EFFECTS OF IMAGERY ON THE LEARNING AND PERFORMANCE

OF BASKETBALL SHOOTING OF ELITE AND NON-ELITE

FEMALE BASKETBALL PLAYERS

by

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ABSTRACT

The main purpose of this study was to examine the effect of motor imagery training (MIT) on the learning and performance of basketball shooting of elite and non-elite female basketball players. The effect of individual differences in imagery ability on shooting performance and the relationship between movement-specific and general imagery ability were also examined. The dependent variable was shooting accuracy as measured by two tests: a practice set shooting test (PSS) which required the S to complete 30 set shots from three designated positions around the free throw line and a transfer set shooting test (TSS) which required the S to complete as many set shots as possible within 60 seconds from the same three designated positions. The independent variables were skill level (elite and non-elite) and treatment (imagery and non-imagery). Thirty-six female basketball players (elite n = 18 and non-elite n = 18) participated in the study. Subjects were pre-tested on three repetitions of the TSS. All subjects assigned to the imagery group were instructed to use MIT prior to each shot during the practice sessions. All subjects completed 12 practice sessions of the PSS test. The PSS test was repeated by all subjects one week after the end of the practice session (RPSS). In addition to the pretest (TSS1), a TSS test was conducted one day following the 12 practice sessions (TSS2) and then again one week later (RTSS). Following testing, all subjects completed three self-report questionnaires of imagery ability. A 2 x 2 x 3 doubly repeated MANOVA revealed an overall condition effect (p < .05), however no significant differences were found on any of the measures of learning, performance, or consistency between the imagery and the control groups collapsed over skill level. Further analysis within skill levels, revealed that the non-elite group trained in MIT performed more consistently, as measured by F-max and independent t-tests, than the non-elite control group. No other significant differences within skill level groups were found. A correlational analysis did not demonstrate any significant relationships between basketball shooting performance and scores on the imagery ability tests. The three imagery questionnaires were found to be significantly related to one another (p < .05). From this study, it may be concluded that MIT does not serve to facilitate learning in either elite or non-elite basketball players, but that it may act as a benefit to performance in non-elite basketball players. Suggestions as to the reasons for these findings and recommendations for further research are offered.

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To my Mother and Father who have always given me every opportunity to enrich my life and to Shauna-girl who taught me to believe in myself.

CHAPTER I

INTRODUCTION

Many sport science researchers, coaches and athletes recognize the potential of imagery as a cognitive rehearsal strategy to enhance skill acquisition and skill performance. Imagery is part of a much more broadly defined area of mental rehearsal, known as mental practice. To date, research in the field of imagery has been equivocal (Feltz & Landers, 1983; Suinn, 1984). Some studies have shown evidence to suggest that imagery training facilitates the performance of motor skills (reviews by Corbin, 1972; Feltz & Landers, 1983; Richardson, 1967; Weinberg, 1982). In contrast, other studies have shown that imagery makes little contribution to motor performance (Eby, 1986; Epstein, 1980; Mumford & Hall, 1985). Despite the contradictory research evidence, imagery continues to be considered among the most promising psychological techniques to improve and enhance motor performance, and is recommended for inclusion in sport training programs (Miller, 1985; Vealey, 1986).

A question that remains largely unanswered is whether mental imagery operates as a learning or performance variable or possibly as both. Historically, research has focussed on the effect of mental imagery in mediating performance. Performance has been defined by Lawther (1968) as the skill level as it functions at any one time. Therefore, there is no expectation of a long term or permanent effect on behavior. As stated previously, the effect of imagery on performance is not clear as there has been conflicting evidence as to its effectiveness (Eby, 1986, Epstein, 1980; Mumford & Hall, 1985). This contradiction in the literature may be due to the lack of understanding of the nature and subsequent application of imagery to sport. Andre and Means (1986) contend that there is a need for more methodologically sound and theoretically based research in order to determine the specific parameters under which imagery can be most effectively applied. As for the effect of imagery on learning, no research to date has used a paradigm appropriate for measuring learning. Learning refers to a change in behaviour or behaviour potential as a result of practice which cannot be attributed to innate tendencies, maturation, or temporary changes in the learner's state (Bower & Hilgard, 1981). It is generally acknowledged that any change in behaviour due to learning is relatively permanent (Schmidt, 1982). Therefore, any study in which there is an attempt to measure the effect of a variable on behaviour, and from which the researcher intends to make inferences about learning as a function of that variable, must assess the durability of the change in the behaviour.

Recent studies by Eby (1986) and Hamilton & Femouw (1985) examined the effect of imagery training on the performance of various sport skills. In both these studies, the researchers stated an intent to assess the long-term effects of imagery on the performance under investigation. The major limitation in these studies was that performance alone was observed. Hamilton & Fremouw's (1985) study on three subjects showed an increase in basketball free-throw performance. Whether or not this was a relatively permanent effect was not determined, in that a retention or transfer test was not employed to measure learning. In the study by Eby (1986) using a larger sample pool ($\underline{N}$ = 38) and with a stringent methodology, she found no effect of imagery training on the performance of selected field hockey skills. Eby concluded that a shortcoming in this study was the lack of a retention test which may have exposed any chronic effects of imagery training on the performance of the field hockey skills. So at this time, there is no evidence to suggest that imagery affects the learning of motor skills in either a positive, neutral, or negative manner. Determining whether or not imagery affects performance and learning will help to determine its most effective application so that maximum gains from its use can be realized.

Another methodological problem that has hindered the investigation of the effect of imagery on learning is the length of the training period for the skills under observation. Increments in learning are generally thought to occur as a function of practice (Schmidt, 1982). In the studies by Eby (1986) and Epstein (1980), the length of practice was relatively short; 18 practice trials over six days (Eby, 1986) and 60 practice trials on one day (Epstein, 1980) respectively. Considering the complexity of the sports skills under investigation, the amount of practice in both these studies may not have been sufficient to produce any significant change in performance levels. In addition, Heil (1984) stated that imagery application should take place over an extended period of time in order to be effective.

In order to assess the effect of imagery on learning and performance a retention or a transfer paradigm must be employed to assess any durable effects of imagery on skill performance. Retention tests are given after a specified time of no practice and are concerned with the internal consistency of the task. Transfer tests assess the amount of learning that has occurred when the practiced skill is tested in a new situation. Both these methods can be used to infer that learning has occurred (Magill, 1985). Also a longer training period than previously used must be arranged to ensure that subjects are given the opportunity to practice the skills in question and to incorporate the skill specific imagery effectively into their practice.

In addition to investigating the effects of imagery on learning and performance, there are other variables that need to be considered in order to determine the appropriate application of imagery in sport settings. Controversy still surrounds the question of whether imagery is more beneficial to elite performers or novice performers. It has been suggested (Schmidt, 1982) that because imagery in general deals with the cognitive aspects of a skill, and because beginners tend to focus on this aspect of the skill (as opposed to skilled performers who tend to focus on cues external to the actual skill) that beginners will benefit more from imagery in the facilitation of learning. It has also been argued (Corbin, 1972) that elite performers who have an understanding of the skill in its totality are better able to produce clearer and more precise images and that these images will produce a greater impact in subsequent performance than those produced by novice performers.

It may be that the question of whether imagery functions as a learning and/or a performance variable and the question regarding the skill level most likely to benefit from imagery training are related. Suinn (1984) contends that imagery rehearsal may have dual application for the novice, as both an acquisition and performance enhancer, but that it may only be useful as a performance enhancer for the expert. There has been no research to date that addresses this hypothesis directly.

