course by position are displayed in Table 3 below:

Table 3

Allotted Shooting Time By Position (minutes)

	Prone	Standing	Kneeling
Preparation Period	3	3	3
Record Fire Period	20	40	30

Note. A 10 minute changeover period between positions was provided to each shooter.

Pretest measures for this study consisted of each subject's most recent competition match score. Pretest data were obtained from university rifle coaches at each school. The posttest measures (targets) were scored by myself utilizing inside and outside scoring gauges and magnifying glasses to insure consistency. As the targets were scored, the coach of the respective team reviewed scoring to insure correctness and fairness. Individual shooters were allowed to challenge any scoring that seemed incorrect. The possible range for scores was between 0 and 600.

Procedure

Ten universities within the Ohio Valley area were identified as potential participants for this study. School representatives were contacted by telephone and asked to participate. Pretest scores were obtained from each school, and pairs of correlated schools were matched based upon school means. Matching, rather than random assignment, of schools was selected due to pairs of schools being similar on the dependent variable ($r=.9997$). As Kerlinger (1973) in his rational for matching states: "when a matching variable is substantially correlated with the dependent variable, matching as a form of variance control can be profitable and desirable" (p. 311). A table of random numbers was utilized to assign teams to either the treatment or control group.

Groups of shooters at respective schools remained intact to prevent diffusion between groups such as that which occured with biathlon skiers (Suinn, 1977). Poulton (1975) also emphasizes the effects for intact groups upon participation in one treatment group and its' (the group's) impact on other treatment conditions. Table 4 below displays the mean scores for each school team and the treatment group for which each school was assigned.

Table 4

Treatment Assignment By School Mean Composite Scores

Imagery Group		Control Group	
School	Mean	School	Mean
Murray State U.	558.000	Eastern Kentucky U.	553.000
U. Of Kentucky	536.700	Ohio State U.	536.700
Xavier U.	509.000	U. Tenn. at Martin	517.000
U. Of Akron	484.000	Miami U.	497.100
Group Total	522.925	Group Total	525.950

After assigning treatments and scheduling of experiment dates, Eastern Kentucky University's Rifle Team was dissolved and therefore excluded from this study.

Analysis of Variance (ANOVA) with Repeated Measures and One-way Analysis Of Variance were the statistical tecniques utilized in the design of this study. Dependent variables were identified as shooters performance on the pre and posttest, with independent variables identified as treatment group and experiential state. The experiential

state of subjects was measured the experiential state questionnaire (ESQ) (see Appendix C) utilized by Ellis, Oglesby, and Whitworth (1986). Two levels of the experiential state measure were obtained (high, and low) by splitting scores at group midpoints.

The experiential state questionaire included experiential state items, and a variety of demographic questions such as sex, age, NRA skill classification, and years of international smallbore shooting experience. Subjects completed this questionaire immediately upon finishing the course of fire.

Subjects in the internal imagery treatment group and the control group were given equal time for all activities. The experimental group received internal imagery instructions (see Appendix A) on the day prior to the experiment, practiced internal imagery for one minute per position on the night before, and practiced for one minute per position on the day of the experiment. The control group received an equal amount of time and instructions in a non-related activity (requirements to be a good shooter).

CHAPTER IV

STATISTICAL ANALYSIS

A 2 (image group: imagers versus control) x 2 (shooting performance: pretest versus posttest) Analysis Of Variance with Repeated Measures (ANOVA-RM) was utilized to determine if significant differences existed between shooters. Individual position scores (prone, standing, and kneeling) were also subjected to the ANOVA-RM. An alternative approach would be Analysis Of Covariance (ANCOVA) with shooters pretest performance functioning as the covariate. ANOVA-RM was selected because: (1) no significant differences were found in pretest scores, and (2) performance gains over time were of concern. Table 5 displays the ANOVA of pretest composite scores. No significant differences existed between treatment groups based on pretest composite scores.

Table 5

Analysis Of Variance Summary Table Of Pretest Composite Scores

Source	df	SS	MS	F	p
Between Groups	1	330.301	330.301	0.159	0.691
Within Groups	1	85028.332	2073.861		
Total	42	85358.625			

Note. Significance level $p < .05$.

[a] $N=43$.

Experiential state effects were examined by splitting treatment groups at their respective median on the experiential state score and dividing them into a high-state and low-state group. This grouping was utilized through all analysis. Table 6 displays descriptive statistics of the experiential state data by group.

Table 6

Experiential State Results By Treatment Group

Group	X	Mdn	Sd	Min	Max	n
Imagery	83.087	83.75	19.988	46	125	23
Control	86.000	84.50	19.903	41	117	20

A One-way Analysis of Variance was utilized to determine if significant differences existed between treatment groups based on the experiential state variable. No significant differences existed between groups. Table 7 displays the results of this analysis.

Table 7

Analysis Of Variance Summary Table Of Experiential State Scores By Treatment Group

Source	df	SS	MS	F	p
Between Groups	1	90.798	90.798	0.237	0.629
Within Groups	41	15715.777	383.311		
Total	42	15806.574			

Note. Significance level $p < .05$.

[a] $N=43$.

Analysis Of Composite Shooting Scores By Treatment Group By Time

ANOVA-RM was utilized to determine if significant differences existed between treatment groups over time based upon shooters composite pre and post performance scores. Results of this analysis is displayed in Table 8 and 9.

Table 8

Analysis Of Variance With Repeated Measures Summary Table Of Composite Scores By Treatment Group By Time

Source	df	SS	MS	F	p
Between Groups					
Image Group	1	474.811	474.811	0.150	0.701
Error	41	130488.769	3182.652		
Within Groups					
Time	1	269.304	269.304	1.240	0.272
Time*Group	1	15.337	15.337	0.070	0.791
Error	41	8910.835	217.337		

Note. Significance level $p < .05$.