Another concern in the literature is the effect of individual differences in imagery ability on the results of imagery training. This variable appears to be the most difficult to control and measure (Weinberg, 1982). It has been proposed that individuals with a high imagery ability to construct mental images can use imagery to improve performance more effectively than those individuals with low imagery ability (Corbin, 1972). Past research (Goss, et al., 1985; Mumford & Hall, 1985; Ryan & Simons, 1982) has shown a positive relationship between imagery ability and motor skill performance. In any investigation of the effect of imagery on subsequent behavior, this variable must be controlled.

Purpose of the Study

The major purpose of this study was to examine the effect of motor imagery training (MIT) on the learning and performance of basketball shooting for two skill ability levels. Attempts were made to overcome many limitations of previous research by using a paradigm suitable for measuring the long and short term effects of imagery training, by testing a larger sample population and by employing a longer training period.

Two secondary purposes were to examine any differences in individual imagery ability, and to determine the relationship between movement-specific and general imagery ability.

To fulfill the purposes of the study, the following hypotheses were tested:

Hypotheses 1.1, 1.2, 1.3, and 2, refer to all subjects in the MIT and control groups.

Hypothesis 1.1 Basketball players instructed in the use of MIT will show a greater increase in shooting performance at the end of 12 practice sessions as compared to basketball players not instructed in the use of MIT.

Hypothesis 1.2 Basketball players instructed in the use of MIT will maintain their practice set shooting (PSS) performance levels seven days after training is completed compared to basketball players not instructed in the use of MIT who will show a decrement in PSS performance over the retention period.

Hypothesis 1.3 Transfer of learning from the PSS to the transfer set shooting task (TSS) and the retention of that transfer (RTSS) will be greater for subjects instructed in the use of MIT as compared to the control group.

Hypothesis 2 Basketball subjects instructed in the use of MIT will show greater consistency over the 12 practice sessions than will players not instructed in the use of MIT.

Hypotheses 3.1, 3.2, 3.3, and **4** refer to elite basketball players in the MIT and control groups.

Hypothesis 3.1 Elite basketball players instructed in the use of MIT will show a greater increase in shooting performance at the end of 12 practice sessions as compared to elite basketball players not instructed in MIT.

Hypothesis 3.2 Elite basketball players instructed in the use of MIT will maintain their PSS performance levels seven days after training is completed, compared to the elite basketball players not instructed in MIT who will show a decrement in PSS performance over the retention period.

Hypothesis 3.3 Transfer of learning from the PSS to the TSS task, and the retention of that transfer (RTSS) will be greater for elite basketball players instructed in the use of MIT, as compared to the elite control group.

Hypothesis 4 Elite basketball players instructed in the use of MIT will perform more consistently over 12 practice sessions than will the elite control group.

Hypotheses 5.1, 5.2, 5.3, and 6 refer to non-elite basketball players in the MIT and control groups.

Hypothesis 5.1 Non-elite basketball players instructed in the use of MIT will show a greater increase in shooting performance at the end of 12 practice sessions as compared to non-elite basketball players not instructed in MIT.

Hypothesis 5.2 Non-elite basketball players instructed in the use of MIT will maintain their PSS performance levels seven days after practice is completed, compared to non-elite basketball players not instructed in the use of MIT who will show a decrement in PSS performance over the retention period.

Hypothesis 5.3 Transfer of learning from the PSS to the TSS task and the retention of that transfer (RTSS) will be greater for non-elite basketball players instructed in the use of MIT, as compared to the non-elite control group.

Hypothesis 6 Non-elite basketball players instructed in the use of MIT will show greater consistency over the 12 practice sessions than will non-elite players not instructed in MIT.

The following secondary hypotheses investigating imagery ability, were also examined:

Hypothesis 7.1 Basketball players in the MIT groups with high imagery ability, will show greater improvement in shooting performance than will players with low imagery ability instructed in the use of MIT.

Hypothesis 7.2 Movement-specific imagery ability, measured by the MIQ, will not be related to general imagery ability, measured by the QMI and VIC.

Definition of Terms

Elite performer - An individual who participates at a varsity level in basketball.

Non-elite performer - An individual who has taken the P.E. 120 elective basketball course.

Learning variable - A variable that permanently affects the rate or level of learning (Schmidt, 1982).

Performance variable - An independent variable that has an immediate effect, but no permanent effect on performance. (Schmidt, 1982).

Transfer paradigm - A research design, whereby groups are shifted to a common condition after an initial practice phase to evaluate the 'relatively permanent' effects of the independent variables (Schmidt, 1982).

Retention paradigm - A research design whereby an inference regarding learning can be made by tests given after a specified time of no practice (Magill, 1985).

Image - Quasi-sensory and quasi-perceptual internal representation of an external object or event which is processed and utilized in cognition, and of which the individual is consciously aware (Kosslyn, 1980; Gopher, 1984).

CHAPTER II

REVIEW OF LITERATURE

This chapter presents a current review of the literature on imagery. The topics to be reviewed are mental practice and imagery research, definition of imagery, theories of imagery, a theoretical framework within which to study imagery, and variables which must be considered when investigating imagery within this framework.

General Review on Mental Practice and Imagery Research

Many studies have been conducted on mental practice (MP) and its relationship to motor skills performance. Mental practice and imagery research to date has been equivocal, and does not conclusively support the relationship between MP and improved performance. Richardson (1967), Corbin (1972), Martens (1982), and Feltz and Landers (1983) have all conducted extensive reviews on studies that dealt with the effects of MP on motor performance.

Richardson (1967) cited 18 studies which document MP as an effective technique to improve performance, and three which reveal negative results. He concluded that the trend of most studies indicates MP procedures were associated with improved performance. Corbin (1972) cited 26 studies which suggest a positive relationship between MP and motor skill performance, and reported four studies where no effect emerged. Corbin (1972) concluded that MP can positively affect skilled motor performance when practice conditions are optimal. More recently, Martens (1982) reviewed the imagery research related to sport and motor performance from 1970 to 1982. He concluded that imagery is an effective technique to enhance motor performance. To resolve some of the controversies concerning the efficacy of imagery, Feltz and Landers (1983) conducted a comprehensive review of the MP and imagery literature using meta-analytic procedures. Briefly, a meta-analytic procedure is a method for systematically combining quantitative data from a number of studies focusing on the same research question, and using similar variables, for the purpose of integrating their findings (Glass, 1977). Feltz and Landers (1983) analyzed 60 published and unpublished MP studies. Results indicated that mentally practicing a motor skill influences performance somewhat better than no practice at all.

These reviews by Corbin (1972), Feltz and Landers (1983), Martens (1982), and Richardson (1967) revealed that MP appears **to** facilitate motor performance in that MP groups performed significantly better than the no practice (NP) groups, but not as well as the physical practice (PP) groups. The most potent paradigm for the application of MP appears to be the combination of MP with PP (Corbin, 1972; Feltz & Landers, 1983; Weinberg, 1982).

Research that has followed these reviews, have for the most part addressed some of the methodological concerns expressed in these review papers, but have continued to produce equivocal results. In support of the positive relationship between MP and performance improvement, Hamilton and Fremouw (1985) showed performance increments in skilled basketball players as a result of imagery training. In contradiction to the relationship revealed in the review papers, Eby (1986), using field hockey players, and Mumford and Hall (1985) using figure skaters and both of whom focused on the improvement in closed skills indigenous to the respective sports, found no evidence to indicate improved performance due to imagery training. It may be that the contradictions in the literature are a product of the variations in operational definition and theoretical framework, as well as subject type, skill level, task characteristics, and experimental design that characterize the research on MP and imagery training. A more specific discussion of these issues will follow in this literature review, but it is quite apparent that there is no consensus on the effectiveness of imagery training on the improvement of subsequent performance.