[a] N=43

Table 9

Least Square Means Of Composite Scores

Image Group	Pretest	Posttest	n
Imagers	521.913	524.608	23
Control	516.350	520.750	20

No significant differences between treatment groups (imagery versus control) were found based upon composite

score. The element of time from pretest to posttest did not yield any significant effects upon treatment groups. No significant interactions between time and treatment groups were detected.

Analysis Of Prone Shooting Scores By Treatment Group By Time

ANOVA-RM was employed to determine if a significant difference existed between treatment groups for pre and posttest prone performance scores. Results of this analysis are presented in Tables 10, and 11.

Table 10

Analysis Of Variance With Repeated Measures Summary Table Of Prone Scores By Treatment Group By Time

Source	df	SS	MS	F	p
Between Groups					
Image Group	1	108.418	108.418	1.120	0.297
Error	41	3983.883	97.167		
Within Groups					
Time	1	97.803	97.803	4.560	0.038*
Time*Group	1	114.361	114.361	5.330	0.026*
Error	41	880.127	21.466		

Note. Significance level $p<.05$.

[a]N=43.

Table 11

Least Square Means Of Prone Scores

Image Group	Pretest	Posttest	n
Imagers	189.739	189.913	23
Control	189.800	185.350	20

Results of the analysis in Table 11 indicated that a significant difference existed in scores based on time. However, no significant differences were found between groups based on mean prone scores. An interaction between time and group was significant. A post hoc analysis, with Tukey's Pairwise Comparison Method, was conducted to determine if means were significantly different. This technique showed that the control group's posttest score was significantly lower than the posttest score of the imagery group, and significantly lower than both treatment groups pretest score.

Analysis Of Standing Shooting Scores

By Treatment Group By Time

ANOVA-RM was conducted to determine if a significant difference existed between groups based on pre to posttest standing performance scores. Results are presented in Tables 12, and 13.

Results of the analysis presented in Table 12 indicated no significant differences between treatment groups based on mean standing scores. A significant difference existed between scores over time. Interaction

Table 12

Analysis Of Variance With Repeated Measures Summary Table Of Standing Scores By Treatment Group By Time

Source	df	SS	MS	F	p
Between Groups					
Image Group	1	85.395	85.395	0.100	0.752
Error	41	34830.534	849.525		
Within Groups					
Time	1	582.891	582.891	5.150	0.028*
Time*Group	1	429.496	429.496	3.790	0.058
Error	41	4641.317	113.202		

Note. Significance level $p < .05$.

[a] $N=43$.

Table 13

Least Square Means Of Standing Scores

Image Group	Pretest	Posttest	n
Imagers	158.478	159.217	23
Control	152.000	161.700	20

effects were nearly significant. A post hoc analysis, with Tukey's Pairwise Comparison method, was conducted to determine if means were significantly different. The control group scored significantly higher on the posttest than pretest. No significant differences between treatment groups were found.

Analysis Of Kneeling Shooting Scores By Treatment Group By Time

ANOVA-RM was utilized to determine if significant differences existed between treatment groups based on shooters pre to posttest kneeling scores. Results of this analysis are presented in Tables 14 and 15.

Table 14

Analysis Of Variance With Repeated Measures Summary Table Of Kneeling Scores By Treatment Group By Time

Source	df	SS	MS	F	p
Between Groups					
Image Group	1	5.000	5.000	0.010	0.912
Error	41	16397.832	399.947		
Within Groups					
Time	1	5.096	5.096	0.260	0.614
Time*Group	1	38.305	38.305	1.930	0.171
Error	41	811.927	19.803		

Note. Significance level $p < .05$.

[a] $N=43$.

Table 15

Least Square Means Of Kneeling Scores

Image Group	Pretest	Posttest	n
Imagers	173.695	175.521	23
Control	174.550	173.700	20

The analyses presented in Table 14 indicated that no significant differences existed between treatment groups based on kneeling scores.

Post-test Analysis Of Composite Shooting Scores By Experiential State

A One-Way Analysis Of Variance was employed to determine if there would be a significant difference in composite shooting scores between shooters classified in high and low experiential state groups. Results of this analysis are displayed in Table 16. The composite means by state are displayed in Table 20.

Table 16

Analysis Of Variance Summary Table Of Composite Scores By State

Source	df	SS	MS	F	p
Between Groups	1	31.404	31.404	0.024	0.879
Within Groups	41	54503.273	1329.348		
Total	42	54534.676			

Note. Significance level $p < .05$.

[a] $N=43$

The results presented in Table 16 indicated that no significant differences existed between the posttest composite scores of shooters classified into the high and low experiential state groups.

Posttest Analysis Of Prone Shooting Scores By Experiential State

A One-way Analysis Of Variance was conducted to determine if any significant differences prone shooting scores of shooters classified into high and low experiential state groups. Table 17 displays the results of

this analysis. The prone mean scores by state are displayed in Table 20.

Table 17

Analysis Of Variance Summary Table Of Prone Scores By State

Source	df	SS	MS	F	p
Between Groups	1	153.385	153.385	2.88	0.097
Within Groups	41	2183.659	53.260		
Total	42	2337.044			

Note. Significance level $p < .05$.

[a]N=43.

The results presented in Table 17 indicated that no significant differences existed between prone scores of shooters classified into the high and low experiential state groups.

Posttest Analysis Of Standing Shooting Scores By Experiential State

A One-way Analysis Of Variance was utilized to determine if significant differences existed between standing scores of shooters classified into high and low experiential state groups. Results of this analysis are presented in Table 18. Standing mean scores by state are displayed in Table 20.

Results of this analysis indicated that no significant differences existed between the standing scores of shooters classified into the high and low experiential state groups.

Table 18

Analysis Of Variance Summary Table Of Standing Scores By State

Source	df	SS	MS	F	p
Between Groups	1	10.884	10.884	0.034	0.855
Within Groups	41	13223.121	322.515		
Total	42	13234.004			

Note. Significance level $p < .05$.

[a]N=43.