Imagery Defined

Traditionally, imagery in the motor skills domain, has been thought of as part of a much larger mental rehearsal technique known as mental practice (MP). MP has been defined as the symbolic rehearsal of physical activity in the absence of any gross muscular movements (Richardson, 1967). Imagery is considered to be the major component of

MP, but all MP does not consist of imagery (Hall, 1985). Imagery has been defined by Denis (1985) as: "a psychological activity which evokes the physical characteristics of an absent object (either permanently or temporarily absent from our perceptual field)." (p. 4s)

This definition is supported by a variety of researchers (Corbin, 1972; Paivio, 1985; Richardson, 1967) who all agree that imagery is a distinct cognitive process, although there is less agreement about the nature of images and about the process by which images are generated, stored, and retrieved.

Within the motor skills literature, the terms symbolic rehearsal, mental practice, visuo-motor behavior, and visualization have been used synonymously with the term imagery. This has led to the common sense notion that imagery is a series of mental pictures. However, Heil (1984) argues that this intuitive interpretation of the nature of imagery is too simplistic and misleading. Suinn (1976) suggests that imagery is much more than mental pictures reconstructing a movement in that it is a multi-sensory experience. However, there is no empirical evidence that leads to a definition of the exact nature of the imagery experience.

For the purposes of this study, the term motor imagery training (MIT) will be used to refer to the imagery experience that the subjects are instructed to use prior to performance, and is defined as the mental rehearsal of motor performance in conditions where the auditory, visual and kinesthetic qualities of movement are experienced.

Theories of Imagery

Paivio (1985) and Nideffer (1976) have stated that there is little agreement on the methods of imagery used in the psychological preparation of athletes, because there is a lack of a theoretical explanation of the imagery construct. Although a number of theories of imagery have been advanced, each suggesting that imagery is a beneficial technique for the improvement of motor behavior, none have gained general acceptance. Four of the most significant theories will be reviewed in this section.

The Gross Framework Theory, proposed by Lawther (1968) is based on the hypothesis that the performer must view or conceptualize the task as a whole (or a Gestalt) before an improvement in skill performance will occur. This theory emphasizes the totality of the skill rather than the details of the movements involved in the skill. Corbin (1972) states that the implications of this theory of MP appears to be advantageous to the beginner in gaining an overall impression of basic skill requirements. However, it seems unlikely that a novice would benefit from this form of mental rehearsal, since they could not readily comprehend the complexities of the skill that produce the resultant skilled performance. With an elite athlete, improvement is most likely to occur if attention during imagery is drawn to the critical performance cues, rather than the generalized action sequence.

A second theory is the Psychoneuromuscular Theory proposed originally by Jacobson (1932). The basis of the theory is that subthreshold muscular contractions occur as a result of imaging a movement. The action currents in the muscle fibers may be utilized by the individual, as kinesthetic feedback to help form perceptual discriminations and improve performance (Corbin, 1972). It has been shown that although electromyographic (EMG) traces may be of reduced magnitude, neuromuscular patterns are generated in muscle groups involved in the actual movement (Hale, 1982; Harris & Robinson, 1986). Corbin (1972) suggests that an increase in performance will result if a strong association between MP and muscle response is repeatedly paired with the MP stimulus.

There are few quantitative studies to support the psychoneuromuscular explanation. One such study was conducted by Harris and Robinson (1986) where, during imagery, muscle innervation between sites or paired limbs appeared to be specific to the muscle group necessary for task execution. This finding along with research by Hale (1982) and Jacobson (1932) supports the Psychoneuromuscular Theory. However, there are difficulties in drawing casual inferences about the effect of imagery based on the Psychoneuromuscular Theory, due to the methodology employed and the inconsistencies in the literature (Denis, 1985; Feltz & Landers, 1983).

In contrast to the Psychoneuromuscular Theory which is physiologically based, the Motivation Theory places its emphasis on psychological aspects of imagery. Corbin (1972) suggests that differences in performance increments between MP and control groups may reflect differing levels of motivation.

Motivation may be enhanced due to the imagery package which creates an interest and a desire to test the effect of this intervention on performance. As a result, the imagery group would better the control group's performance because of the motivation to successfully execute the mentally practiced skill.

A second explanation for the Motivational Theory relates to the proposition that individuals instructed in the use of imagery will perform better as a result of the 'Hawthorne Effect'. The Hawthorne Effect refers to the phenomenon of working efficiently and productively, due to a feeling of special attention and participating in a new and stimulating environment (Wrightsman & Deaux, 1981). The fact that some form of special practice or treatment is given to the experimental group may act as a motivator in itself, and not be a function of the context of their imaging experience.

While the Motivational Theory of imagery is useful in highlighting the relationship between motivation and performance, it is limited by its analysis as it does not account for factors related to the process of imagery which appears to influence performance.

The final explanation of imagery as a MP technique is the Symbolic Perceptual Theory. This theory addresses the cognitive and symbolic components of skill acquisition (Richardson, 1967). Movement information is represented at a high level in the formation of cognitive entities, which can be manipulated by purely psychological processes and do not necessarily involve concomitant motor acts (Minas, 1980). According to the symbolic learning explanation, imagery will facilitate motor performance only to the extent that the task is cognitively oriented. In support of this contention Schmidt (1982) suggests that imagery should be most influential in the early stages of learning when cognitive and verbal processing are crucial to performance.

Fitts and Posner (1967) describe the first phase of learning as a cognitive stage, during which imagery should be beneficial to skill acquisition. Once the skill is automated, cognitive factors are well defined and therefore, imagery should not facilitate skill specific performance to the same extent. The Symbolic Perceptual Theory has received consistent support from the imagery literature which suggests that learning symbolic components of a skill is enhanced by mental rehearsal (Minas, 1980).

All these theories provide partial explanations of the construct of imagery and its efficacy on performance. The forementioned theories provide the foundation for investigating the constructs of MIT however, there is a need for a theoretical framework in order to evaluate the imagery literature and to direct further research (Feltz & Landers, 1983; Nideffer, 1976; Paivio, 1985; Weinberg, 1982).

Theoretical Framework for the Study of Imagery

Paivio (1985) suggests an analytical framework based on the cognitive and motivational explanations for imagery in the mediation of behavior. Paivio's framework includes four components: general motivation, specific motivation, general cognition, and specific cognition.

1. **General Motivation**. This component includes a general arousal dimension which is associated with positive or negative emotions affecting performance. The performer's motivational level may be influenced by his/her capacity to symbolically represent behavioral situations. If the motivational level increases, performance should be enhanced.

2. **Specific Motivation**. More specific behaviors are classified as goal-oriented responses. Motivation levels are influenced by the approach or avoidance responses to goal directed tasks. The performer can image situations where the attainment on non-attainment of specific goals can mediate success or failure.

Many researchers (Miller, 1985; Nideffer, 1976; Vealey, 1986) believe that imagery has a motivational function in facilitating motor behavior. As a result several imagery techniques have been developed such as energizing, visualization, and visuo-motor behavior rehearsal (Miller, 1985; Orlick & Partington, 1986).

The general and specific motivational components can be considered as performance enhancers which may only affect immediate performance. In this context, imagery serves to enhance the psychological environment so that the subject can perform at his/her optimal level.

3. General Cognition. This component examines the contribution of imagined strategy rehearsal to motor learning and performance. It is suggested that visualizing strategies can provide the performer with important analytic cues in mediating their own performance and countering their opponent's strategy. The use of imagery to learn strategies involves mentally rehearsing team concepts or individual tactics. Although imagery cannot replace physical practice, it is a useful technique to learn new strategies (Vealey, 1986).

4. Specific Cognition. On the specific level, emphasis is placed on individual skills and task analysis. Imagery can be used to practice a specific sport skill in the mind. Many studies (Eby, 1986; Epstein, 1980; Hamilton & Fremouw, 1985; Wrisberg & Ragsdale, 1979) have focused on the development and improvement of skill using imagery as a cognitive training procedure. This procedure is employed to strengthen the correct response and to aid in the transfer of the correct behavior to the competitive environment.

Consequently, imagery may have some value in aiding changes in motor behavior and contributing to learning.

This model can be very useful in conceptualizing the various roles that imagery can play and provides direction for future research, in that it helps to define variables that may have an effect on the outcome of imagery application and must be considered in researching the relationship between imagery and performance. Specifically, these variables are skill level of subjects, type of task used in the research, and individual differences in imagery ability. In addition, this model suggests that imagery can function as a performance variable and as a learning variable dependent on its application. It is upon this aspect of the model that this study will focus and, more specifically, within the fourth category of the model which deals with skill specific imagery.

A General Review of Imagery in the Learning and Performance of Motor Skills

Most of the MP and imagery research has been concerned with the measurement of increases in motor performance. To date, very little evidence has been provided to indicate that imagery enhances the learning of a task. Some problems arise when differentiating between a learning variable and a performance variable. They are clearly not the same, however, many researchers have neglected to differentiate between the two when measuring improvement in motor skills.

Schmidt (1982) makes the distinction between learning and performance variables. He defines a performance variable as having an immediate effect on performance while it is present, but the effect is altered when transferred to another task or situation and therefore, the effect is not 'relatively permanent'. This indicates that no learning has taken place. In sport, a performance variable may be better described as a variable which serves to enhance the performance environment so the athlete is better able to perform to his/her potential.

On the otherhand, Schmidt (1982) classifies a learning variable as one not only affecting performance when it is present, but also affecting performance when the variable has been removed. Hence, we would expect the effect of a learning variable to be 'relatively permanent' in that the variable has affected the level or rate of learning. As a result, imagery may operate to enhance retention and as such facilitates future performances when the variable is no longer present, or is in an altered form. An area which requires attention is whether or not imagery facilitates learning, or whether it merely affects immediate performance.

(a) Review of Studies on Imagery and Learning

Several studies have been conducted on MP and its relationship to motor skills learning. Major reviews (Corbin, 1972; Feltz and Landers, 1983; and Richardson, 1967) conclude that overall, MP was associated with performance gains demonstrating improvement in learning, however, paradigms have not been used that allow for the measurement of learning.

A study by Ryan and Simons (1981) investigated the effect of imagery on two novel perceptual motor tasks. A stabilometer and a dial-a-maze were used to determine if imagery affected the learning of these two tasks. Results indicated that the PP group was superior to the MP and NP groups on the stabilometer task, but no significant differences in learning emerged between the MP and NP groups. On the dial-a-maze task the MP group performed equally to that of the PP group and both were superior to the NP group. However, Ryan and Simons (1981) did not include any retention period to test whether the effect was permanent, so in fact their study reflects the use of MIT as a performance variable. A study on the effects of mental rehearsal on the acquisition of rotary pursuit tracking by Rawlings et al. (1972) also purported to investigate learning. They showed that after 10 days practice the mental rehearsal groups were superior to the control group, but again no testing was done over a retention period to measure for any permanent effect.

One study which did use an appropriate paradigm for measuring learning was conducted by McBride and Rothstein (1979). They investigated the learning and retention of a novel skill in open and closed conditions by employing retention periods of one day, one week, and one month. Hence, the researchers specifically tested for relatively permanent changes in performance. They found that all groups (MP, PP, or MP+PP) showed retention of accuracy, however, no significant differences emerged between the groups over the retention periods.

Corbin (1972) indicates that the type of skill to be learned may be related to the extent which imagery promotes learning. A closed skill is one where the environment is predictable, stable, and fixed (Schmidt, 1982). Skills which take place in a closed environment are constant and controlled, whereas an open skill is performed in an environment which is constantly changing and will not be executed in exactly the same way as practiced (Magill, 1985). The performance of an open skill requires anticipation and prediction of moving objects (McBride & Rothstein, 1979). If imagery is effective as a learning variable, then it may have potent application for use in practicing open skills and thereby, enhancing the transfer to game situations.

Results from Epstein's (1980) study revealed that dart-throwing performance, which is a closed skill, was not facilitated by imagery. However, McBride and Rothstein (1979) reported that performance increases as a function of imagery training in closed skills was significantly better than the increases observed in open skills. Type of task appears to be a variable which must be considered when assessing the effect of imagery on learning.

Another variable that should be addressed in the investigation of learning is the skill level of the subjects (White, Ashton, and Lewis, 1979). The traditional view is that MP is effective mainly in the initial phase of skill learning. The initial phase of skill learning is essentially cognitive rather than motor in nature, and therefore imagery would be most effective during this phase (Fitts & Posner, 1967; Schmidt, 1982). Schmidt (1982) suggests that as the skill is automated during the latter stages of learning, mental strategies become ineffective. This issue remains unresolved by the current literature.

(b) Review of Studies on Imagery and Performance

There is little research evidence to substantiate the effectiveness of imagery as a performance-enhancing technique. Many researchers (Orlick & Partington, 1986; Suinn, 1983; Vealey, 1986) provide anecdotal evidence on various mental approaches utilized by elite athletes. In most accounts from this type of research, positive attributions have been made regarding imagery's potent effect on motor performance. It cannot be assumed however, that imagery is the causal factor in any anecdotal account of sporting success (Wollman, 1986). In the case where performers found imagery interfered with performance, Nideffer (1976) suggests that this is more likely due to the inappropriate application rather than to the procedure itself. Yet, controlled empirical studies conducted by Eby (1986) and Mumford & Hall (1985) produced little support of skill specific imagery as a mediator of elite sports performance.

In contrast to the previous studies, Hamilton and Fremouw (1985) found skill specific imagery facilitated basketball free-throw performance. The methodology employed however, was a single subjects design (N = 3) and effects due to physical practice were not controlled. Clarification of imagery's role in the performance of motor skills would help remedy the contradiction surrounding the current literature and specify imagery's function in maximizing performance.

Imagery Effectiveness as a Function of Level of Skill

As stated previously in the review on imagery and learning, skill level should be considered to determine the effectiveness of imagery. There have been several studies that have investigated the extent to which skill level influences the effectiveness of imagery, but for the most part have considered the relationship between imagery, skill level, and performance. Prior exposure to the skill and familiarity in executing the task appears to enhance the effectiveness of imagery (Corbin, 1972; Feltz & Landers, 1983). Corbin (1972) states that skill level is known to influence the impact of mental rehearsal.

Mumford and Hall's (1985) study investigating imagery in figure skating, provided further evidence to suggest that elite performers benefited more from imagery than less skilled performers. They found that senior skaters showed greater improvement in performance when using imagery than junior skaters. In this study the type of imagery training used focused on the kinesthetic aspects of the image. It appears from this study that elite performers may gain performance enhancement when using kinesthetic imagery.

In partial support of Mumford and Hall's (1985) findings, Harris and Robinson (1986) reported that advanced karate students produced more localized and specific muscular efference (measured by EMGs) during imagery, and were better at responding to the imagery instructions.