Posttest Analysis Of Kneeling Shooting Scores By Experiential State

A One-way Analysis Of Variance was employed to determine if significant differences existed between the kneeling scores of shooters classified into high and low experiential state groups. Results of this analysis is displayed in Table 19. Kneeling mean scores by state are displayed in Table 20.

Table 19

Analysis Of Variance Summary Table Of Kneeling Scores By State

Source	df	SS	MS	F	p
Between Groups	1	112.971	112.971	0.541	0.466
Within Groups	41	8554.473	208.646		
Total	41	8667.441			

Note. Significance level $p < .05$.

[a]N=43.

Results of the analyses displayed in Table 19 indicated that no significant differences existed between the kneeling scores of shooters classified into the high and low experiential state groups.

Posttest Means By Experiential State

The scores used in the experiential state analyses are presented in Table 20. No significant differences were found between the posttest scores of shooters classified into the high and low experiential state groups.

Table 20

Posttest Shooting Means By State

	High ES	Sd	Low ES	Sd
Prone	189.636	6.145	185.857	8.338
Standing	160.864	18.360	159.857	17.528
Kneeling	173.091	15.065	176.333	13.764
Composite	523.591	36.813	522.000	36.086

[a]High ES n=22.

[b]Low ES n=21.

Posttest Analysis Of Interaction Effects

Between Treatment Group And Experiential State

A 2 (image group: imagers versus control) x 2 (state: high versus low) Analysis Of Variance was conducted to determine if significant interactions existed on the posttest composite score between treatment group and experiential state. Results of this analysis are displayed in Table 21.

Table 21

Analysis Of Variance Summary Table Of Posttest Interaction Effects

Source	df	SS	MS	F	p
Main Effects	2	183.708	91.854	0.067	0.935
State	1	24.425	24.425	0.018	0.894
Group	1	156.515	156.515	0.114	0.737
Interactions	1	934.09	934.091	0.682	0.414
Image * State	1	934.091	934.091	0.682	0.414
Explained	3	1117.801	372.600	0.272	0.845
Residual	39	53412.641	1369.555		
Total	42	54530.441	1298.344		

Note. Significance level $p < .05$.

[a] $N=43$.

Results of the analyses displayed in Table 21 indicated that no significant interactions existed between treatment group and experiential state.

CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

HO1 was accepted. Analysis of posttest composite performance scores indicated that no significant differences between the imagery and control group were found. Therefore, the null hypothesis was accepted. This is consistent with the studies of Epstein (1980), Ammons (1951), and Ryan and Simons (1983).

HO1a was rejected. The posttest prone scores of the control group were significantly lower than those of the imagery group.

HO1b and HO1c were accepted. No significant differences between treatment groups were found in either position based on mean scores. These results may have been different with a greater number and longer periods of imagery practice sessions. Epstein (1980) posed that imagery might be distracting to lower ability shooters. It must be considered in these results that there were a large number of lower ability shooters. Imagery may not have significantly changed scores in the standing and kneeling position due to the fact that each treatment group probably contained both imagers and non-imagers, which would be consistent with Epstein's conclusions. These results are also in line with the conclusions of Feltz and Landers

(1983) that imagery could be expected to be found significant about 50 percent of the time.

The results of this study seem to support the conclusions of Phipps and Morehouse (1969) that the effects of mental rehearsal are skill specific and more pronounced in simple skills. According to Pullum and Hanenkrat (1973) "...prone is the most stable of the three positions" (p. 176), possibly explaining why the effects were greatest in this position. Pullum and Hanenkrat (1973) further state that "standing is the most difficult..." and that "the mental effort, or willpower, required by the position is greater..." (p. 202). The United States Army Marksmanship Unit's International Rifle Marksmanship Guide (1978, p. 39) posits that "in standing, position refinement is perhaps only 60% of the total problem, leaving a major portion to concentration, trigger control, and mental discipline" (p. 39). This may account for the difference in significance along with Epstein's (1980) reasoning of distraction. The effects of the imagery treatment, which were position specific to prone, might be due to the number of symbolic components of each position (Corbin, 1972; Minas, 1978; Sackett, 1938), or due to the supposition of Fiske and Maddi (1961) that simple skills have a broad range of optimal arousal while complex skill have a narrow range of optimal arousal.

Although an analysis of statistical significance by classification cannot be justified due to small $\underline{n}$ sizes per

group, a review of the mean performance scores by classification indicated that unclassified and marksman shooters in the imagery group tended to be higher in prone performance, but lower in standing and kneeling performance; and also slightly lower in composite performance. The master and expert classes were also higher in the prone and kneeling positions, but lower in standing and composite scores than the control group. The imagery group in the sharpshooter class scored consistently higher in every position than did the control group. Results of the sharpshooter class (imagery n=6, Control n=4) may be seen in Table 22 below.

Table 22

Mean Performance Scores By Sharpshooter Classification By Group By Position

		Least Square Means By Group	
Position	Position Mean	Imagery goup	Control group
Prone	187.900	190.167	184.500
Standing	163.200	163.345	162.983
Kneeling	178.800	179.917	177.123
Composite	529.900	533.795	524.058

The above is consistent with Decaria's (1977) finding that intermediate subjects showed the greatest effects of imagery. This was also consistent with studies by Clark (1960), Corbin (1967), Egstrom (1964), Kuhn (1971), Start (1962), and Zecker (1982) that support the conclusion that effects are greater with experienced subjects versus

novices. It would seem that future research would show the greatest effects with this group.

HO2 was accepted. Analysis of experiential state means by treatment showed no significant differences between the internal imagery group (n=23) and the control group (n=20). Follow up t-test analyses were computed for each of the 16 items on the experiential state questionnaire. Only item 11 (detached-involved) was found to be significant ($p<.05$). See Appendix D for data. A longitudinal study of the experiential state variable based on imagery might over the long term show significant differences between the two groups.