The outcome of these studies would suggest that the more advanced athlete may be able to effectively utilize imagery and internalize the correct responses to enhance performance skills. However, this is not to suggest that imagery will have the same positive effect on learning for skilled performers.

Fitts and Posner (1967) suggest that learners go through a transition of phases when they acquire and learn a skill. In the cognitive phase, the emphasis is on discovering the requirements necessary to successfully execute the skill. The second phase is an associative phase where the primary concern is to identify the correct motor pattern, by adjusting and correcting movements to produce effective performance. The final phase is characterized by a reduction of attentional requirements. The autonomous phase allows for skilled performance that is controlled, with a limited use of resources and procedures which match the environmental demands.

Minas (1980) using a 'hop scotch-like' gross motor skill at two different stages of learning, reported that MP facilitated performance when at an early stage of learning relative to a no-practice control group. Wrisberg & Ragsdale (1979) found that imagery was as effective as physical practice only during the early stages of learning on a high cognitive demand task (The McCloy Test of Multiple Response), compared to a low cognitive demand task (stabilometer).

In contrast to these studies, Clark (1960) found that MP was almost as effective as physical practice for the varsity groups and not nearly as effective for the novices. Research evidence regarding the relationship between imagery, skill ability, and learning is not clear and further study is needed to define this relationship.

Imagery Ability

Hall (1985), Richardson (1967), and Ryan and Simons (1981) have shown that individual differences in imagery ability is an important variable affecting performance. Imagery ability reflects an innate or acquired conceptual habit, to think in 'pictures' rather than in words. Corbin

(1972) proposed the logical assumption that individuals with an above average ability to construct mental images, would achieve better results from the use of mental practice. It appears from Paivio's (1985) explanation of his four categories of imagery function that it may be advantageous to have the ability to image clearly and with control, especially within the skill specific image category.

Many studies have neglected to measure individual differences in imagery ability, and yet individual differences in imaginal abilities seem to effect the facilitation of performance (Hall, 1980). A study by Ryan and Simons (1981) demonstrated that individuals who reported strong visual images showed more improvement on a stabilometer, than those with weak visual images.

Imagery ability has also been measured in relation to memory of movement information. Housner and Hoffman (1981) compared high and low imagers on their ability to reproduce criterion end locations. Imagery ability was determined by the Vividness of Visual Imagery Questionnaire. Subjects were required to reproduce the criterion end location after 30 secs of mental imagery or 30 sec of visual interference. More accurate reproductions of movement locations were achieved by individuals classified as high imagers. High imagers performed consistently better than low imagers, however this was not supported after testing subjects over three retention periods. Harris and Robinson (1986)

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Other studies have failed to show any relationship between imagery ability and performance. Epstein (1980) investigated performance on a dart-throwing task and was unsuccessful in showing any significant differences between high and low imagers, and their respective performances. Similar results were replicated by Eby (1986) investigating the effects of imagery as a mediator of performance in elite female field hockey players. Eby found no significant correlation between high and low imagers, with respect to their performances.

Vividness and controllability of imagery was measured by Start and Richardson (1964) on the learning and performance of a gymnastic skill. No significant relationship between these aspects of imagery ability and performance emerged. White, Ashton & Lewis (1979) investigated action-reaction swimming starts and also found no significant correlation between performance improvement scores of subjects using mental practice, and total scores on Sheehan's (1967) adaptation of Betts' Imagery Scale.

As reliability data on self-report measures are scant, this leads us to question the validity of such instruments. This has also been proposed by Hall, Pongrac and Buckolz (1985) who concluded that most of the inconsistencies resulting in the area of imagery ability, can be traced to the imagery tests and task validation.

There are three categories of imagery ability tests; phenomenological, self-report measures; spatial intellective measures, objectively assessed; and self-report measures of cognitive style (Heil, 1984). Although there are many problems relating to the inconsistency in ratings and the socially desirable characteristics which may effect the self-report measures (White, Ashton & Lewis, 1979), the self-report method has respectable test-retest reliabilities and construct validity. In addition, the nature of imagery is conducive to the self-report inventories.

It is important to assess individual abilities in experiencing each sensory modality through the use of imagery, to measure the influence of imagery training on imagery ability and performance. Given that a suitable imagery test is available, it appears that the assessment of imagery ability prior to the commencement of an imagery training program would be instrumental in assessing the effect of imagery on performance (Hall, 1985; Heil, 1984; Vealey, 1986).

Related literature on vividness, controllability, exactness of reference, imagery perspective,and orientation is presented in Appendix A.

Methodological Concerns

Many researchers (Feltz & Landers, 1983; Corbin, 1972; Weinberg, 1982) have criticized the lack of control in imagery experiments. Weinberg (1982) highlights many methodological problems and questions the generality of imagery research findings. Large variances in research designs, experimental procedures, selection of task, subject characteristics, and the validation of imagery tests have limited the usefulness and practical application of imagery research. For maximum effectiveness, imagery should be used in conjunction with physical skills practice. Corbin (1972) and Weinberg (1982) suggest that the degree of effectiveness of MP depends on the type of task, the length of practice, and the individual's ability to conceptualize and experience the movement. Research designs should account for all these variables when testing for the effect of imagery on motor performance.

Imagery Paradigms

As stated earlier, little use has been made of retention paradigms to test the effect imagery makes to the learning process in motor performance. Most designs compare the performances of subjects using imagery to a control group. Both groups are then usually tested under standardized conditions to determine any differences resulting in performance scores. Some studies using this design have found that imagery groups do not perform as well as physical practice (PP) groups, or groups with combined imagery and PP (Corbin, 1972). Single subject designs have also been utilized to investigate the effect of imagery (Hamilton and Fremouw, 1985) but very little can be generalized from these results.

Length of Practice

Paradigms used, have been designed mainly to test performance increments as a result of both physical and mental practice. A number of studies have looked at performance in trial blocks (Epstein, 1980; McBride and Rothstein, 1979; and Rawlings and Rawlings, 1974), all differing in the length of time. The number and length of practice sessions are varied and according to Corbin (1972) there may be an optimal level at which MP is most effective for skill learning. Performance to rest ratios have also varied with respect to the type of task used. Vealey (1986) recommends imagery be practiced on a daily basis to attain optimal arousal, to review what has been physically practiced, and to create realistic practice situations.

Parameters of Imagery Training

The parameters of imagery training programs may be a critical factor in the mediation of performance. It is suggested that athletes should be in a relaxed state, the practiced skill identified, attention directed internally or externally depending on the stage of learning, and demands of the task. In addition, skill related cues or labels should be provided and the athlete should employ mnemonic devices to aid retention. The imagery session should be positive and successful (Bird & Cripe, 1986; Miller, 1985). It is suggested (Feltz & Landers, 1983) that the duration of the imagery session should be based on the demands of the task.

Task

Lack of consistency in the type of tasks used in the current literature may account for some of the contradictory results regarding imagery training and performance. The type of task selected to measure the effect of imagery should be appropriate in that the task should lend itself to being imaged (Hall, 1985). Schmidt (1982) suggests that tasks with a high cognitive demand will benefit more from imagery rehearsal than tasks with a low cognitive demand. A vast number of imagery studies have used novel motor skills or cognitive tasks, such as mirror tracing and maze tasks.

Open and closed skills have been studied by McBride and Rothstein (1979) and Rawlings et al. (1972) using rotary pursuit tracking. Other studies dealing with imagery in sport have used a variety of skills including figure skating (Mumford & Hall, 1985) basketball shooting (Hamilton & Fremouw, 1985) and ice hockey goal tending (McFadden, 1982) as gross motor skills. All these varied task characteristics need to be systematically controlled in future research.

Subject Characteristics

Subjects tested in the imagery literature have varied significantly on a number of characteristics including age, gender, skill level, and imagery ability. Subjects have ranged in age, from elementary school to college (Feltz & Landers, 1983). Van Gyn and Docherty (1984) suggest that imagery as a mediator of motor performance is age dependent, and may be less functional for younger age groups in terms of accuracy and consistency recall.

Concerning gender, differences have also been observed between males and females in their ability to use imagery. Results have shown that females tend to have higher visual ability than males (White, Sheehan and Ashton, 1977).

A study by Epstein (1980) found that males significantly outperformed females, due to skill ability. The relationships of skill level and imagery ability to imagery and performance have already been covered in the literature reviewed.

Questionnaires Measuring Imagery

Another concern is the validity of the test instruments used to measure imagery which have also produced inconsistent results (Hall, 1985). Self-report data of imagery questionnaires does not lend itself toward demonstrating an objective relationship between imagery ability and motor performance. Most questionnaires are not designed to measure imagery of movement, with the exception of the MIQ. The MIQ has shown a stable internal structure and respectable reliabilities (Hall, Pongrac and Buckolz, 1985).

Validating the results of imagery questionnaires used in motor skill studies is open to much criticism. Hall (1985) suggests that more appropriate methods of measuring visual and kinesthetic imagery of movement are required. A study by Eby (1986) revealed that imagery ability of field hockey players, as measured by the MIQ, QMI and VIC did not change over time with practice for the imagery group. She found that all of her subjects were classified as having high imagery ability and therefore, could not speculate on the differences in imaginal abilities due to the homogeneity of the group. The more researchers employ these imagery questionnaires, the more external validation can be established for the appropriateness and use of these tests.

CHAPTER III

RESEARCH METHODS

This chapter reports the research methodology and procedures employed in the study. The selection of subjects, variables, the limitations and delimitations, data collection, instrumentation and statistical analyses are presented.

Selection of Subjects

Thirty-six volunteer subjects participated in the study. Eighteen elite female basketball players volunteered from the women's junior and senior varsity basketball teams at the University of Victoria. The remaining eighteen subjects volunteered from the elective P.E. 120 basketball course held in the spring semester in 1987, and were categorized as non-elite basketball players. Subjects were randomly assigned to either the control or imagery group, with an equal number of elite and non-elite players in each.

Subjects were assessed on their ability level, as determined by a pre-test shooting performance score (TSS1) and subjective ratings by the university women's basketball coaches and the P.E. 120 instructor. As the elite varsity teams were away at the National Championships during the pretest, the 18 elite subjects were tested one week after the non-elite players. Subjects ranged in age from 17 to 34 years (average age 21.5 years).

Variables

Independent Variables

The independent variables were:

(a) Level of skill ability, specific to the set shot in basketball. There were two levels of this variable: (i) elite, and (ii) non-elite;

(b) Imagery versus non-imagery (control).

Dependent Variables

The dependent variables were:

(a) Shooting performance, which was reflected by TSS1, TSS2, RTSS, PSS1, PSS2 and RPSS shooting scores; and

(b) The discrepancy scores between TSS1 - TSS2; TSS2 - RTSS; TSS1 - RTSS; PSS1 - PSS2; PSS2 - RPSS; and PSS1 - RPSS performance scores.

These variables will be defined in detail in the description of the task.

Limitations and Delimitations

The following factors were in effect for this study:

1. The study was restricted to females and therefore, cannot be generalized to the male population.
2. The study was limited by the subjective ratings for skill ability.
3. The study was limited by self-report measures as indicators of imagery ability.
4. The study's validity was also limited due to the varying appropriateness of the test instruments.

5. The study was limited by the closed nature of the skill and therefore, has restricted application to other sports skills.
6. The assumption was made that the PSS skill would transfer positively to the TSS time pressured condition.

Task

1. <u>The Transfer Set Shooting Test (TSS)</u>

   This test is a derivative of the American Alliance for Health, Physical Education, Recreation, and Dance (AAHPERD) speed spot shooting test developed by Hopkins, Schick and Plack (1984) (see Appendix B). The speed spot shooting test is one of four in a battery of tests to measure basketball motor skill ability. The purpose of the speed shooting drill is to measure skill in rapid shooting from specified positions and, to a certain extent, agility and ball handling.

   Female norms at elementary, junior high, senior high and college levels have been established for this test. College female norms include both high interclass stability reliability (r = .91) and a validity estimate for the whole battery of tests, (r = .94).

   Although the AAHPERD speed spot shooting test has good reliability, it was anticipated that due to the various levels in skill ability for agility and ball handling, a more specific test could be developed for this study . Consequently, the TSS test was modelled on the speed spot shooting test, but was restricted in that only the set shot can be taken from three designated positions. The TSS test closely resembles the AAHPERD speed spot shooting test, in that both tests are conducted in a time limit of 60 seconds.

The TSS test was designed to measure skill in rapid shooting from three designated positions around the key. These include one position 45° to the right of the free throw line, one position from on the free throw line, and one position 45° to the left of the free throw line, in that order. The same rotation was carried out for all test phases.

The TSS test was employed to measure the transfer of learning from the PSS condition to the TSS condition. The TSS test was administered at T1 as a pretest measure of shooting ability (TSS1). It was administered a second time as a posttest score, after the 12 practice sessions at T4 (TSS2). The final TSS test was given at T5, six days after the completion of the practice period which represented a retention score (RTSS). Subjects were instructed to score as many baskets as possible in 60 secs. All subjects completed the TSS test three times, so an average performance score at each testing phase could be obtained.

2. <u>The Practice Set Shooting Test (PSS)</u>

The PSS test was modelled on the TSS test. The PSS and TSS tests contained the same skill, however, the PSS test had no time constraint but involved shots taken from each of the designated positions around the key as in the TSS test. Ten shots were taken from each position for a total of 30 shots.

The objective of the test was to score as many baskets as possible out of the 30 shots taken. The PSS test was administered on each of the 12 practice days. Due to daily shooting performance variability, practice sessions P1-P6 were averaged to obtain a representative measure of shooting performance at the beginning of the practice phase (PSS1 - taken at T2). Practice sessions P7-P12 were averaged to obtain a representative measure of shooting performance at the end of the 12 day practice phase (PSS2 - taken at T3). A retention test of PSS (RPSS) was taken one week after the completion of the practice phase at T5. The PSS testing was organized to permit MIT to be utilized prior to each shot. For a complete description of the shooting layout, see Appendix C.

Instrumentation

Questionnaires

(a) A general information questionnaire was administered to all subjects which reported on age, basketball playing experience, and the amount of basketball practice that the subject was involved in per week (see Appendix D).

Three imagery questionnaires were also administered to each subject in the MIT group prior to practice. The results of these questionnaires established each subject's imagery ability before MIT. The same questionnaires were used after training on both groups, to establish any difference in imagery ability between the MIT and control groups and to assess any change in the MIT group over the training period.

(b) The revised Betts' Questionnaire Upon Mental Imagery (QMI), developed by Sheehan (1967), measures the vividness component of imagery in seven modalities: visual, auditory, cutaneous, kinesthetic, gustatory, olfactory, and organic (see Appendix E). Sheehan (1967) selected 120 of the original 150 items of the Betts' (1909) Questionnaire Upon Mental Imagery and then revised the test, reducing the number of items to 35.