Due to an inadequate number of subjects in each skill level, skill levels within the two treatment groups could not be examined with any capability to draw valid conclusions. However, by observing the means of each skill level group some tendencies were observed. Analysis of data presented in Appendix E indicated that sharpshooters might receive the greatest benefit, as compared to other skill levels, from imagery based on the experiential state variable mean.

HO3 was accepted. HO3a, HO3b, and HO3c were accepted as well. No significant differences were found between the shooting performance scores (in any position or composite) of shooters classified into the high and low experiential state groups.

HO4 was accepted. No significant interactions between internal imagery and experiential state were found.

Conclusions

Within the limits of this study, the following conclusions were drawn:

1. Across all three positions, internal imagery did not have a significant impact upon composite shooting performance scores.
2. The posttest prone shooting scores of the control group were significantly lower than those of the imagery group.
3. No significant differences were found between the experiential state scores of shooters who received the internal imagery treatment and those who did not.
4. No significant differences were found between the posttest scores of shooters classified into the high experiential state group and those shooters classified into the low experiential state group.
5. No significant interactions were found between internal imagery and experiential state on posttest composite scores.

The above conclusions support the use of imagery for the prone position with a comparable group of shooters. Results (presented in Table 22) suggest that internal imagery may be most effective in improving the performance of shooters classified as sharpshooters. The implications for rifle coaches are that internal imagery may improve

(and be most beneficial to) the prone shooting scores of intermediate level shooters (sharpshooters) who are internal imagers. Results (see Appendix E) also suggest that internal imagery may improve (and be most beneficial to) the experiential state score of sharpshooters. Other mental rehearsal techniques may improve the experiential state score as well.

Recommendations

It is recommended that

1. A study be conducted utilizing a longer posttest.
2. A study be conducted involving a greater number of subjects that will allow analysis of the effects of internal imagery and experiential state on performance based on sex, NRA classification, and years of experience.
3. A study be conducted that includes a physical practice group, a relaxhation group, and a visuo-motor behavior rehearsal group.
4. A study be conducted to examine the effects of various mental rehearsal techniques on the experiential state of shooters.
5. A study be conducted utilizing varying length's and numbers of mental rehearsal sessions.
6. A study be conducted to examine the effects of mental rehearsal techniques while having the shooters to actually hold a rifle.

7. A study be conducted to examine follow up scores and determine retention effects.
8. A study be conducted to itentify the type(s) of mental rehearsal technique(s) utilized by elite shooters.
9. A study be conducted to identify and develop an experiential state typology of elite shooters.
10. A study be conducted utilizing both scholarship and non-scholarship shooters to determine the effects of extrinsic motivation on experiential state and scores.
11. A study be conducted to determine the effects of organized competitions versus practice events on shooters experiential state.
12. A replication be conducted of the present study with shooters classified as sharpshooters.

APPENDIX A

INTERNAL IMAGERY INSTRUCTIONS

APPENDIX A

INTERNAL IMAGERY INSTRUCTIONS

An orientation session was provided for the imagery group session the night before the record fire in which the following instructions were given. On the day of the record fire, the instructions for each position were given once again along with the last paragraph.

The National Rifle Association, coaches and elite shooters have espoused the use of mental rehearsal as being very beneficial to performance. Ed Etzel, a 1984 olympic gold medalist, utilized mental rehearsal to win the gold. Mental rehearsal techniques occur in many forms, one of which is called internal imagery.

Internal imagery is defined as a situation in which the shooter "actually images being inside his or her body and experiencing those sensations which might be expected in the actual situation" of shooting (Mahoney & Avener, 1977, p.137). In other words we imagine or mentally rehearse that perfect shot while seeing and feeling these imaginary performances of the shot as if we were actually in position and firing. To get a feel of what imagery is lets give it a try. Close your eyes and imagine yourself in a wilderness area watching a tiger from a safe distance. See if

(appendix continues)

you can mentally feel the hot sun against your skin. Can you smell the wildflowers? Can you hear the birds singing in the nearby trees? Can you feel the soil on which you are standing? Now look at the tiger. How many stripes does he have? From what perspective are you viewing him? If you arre viewing him from the side, see if you can rotate the image, by swinging around and viewing him from the front. If you are viewing the tiger from the front, can you rotate the image and see the tiger from the side? Now see if you can put the tiger in motion. Imagine him running across a plateau directly in front of you. Try to mentally experience the situation with your feelings and your senses: seeing, hearing, touching, and tasting. Open your eyes now. Hopefully, you now have a grasp of what we are doing with internal imagery.

Lets now apply this to shooting. Were going to mentally image ourselves fire the perfect prone shot. Close your eyes. Observe the range, try to imagine how long and wide it is. Look at the backstop and your targets. Feel yourself laying on the mat as you position yourself in relation to the targets. Feel your body as it is stretched out and relaxed with your left leg parallel to your spine and your right leg pulled up and angled away from the spine. Feel your hips and pelvis in relation to the target. Feel your left elbow as it is slightly to the left of the gun.

(appendix continues)

Feel your left hand snug against the fore-end stop. The right arm is resting comfortably as you apply a consistent pressure against the stock. The rifle fits snug into the shoulder as you look through the sights. Allow the rifle to settle as you feel yourself obtain a good hold. Release a breath of air. Now squeeze the trigger. Feel the jump of the muzzle as you follow through. Smell the lead in the air. Now look through the scope at the ten you have just fired. Let's now mentally practice this prone shot on our own for one minute.

Let's now try the standing position. Close your eyes. Observe the range, try to imagine how long and wide it is. Look at the backstop and your targets. Now look down at your feet and orient them in relation to the target. Feel the weight distribution in your legs. Feel yourself pick up the rifle and place it in your shoulder as you twist your torso and bend your back. Settle into position. Feel the tension in your back. Feel your left arm against the rib cage and hip. Observe and feel the way the palmrest is positioned. Feel the right hand grip the stock. Watch the sway of the barrel. Get that perfect sight picture. Release a breath of air. Now squeeze the trigger. Feel the jump of the muzzle as you follow through. Smell the lead in the air. Now look through the scope at the ten you have just fired. Let's now

(appendix continues)

mentally practice this kneeling shot on our own for one minute.