The QMI is used extensively as an effective measure of imagery vividness and has been shown to have internal and test-retest reliabilities as well as construct validity (White, Sheehan & Ashton, 1977). The QMI is a subjective, self-report questionnaire comprising of the initial seven sensory modalities. Each of the modalities, corresponding to seven subscales, contains five descriptive items which the individual is asked to image. The subject is required to rate the assessment of their image in terms of vividness on a scale from one (maximum vividness) to seven (total absence of an image). The possible range of scores for each subscale is 5 to 35. To obtain a total vividness score, all 35 items are totalled collectively by summing the ratings on each subscale. The total score range is 35 to 245, where a low score depicts a high ability to image clearly and vividly.

(c) The Gordon Test of Visual Imagery Control (VIC) was revised by Richardson (1969) and measures an individual's ability to control or manipulate visual images (see Appendix F). The VIC is a recognized and accepted test of imagery control. Sound reliabilities and predictive efficiency have been established using the VIC as reported by White, Sheehan and Ashton (1977).

The VIC is comprised of 12 items and is a subjective self-report test which requires subjects to visualize a scene and then change the image as instructed. The subject is to answer 'yes', 'no', or 'unsure' to each of the 12 questions related to visualizing the scene described. The items are scored according to the response using the following scale: 'yes' = 2 points; 'no' = 0 points; and 'unsure' = 1 point. All scores are totalled to obtain a composite score for the controllability of images. The possible range of scores include 0 to 24, where a high score indicates better control of the image.

(d) The Movement Imagery Questionnaire (MIQ) was developed by Hall and Pongrac (1983) and measures the visual and kinesthetic components of imagery specific to movement (see Appendix G). This questionnaire is concerned with the formation of images of motor performance. Hall (1985) reports respectable reliabilities and a stable internal structure in regard to the MIQ test. The MIQ is a paper and pencil test and includes 18 items, nine of which describe the visual subscale (MIQ-V) and nine of which form the kinesthetic subscale (MIQ-K).

The subject is required to perform a given movement with his/her arms and/or legs and/or entire body. Subjects are then asked to either visualize or feel the same movement without physically performing the task. According to the ease or difficulty they have with imaging the task, subjects rate their ability on a seven point scale (one for maximum ease - seven for maximum difficulty).

The MIQ-V subscale is calculated by summing the ratings of items: 1, 3, 5, 7, 11, 13, 15, 17, and 18. The MIQ-K subscale is obtained by summing the ratings of items: 2, 4, 6, 8, 9, 10, 12, 14, and 16. The possible range of scores for each subscale is from 9 to 63, where a low score indicates high imagery ability relating specifically to visualizing, or kinesthetically feeling movements. For the purposes of this study, the MIQ was orally administered so subjects were able to concentrate on the imagery task.

Procedure

The 36 subjects were contacted during their basketball practice sessions or the PE 120 basketball elective class, to obtain an initial commitment of their involvement in this study. Each subject met individually with the researcher to be notified of the purpose of the study, to complete the informed consent form (see Appendix H), and to complete the subject information questionnaire (see Appendix D) in a laboratory setting.

At this time, the schedule for testing and subjects' role in the study was explained. Each subject was told that they would be tested 16 times over the three week testing period. Prior to shooting practice, subjects assigned to the MIT group met individually with the researcher on either day 9, 10 or 11 and were instructed on the use of skill specific imagery. Testing commenced on March 11th, 1987 and practice concluded on April 1st, 1987. After a six day retention period, all subjects were retested on the 8th of April (see Appendix I).

Each subject reported to the University of Victoria gymnasium and was tested three times on the TSS test to obtain an average pre-test score before assignment to experimental groups. For statistical analyses of both TSS and PSS tests, one point was awarded to a subject if the shot was successful and no points were allocated for an unsuccessful shot. Scores were summed to determine a baseline score. The possible range of scores for 30 shots included 0 to 30 points. It was anticipated that 30 individual shots around the free throw line constituted a viable sample of ability and provided an adequate baseline measure for each subject.

For feedback to the subjects, shooting success for the PSS and TSS tests was gauged as follows:

3 points = successful shot through the ring,

2 points = shot where the ball touched the ring but did not pass through the ring,

1 point = shot where the ball only touched the backboard and,

0 points = an air ball, where no contact is made with the ring or backboard.

This scoring procedure was used merely as an incentive for the players. It was anticipated that it would eliminate discouragement and frustration for missed baskets, particularly in the non-elite group.

Prior to practice, subjects in the MIT group met individually with the researcher for a one hour session on MIT. The concept of imagery was explained to them, as well as the real intent of the study. Subjects completed three imagery questionnaires (QMI, VIC and MIQ) as previously described. Tabulation of scores on all imagery tests, however, were not analysed until the completion of testing to protect against experimenter bias.

Written and oral instructions were given to subjects describing the MIT process and methods. Subjects were instructed on skill specific MIT to be used prior to each set shot. Approximately 10 minutes were spent on imaging the shot in detail, and focussing on pertinent cues. Standarized verbal instructions on MIT were given to all imagery subjects (see Appendix J).

In addition, subjects were asked to recall their images and were questioned on the details of their visualization. This information was used throughout the session to identify problem areas, to redirect and focus attention on certain areas of the skill, and to familiarize the subject with the imagery procedure.

Subjects were asked to orally respond to several questions. These included:

1. What did you actually image?
2. How clear was your mental picture?
3. Did you 'hear' the ball bouncing on the floor?
4. Did you 'feel' your muscles move?
5. Did you focus on the ring?
6. How well did you control your image?
7. Did you 'see' yourself shooting the basketball?
8. How difficult was it to control the image?
9. Did you 'see' parts of your body move?

10. Did you 'hear' anything?

11. Did you 'feel' the leather ball in your hands?

12. Did you 'smell' anything related to the image?

(Epstein, 1980).

Standardized imagery instructions were given to each subject and they were encouraged to practice imagery as often as possible, in a relaxed state each day.

All subjects in the experimental group were encouraged to use MIT specifically for set shooting in basketball. An account of this practice was recorded by the subject on a daily log sheet (see Appendix K). Details of their imagery session including time, date, vividness, and control were reported as well as any basketball activities. Subjects were also instructed to go through the imagery process prior to each shot during the practice sessions.

The control group were informed that the study involved observing their shooting performance as a result of daily shooting practice over 12 practice days. No indication was given to these subjects regarding the imagery task practiced by the experimental group. The control group also met individually with the researcher to complete a bogus questionnaire on shooting (see Appendix L). They were also asked to complete daily log sheets describing the amount of shooting practice done each day. Log sheets were consulted to ensure relative consistency in the amount of daily shooting practice by all subjects.

As previously mentioned, each subject performed ten shots at the basket, from each of the three designated locations during the 12 day practice period.

Procedures were standardized as follows:

1. All subjects were instructed to stretch and warm up prior to their testing session. Subjects were also told to dress comfortably with appropriate footwear.
2. All subjects were encouraged to do their best, and to concentrate on successfully scoring each shot.
3. Each location was marked on the floor with tape and testing took place in the University of Victoria gymnasium each day between 8 - 9:30 a.m. and 1:30 - 6:30 p.m.
4. Ten shots were taken from the three locations and scores were totalled for a daily record of performance.

All subjects were tested on the PSS test each day (Monday to Friday) for a total of 12 practice sessions containing a total of 120 shots from each position. To obtain a posttest score and a measure of immediate transfer, subjects performed the TSS test one day after the 12th practice session. A six day retention period followed so that RPSS and RTSS scores could be obtained to provide a measure of retention and delayed transfer.