We can use this mental rehearsal technique before during and after we shoot. From now until the posttest firing, lets try to practice internal imagery. As we are actually firing, lets try to use this technique.

APPENDIX B

CONTROL GROUP INSTRUCTIONS

APPENDIX B

CONTROL GROUP INSTRUCTIONS

The following instructions were given to the control group on the evening prior to the performance test. On the day of the performance test subjects were presented with a verbal review and practice.

The purpose of this project that we are about to engage in is to make you a better shooter. There are several qualities that you need to be a good shooter. In the United States Army Marksmanship Unit's Profile Of A Champion (1978) booklet many of these qualities are described. Lones W. Wigger, Jr. (who is one of the top international rifle shooters in the world) describes the qualities that he believes is necessary to be a champion. Among these complete dedication to the sport with definite goals is among one of the most necessary qualities along with the desire for competitiveness and a desire to win. Wigger describes how that target shooting must be personally rewarding, fun, and challenging. He cites Pullum as stating that shooting is about 90% mental. It is Wigger's belief that one must have complete control over his mind to cope with match pressure. To excel we must be able to control our emotions, reactions, and mind. We must

(appendix continues)

also have the utmost faith in our equiptment and our ability.

LTC. William Pullum has described several other aspects to performance in an article Champions Beat Match Nerves By Thorough Mental Preparation (Pullum, 1979). Pullum attributes anxiety that we encounter while shooting to a fear of failure, fear of success, lack of confidence, and an overall feeling of uncertainty. He describes how that shooters must develop a training program with thought in mind and the purpose of the trouble. This program must include a goal or goals or the level of achievement desired in a manner which is measurable and obtainable, while accounting for the time required to meet these goals. My goal may be to be an olympic gold medalist, but as a shooter classified as a marksman it would be unlikely to be obtained this year. However, if I set this as my goal in five years, with subgoals along the way it could be accomplished. An immediate goal may be to be reclassified as a sharpshooter in six months. Pullum (1979) emphasizes the use of dry firing in which we are training our muscle motor groups to react the same way each time we shoot.

Pullum (1979) also descibes how we need to be able to ignore outside influences. We must train ourselves to eliminate negative thoughts and shooting just to beat someone else. We must know our

(appendix continues)

capabilities and limits. He also describes how that positive thinking leads to self improvement and accomplishment. We must guard against placing a psychological ceiling on performance and always strive for our best performance. Pullum (1979) describes also how that we must concentrate on the quality of practice more so than the quantity of practice, and attempt to make each shot perfect. To accomplish this he describes how that we must overcome nervousness and the fear of messing up. He further discusses how that worrying detracts from performance, instead we should concern ourself only with performance and not worry about score. He points out how we must concentrate on stopping movement, and strive for the best performance possible. Pullum further points out how we must concentrate on the positive side as we annalyze our performance and plan corrections. In our analysis he also elaborates on the importance of accepting the positive criticism of others. Pullum also describes that we need confidence, that you, as a shooter, are the best man to beat; that you have a desire to win, and that you will perform harder than anyone else; and that you will accept nothing but the best.

In summary lets think about some of the thing we have just discussed. We need to control our emotions and reactions. We must eliminate negative thoughts and concentrate only on performance. We must

(appendix continues)

concentrate on performance such that instead of firing a 60 shot match, we should fire 60 matches that are 1 shot courses of fire. You must also have confidence that you are the best shooter and this will be your best performance. Right now lets close our eyes. For the next three minutes, I would like you to set a goal for your performance, think about eliminating negative thoughts, and concentrate on the thought that you are the best shooter to beat, and that you will fire each shot as a one shot match.

APPENDIX C

EXPERIENTIAL STATE QUESTIONNAIRE

APPENDIX C

EXPERIENTIAL STATE QUESTIONNAIRE

Name.....

School.....

Male....Female.....

NRA Class.....

Instructions: This questionnaire is designed to generate information concerning how you felt Today while you were shooting. Please try to remember how you felt Today while you were shooting before you answer the following questions. Responses will be strictly confidential.

Please read each item and place an X on the line corresponding to the strength of your answer.

1. Today while you shot,how self-conscious were you? Not at all----------Very
2. Today while you shot,how much skill did you feel you had? Low----------High
3. Today while you shot, how strong was the challenge of the activity. Low----------High

(appendix continues)

4. Today, how did you feel while you shot?

Sad----------Happy
Irritable----------Cheerful
Angry----------Friendly
Lonely----------Sociable
Drowsy----------Alert
Weak----------Strong
Passive----------Active
Detached----------Involved
Bored----------Excited

5. Today while you shot, how strong was your desire to be doing something else?

Not at all----------Very Strong

6. Today while you shot, to what extent did you feel "in control."

Not at all----------Very

7. Today while you shot, how much did you feel was "at stake."

Nothing----------Very Much

8. Today while you shot, how hard was it to concentrate?

Not at all----------Very

APPENDIX D

ANALYSIS OF EXPERIENTIAL STATE BY GROUP

APPENDIX D

ANALYSIS OF EXPERIENTIAL STATE BY GROUP

					Pooled Variance		2-Tail
Item	Grp	Mean	sd	SE	t	df	p
ESQ	I	83.087	19.988	4.168	-0.49	41	0.847
Score	C	86.000	19.093	4.269			
Self	I	4.044	2.477	0.516	1.04	41	0.304
Consc.	C	3.250	2.511	0.561			
Pcvd.	I	5.739	2.027	0.423	0.46	41	0.648
Skill	C	5.450	2.089	0.467			
Pcvd.	I	6.087	2.503	0.522	-0.59	41	0.558
Chlng.	C	6.500	2.013	0.450			
Sad-	I	4.913	2.214	0.462	-1.42	41	0.163
Happy	C	5.850	2.084	0.466			
Irtbl.-	I	4.965	2.246	0.468	-0.64	41	0.523
Chrfl.	C	5.400	2.257	0.505			
Angry-	I	5.435	2.293	0.478	-1.04	41	0.304
Frndly.	C	6.200	2.256	0.565			
Lonely-	I	5.000	2.276	0.475	-1.78	41	0.082
Socibl.	C	6.150	1.899	0.425			
Drowsy-	I	5.044	2.458	0.513	-0.01	41	0.994
Alert	C	5.050	2.892	0.647			

(appendix continues)

					Pooled Variance		2-Tail
Item	Grp	Mean	sd	SE	t	df	p
Weak-	I	5.130	2.399	0.500	-0.48	41	0.636
Strong	C	5.450	1.932	0.432			
Pasv.-	I	5.087	2.429	0.507	1.01	41	0.317
Active	C	4.250	2.989	0.668			
Dtchd.-	I	5.000	2.132	0.445	-2.04	41	0.048*
Invlvd.	C	6.300	2.029	0.454			
Bored-	I	5.696	1.845	0.385	0.08	41	0.937
Excitd.	C	5.650	1.899	0.425			
Desire-	I	6.044	2.637	0.550	-0.22	41	0.831
Else	C	6.200	2.042	0.457			
Feel In	I	5.391	2.169	0.452	-0.23	41	0.819
Cntrl.	C	5.550	2.350	0.526			
Feel At	I	5.130	2.881	0.601	1.43	41	0.160
Stake	C	3.900	2.732	0.611			
Hard To	I	4.391	2.589	0.540	-0.58	41	0.563
Cncntrt	C	4.850	2.560				

Note. I= Imagery group, C= Control Group.

APPENDIX E

T-TEST ANALYSIS OF EXPERIENTIAL STATE BY SKILL LEVEL BY GROUP

APPENDIX E

T-TEST ANALYSIS OF EXPERIENTIAL STATE BY SKILL LEVEL BY GROUP

					Pooled Variance		
Skill Level	Group	Mean	sd	se	T Value	df.	p
Unclassified	I	70.000	00.000	00.000	-0.18	2	0.876
	C	74.000	19.672	11.358			
Marksman	I	90.778	15.506	5.169	0.01	16	0.989
	C	90.667	17.656	5.885			
Sharpshooter	I	92.500	18.641	7.610	0.81	8	0.440
	C	80.750	27.536	13.768			
Expert	I	67.250	22.381	11.191	-1.77	5	0.137
	C	93.667	14.224	8.212			
Master	I	66.667	17.010	9.821	-0.58	2	0.622
	C	78.000	00.000	0.000			

Note. I=imagery group, C=control group.

REFERENCES

Adams, J. A. (1971). A closed-loop theory of motor learning. Journal of Motor Behavior, 3, 111-150.

Ammons, R. B. (1951). Effects of prepractice activities on rotary pursuit performance. Journal of Experimental Psychology, 41, 187-191.

Arnold, M. B. (1946). On the mechanism of suggestion and hypnosis. Journal of Abnormal and Social Psychology, 41, 107-128.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.

Bandura, A., Adams, N. E., & Beyer, J. (1977). Cognitive processes mediating behavioral change. Journal of Personality and Social Psychology, 35, 129-139.

Bandura, A., & Schank, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. Journal of Personality and Social Psychology, 41, 586-598.

Barnes, P. R. (1982). Internal vs. external imagery as a mental preparation when applied by intermediate league bowlers. (Doctoral Dissertation, North Texas State University, 1982). Dissertation Abstracts International, 43, 896-B.

Block, N. (Ed.). (1981). Imagery. Cambridge, MA: MIT Press.

Borg, W. R., & Gall, M. D. (1983). Educational research: An introduction. New York, NY: Longman Inc.

Carpenter, L. B. (1894). Principles of mental physiology (4th Ed.). New York: Appleton.

Carver, C. (1979). A cybernetic model of self-attention processes. Journal of Personality and Social Psychology, 37, 1251-1281.

Chalip, C., Csikszentmihalyi, M., Kleiber, D., & Larson, R. (1984). Variations of experience in formal and informal sport. Research Quarterly for Exercise and Sport, 55, 109-116.

Clark, L. V. (1960). Effect of mental practice on the development of a certain motor skill. Research Quarterly, 31, 560-569.

Corbin, C. B. (1967a). The effect of covert rehearsal on development of a complex motor skill. Journal of General Psychology, 76, 143-150.

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

Corbin, C. B. (1972). Mental practice. In W. P. Morgan (Ed.). Ergogenic aids and muscular performance. New York: Academic Press.

Csikszentmihalyi, M. (1975). Beyond boredom and anxiety. San Francisco: Jossey-Bass.

Csikszentmihalyi, M. (1978). Attention and the wholistic approach to behavior. In K. S. Pope and J. L. Singer (Eds.), The stream of consciousness. New York: Plenum.

Csikszentmihalyi, M., & Figurski, T. J. (1982). Self-awareness and aversive experience in everyday life. Journal of Personality, 50, 15-28.

Courtney, J. E. (1984). Golf performance: Thinking, imaging, and doing (Doctoral Dissertation, Illinois Institute of Technology, 1983). Dissertation Abstracts International, 44, 3960-B.

Davidson, R. J., & Schwartz, G. E. (1977). Brain mechanisms subserving self-generated imagery: Electrophysiological specificity and patterning. Psychophysiology, 14, 548-602.

Davidson, R. J., Schwartz, G. E., & Rothman, L. P. (1976). Attentional style and the self regulation of mode specific attention: An electroencephalographic study. Journal of Abnormal Psychology, 85, 611-621.

Davis, F. (1932). The functional significance of imagery differences. Journal of Experimental Psychology, 15, 630-661.

Dalton, J. E., Maier, R. A., & Posavac, F. J. (1977). A self-fulfilling prophecy in a competitive psychomotor task. Journal of Research in Personality, 11, 487-495.

Decaria, M. D. (1977). The effect of cognitive rehearsal training on performance and on self-report of anxiety in novice and intermediate female gymnasts (Doctoral Dissertation, University of Utah, 1977). Dissertation Abstracts International, 38, 351-B.

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

Ellis, G, Oglesby, B., & Whitworth, P. (1986, April). Effects of imagery and mental preparation on experiential states of college students learning to bowl. Poster presentation at the meeting of the American Alliance for Health, Physical Education, Recreation, and Dance, Cincinnati, OH.

Epstein, M. L. (1980). The relationship of mental imagery and mental rehearsal to performance of a motor task. Journal of Sport Psychology, 2, 211-220.

Epstein, M. L., & Mahoney, M. J. (1979). Anxiety in high school female track team participants. Unpublished study (available from Department of Psychology, The Pennsylvania State University, University Park, Pa. 16802).

Feltz, D. L., & Landers, D. M. (1983). The effects of mental practice on motor skill learning and performance: A meta-analysis. Journal of Sports Psychology, 5, 25-57.

Fiske, D. W., & Maddi, S. R. (1961). Functions of varied experience. Homewood, Ill: Dorsey Press.

Fosbury, D. (1974). Fosbury on flopping. Track Technique, 55, 1749-1750.

Fitts, P. M., & Possner, M. I. (1967). Human performance. Belmont, CA: Brooks/Cole.

Freeman, G. L. (1931). The spread of neuro-muscular activity during mental work. Journal of General Psychology, 5, 479-494.

Fromm, E. (1959). The creative attitude. In H. H. Anderson (Ed.) Interdisciplinary symposium on creativity. New York: Harper and Row.

Gallwey, W. T. (1974). The inner game of tennis. New York: Random House.

Gallwey, W. T., & Kriegel, B. (1977). Inner skiing. New York: Random House.

Gould, D., Weinberg, R., & Jackson, A. (1980). Mental preparation strategies, cognitions, and strength performance. Journal of Sport Psychology, 2, 329-339.

Graef, R., Csikszentmihalyi, M., & Gianinno, S. (1983). Measuring intrinsic motivation in every day life. Leisure Studies, 2, 155-168.

Hale, B. D. (1981). The effects of internal and external imagery on muscular and ocular concomitants. Unpublished doctoral dissertation, The Pennsylvania State University.

Hale, B. D. (1982). The effects on internal and external imagery on muscular and ocular concomitants. Journal of Sport Psychology, 4, 379-387.

Hall, E. G., & Erffmeyer, E. S. (1983). The effect of visuo-motor behavior rehearsal with video taped modeling on free throw accuracy of intercollogiate female basketball players. Journal of Sport Psychology, 5, 343-346.

Jacobson, E. (1930). Electrical measurement of neuro-muscular states during mental activities. American Journal of Physiology, 94, 22-34.

Jacobson, E. (1931). Electrical measurement of neuromuscular states during mental activities. American Journal of Physiology, 96, 115-121.

Jacobson, E. (1932). Electrophysiology of mental activities. American Journal of Psychology, 44, 677-694.

Jones, J. G. (1964). Motor learning without demonstration of physical practice, under two conditions of mental practice. Research Quarterly, 36, 270-276.

Kerlinger, F. N. (1973). Foundations of behavior research (2nd Ed.). New York: Holt, Rinehart, and Winston, Inc.

Knapp, J. (1966). Emotional reactions of college women gymnasts as a function of time to competition. Unpublished masters' thesis, University of Massachusetts.

Kohl, R. M., & Roenker, D. L. (1980). Bilateral transfer as a function of mental imagery. Journal of Motor Behavior, 12, 197-206.

Korman, A. K. (1970). Toward an hypothesis of work behavior. Journal of Applied Psychology, 54, 31-41.

Kosslyn, S. M. (1973). Scanning visual images: Some structural implications. Perception and Psychophysics, 14, 90-94.

Kosslyn, S. M. (1975). Informational Representation in visual images. Cognitive Psychology, 7, 341-370.

Kosslyn, S. M., Ball, T. M., & Reiser, B. J. (1978). Visual Images preserve metric spatial information: Evidence from studies of imagery scanning. Journal of Experimental Psychology: Human Perception and Performance, 4, 47-60.

Kosslyn, S. M., Pinker, S., Smith, G. E., & Schwartz, S. P. (1981). On the demystification of mental imagery. In N. Block (Ed.), Imagery. Cambridge, MA: MIT Press.

Kuhn, W. (1971). The effects of physical warm-up and mental rehearsal on the performance of experienced and non experienced soccer players in the soccer dribble test. Unpublished doctoral dissertation, University of Oregon.

Lang, P. J. (1979). A bio-informational theory of emotional imagery. Psychophysiology, 16, 495-512.

Mahoney, M. J. (1979). Cognitive skills and athletic performance. In D. C. Kendall and S. D. Hollon (Eds.) Cognitive-behavioral interventions: Theory, research and procedures. New York: Academic Press.

Mahoney, M. J., & Avener, M. (1977). Psychology of the elite athlete: An exploratory study. Cognitive Therapy and Research, 1, 135-141.

Marks, D. F. (1977). Imagery and consciousness: A theoretical review from an individual differences perspective. Journal of Mental Imagery, 2, 275-290.

Mendoza, D., & Wickman, H. (1978). Inner darts: Effects of mental practice on dart throwing. Perceptual and Motor skills, 47, 1195-1199.

Meyers, A. W., Cooke, C. J., Cullen, J., & Liles, C. (1979). Psychological aspects of athletic competitors: A replication across sports. Cognitive Therapy and Research, 3, 361-366.

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

Morrisett, L. N. (1956). The role of implicit practice in learning. Unpublished doctoral dissertation, Yale University.

Morrison, A. J. (1932). A new way to better golf. New York: Simon and Schuster.

Morrison, A. J. (1940). Better golf without practice. New York: Simon and Schuster.

Muller, D., & Spuhler, R. (1976). The effects of experimentally induced changes in self-concept on associative learning. Journal of Psychology, 92, 89-95.

Nideffer, R. M. (1976). The inner athlete: Mind plus muscle for winning. New York: Crowell.

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. Psychological Review, 84, 231-258.

Noel, R. C. (1980). The effect of visuo-motor behavior rehearsal on tennis performance. Journal of Sport Psychology, 2, 221-226.

Oxendine, J. B. (1968). Psychology of motor learning. New York: Appleton-Century Crafts.

Oxendine, J. (1969). Effect of mental and physical practice on the learning of three motor skills. The Research Quarterly, 38, 95-107.

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

Poulton, E. C. (1975). Range effects in experiments on people. American Journal of Psychology, 88, 3-32.

Pullum, B. P., Hanenkrat, F. T. (1973). Position rifle shooting: A how-to text for shooters and coaches. Hackensack, N.J.: Stoeger Publishing Company.

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

Richardson, A. (1967a). Mental practice: A review and discussion (Part 1). Research Quarterly, 38, 95-107.

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

Roberts, G. C., Kleiber, D. A., & Duda, J. L. (1981). An Analysis of motivation in children's sport: The role of perceived competence in participation. Journal of Sport Psychology, 3, 206-216.

Rogers, C. R. (1959). Toward a theory of creativity. In H. H. Anderson (Ed.) Interdisciplinary symposia on creativity. New York: Harper and Row.

Rosenthal, R., & Jacobson, L. (1968). Pygmalion in the classroom. New York: Holt, Rinehart, and Winston.

Russell, B., & Branch, L. (1979). Second wind: The memoirs of an opinionated man. New York: Random House.

Ryan, E. D., & Simons, J. (1981). Cognitive demand, imagery, and frequency of mental rehearsals as factors influencing acquisition of motor skills. Journal of Sport Psychology, 3, 35-45.

Ryan, E. D., & Simons, J. (1982). Efficacy of mental imagery in enhancing mental rehearsal of motor skill. Journal of Sport Psychology, 4, 41-51.

Ryan, E. D., & Simons, J. (1983). What is learned in mental practice of motor skills: A test of the cognitive-motor hypothesis. Journal of Sport Psychology, 5, 419-426.

Sackett, R. S. (1934). The influences of symbolic rehearsal upon the retention of a maze habit. Journal of General Psychology, 10, 376-395.

Sackett, R. S. (1935). The relationship between amount of symbolic rehearsal and retention of a maze habit. Journal of General Psychology, 13, 113-128.

Sage, G. (1977). Introduction to motor behavior: A neuropsychological approach. Reading, MA: Addison-Wesley.

Scanlan, T. K., & Passer, M. W. (1981). Determinants of competitive performance expectancies of young male athletes. Journal of Personality, 49, 60-74.

Schilling, G. (1980). Psycho-regulative procedure in swiss sport--more as an alibi or fire brigade? Reports on experiences had. Journal of Sports Psychology, 11, 189-201.

Schmidt, R. A., & White, J. L. (1972). Evidence for an error detection mechanism in motor skills: A test of Adam's Closed Loop Theory. Journal of Motor Behavior, 4, 143-153.

Schramm, V. (1967). An investigation of the electromyographic responses obtained during mental practice. Unpublished masters' thesis, University of Wisconsin-Madison.

Shaw, W. (1938). The distribution of muscular action potentials during imaging. The Psychological Record, 2, 195-216.

Shaw, W. A. (1940). The distribution of muscular action potentials to imaginal weight lifting. Archives of Psychology, 35, 5-50.

Sheehan, P. W. (1967). A shortened form of Betts' questionnaire upon mental imagery. Journal of Clinical Psychology, 23, 386-389.

Short, P. L. (1953). The objective study of mental imagery. British Journal of Psychology, 44, 38-51.

Smith, L. E., & Harrison, J. S. (1962). Comparison of the effects of visual, motor, mental and guided practice upon speed and accuracy of performance of a simple eye-hand coordination task. Research Quarterly, 33, 299-307.

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

Start, K. B. (1962). The influence of subjectively assessed "games ability" on gain in motor performance after mental practice. Journal of General Psychology, 67, 169-173.

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

Suinn, R. M. (1972). Behavior rehearsal training for ski racers. Behavior Therapy, 3, 319-320.

Suinn, R. M. (1976). Body thinking: Psychology of olympic champs. Psychology Today, 10, 38-44.

Suinn, R. M. (1977). Behavioral methods at the winter olympic games. Behavior Therapy, 8, 283-284.

Trussel, E. M. (1952). Mental practice as a factor in the learning of a complex motor skill. Unpublished masters' thesis, University of California.

Trussel, E. M. (1958). Mental practice as a factor in learning a complex motor skill. Unpublished doctoral dissertation, University of California, Berkeley.

Twining, W. E. (1949). Mental practice and physical practice in learning a motor skill. Research Quarterly, 20, 432-435.

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

The United States Army Marksmanhip Unit International Rifle Guide. U. S. Government Printing Office, 1978-640-000/147, Region No. 4.

The United States Army Marksmanship Unit Profile of a Champion. U. S. Government Printing Office, 1978-640-000/145, Region NO. 4.

Vandell, R. A., Davis, R. A., & Clugston, H. A. (1943). The function of mental practice in the acquisition of of motor skills. Journal of General Psychology, 29, 234-50.

Weinberg, R. S., Seabourne, T. G., & Jackson, A. (1981). Effects of visuo motor rehearsal, relaxation, and imagery on karate performance. Journal of Sports Psychology, 3, 228-238.

Wrisberg, C. A., & Ragsdale, M. R. (1979). Cognitive demand and practice level: Factors in the mental rehearsal of motor skills. Journal of Human Movement Studies, 5, 201-208.