The TSS test was employed to create a situation where skill specific imagery was unavailable prior to each shot, as the skill was performed under a time pressured condition and thereby simulating a game situation.

Upon completion of the RPSS and RTSS tests, all subjects completed the QMI, VIC, and MIQ in a laboratory setting. Subjects were debriefed, and asked to respond to some follow-up questions regarding their knowledge about the intent of the study (see Appendix M).

Data Analysis

Sixteen performances (pretest [TSS1], 12 practice sessions [P1-P12], posttest [TSS2], and the retention tests [RTSS, RPSS]) per subject were used for the data analyses (see Appendix N). A doubly repeated measures multivariate analysis of variance (MANOVA, SPSSX) was conducted on the PSS and TSS performance scores at five different testing times. The TSS was measured as follows: pretest TSS1 (T1), posttest TSS2 (T4), and retention test RTSS (T5). The PSS test performance scores were taken at T2 (average practice performance score, P1-P6); T3 (average practice performance score, P7-P12); and T5 (retention test, RPSS).

Initially, the doubly multivariate factorial design involved a 2 x 2 x 2 x 3 model. The three independent variables were: group (two levels; elite and non-elite) condition (two levels; imagery and control), imagery ability (two levels; high and low) and time (three levels; pretest, performance test and retention test). However, after careful examination of the imagery ability scores it was observed that most subjects were classified as high imagers. As a result, distinct high and low groups could not be categorized accurately and therefore, all data was collapsed over imagery ability.

Analysis of the subsequent 2 (group) x 2 (condition) x 3 (time) doubly repeated measures MANOVA determined how these three independent variables were related to shooting performance, as measured by two shooting performance tests; PSS and TSS over time. Moreover, the doubly repeated measures MANOVA on the mean scores for each day over all 36 subjects determined whether or not there was a significant main effect for either group, condition, and/or time. The MANOVA also determined the interaction effect of the independent variables (skill level and condition) with respect to the dependent variables (PSS1, PSS2, RPSS, TSS1, TSS2, and RTSS) over time.

The two dependent variables are interval data. Repeated measures were taken on the dependent variables at five different times over the 36 day period, representing TSS1 pretest (T1), PSS1 (T2), PSS2 (T3), posttest TSS2 (T4) and retention tests RPSS and RTSS (T5). The differences in improvement between the MIT and control groups over time, were examined by repeated measures MANOVA on the difference in mean scores for each testing time. These included the discrepency scores between TSS1-TSS2, TSS2-RTSS, TSS1-RTSS, PSS1-PSS2, PSS2-RPSS, and PSS1-RPSS. TSS score range was from 0 - 40 points in 60 secs. The PSS score range was from 0 - 30 points.

When F ratios indicated significant main and/or interactive effects ($p < .05$) individual univariate ANOVAS followed by post hoc Scheffe procedures were performed on each variable to characterize the changes over time for condition and status.

Doubly multivariate repeated measures MANOVA was the most appropriate statistic to use for this experimental design to investigate both main and interactive effects between group, condition, and time on shooting performance. The MANOVA design allows for the control of overall Type 1 error when a number of comparisons between groups are performed. This study examined the effects of the independent variables on four groups of female basketball players, varying in status and condition, on their PSS and TSS performance scores over time.

To test whether there was a difference in the consistency of performance between the MIT and control groups across status levels for the PSS test, F-Max tests were conducted on shooting variances and were examined by independent t-tests. Using the independent t-tests, it could be determined whether there was a significant difference in the variability of shooting performance between the four groups over the practice period.

Data were also analyzed using an intercorrelation (Pearson's product moment) of each imagery subjects' average performance score on the PSS and TSS tests, and the total scores from the QMI, VIC, and MIQ. The correlation matrix was evaluated using the Bonferroni procedure with an experiment-wise error rate of ($p < .05$). Using this analysis, it could be determined if high imagery ability facilitated performance to a greater extent than poor imagery ability, and if one aspect of imagery (control, vividness, or movement-specific) was more influential in augmenting performance in basketball shooting. The required level of significance was set a priori at ($p < .05$) for both the MANOVA procedure and the correlation analysis.

Finally, to examine whether a relationship among the three questionnaires of imagery ability existed, intercorrelations (Pearson's product moment) of all subjects' total scores from the QMI, VIC, and MIQ were performed. This matrix was also run using the stepwise Bonferroni procedure with an experiment-wise error rate of ($p < .05$).

A major limitation to the study was the small sample size ($N = 36$) given the number of variables and therefore, the results should be interpreted with caution.

CHAPTER IV

RESULTS

This chapter presents the results of the data analyses for each of the hypotheses stated in Chapter I.

Results

A 2 (status) x 2 (condition) x 3 (time) doubly multivariate repeated measures MANOVA was carried out using the TSS and PSS performance scores taken over five testing periods. The TSS and PSS tests were used as dependent variables, to measure shooting performances over time.

The means and standard deviations of shooting performances on the PSS test during the practice phase for all four groups are listed in Table 1. The mean PSS and TSS performance scores for the 36 female basketball players are listed in Tables 2 and 3 (see Appendix O). Means and standard deviations were obtained for all groups on the dependent variables as measured by the PSS and TSS tests. The mean performance scores over time for all groups on the two shooting skills are illustrated in Figures 3 and 4. Homogeneity of variance among the groups was determined using Box's M test ($p = .819$).

Results of the MANOVA on the PSS tests (see Table 4) revealed a number of between-subjects effects. An overall condition effect was found between the PSS1 (T2), PSS2 (T3) and the RPSS (T5) tests, $F(1,32) = 4.7$, $p < .05$. An

Table 1

Mean and Standard Deviations of Shooting Performances on the PSS Test During the Practice Phase Over Time for all Treatment Groups

Practice Session	Group[a] Elite Imagery		Group[a] Elite Control		Group[a] Non-elite Imagery		Group[a] Non-elite Control	
P1	21.3	(3.4)	16.3	(5.3)	12.0	(5.0)	10.8	(3.6)
P2	22.6	(3.1)	20.1	(2.3)	11.8	(5.6)	11.4	(4.2)
P3	21.3	(3.6)	19.5	(3.0)	12.5	(6.0)	13.6	(3.7)
P4	22.1	(3.6)	19.6	(4.8)	12.3	(5.3)	12.2	(4.5)
P5	23.6	(3.5)	19.4	(3.7)	15.1	(3.9)	12.8	(2.9)
P6	22.3	(3.4)	19.2	(4.7)	14.5	(5.3)	15.4	(4.1)
P7	20.6	(4.2)	18.2	(5.1)	14.6	(3.5)	12.5	(3.9)
P8	23.7	(2.9)	19.5	(3.3)	14.7	(4.7)	14.0	(4.0)
P9	22.8	(3.6)	18.8	(3.7)	14.6	(4.8)	12.7	(3.9)
P10	21.7	(3.7)	21.1	(2.8)	15.4	(4.3)	14.6	(2.7)
P11	22.1	(4.0)	23.1	(3.1)	15.2	(5.1)	14.4	(4.4)
P12	21.4	(3.5)	19.1	(3.3)	15.1	(4.8)	12.1	(3.8)

[a] *n* = 9 for each

Table 4

Doubly Repeated Measures MANOVA on the Mean PSS Performance Scores Over Time for all Subjects (N = 36), Summary Statistics

		MANOVA Values		
Effects		F	DF	p
Condition	(C)	4.70	1,32	.038
Status	(S)	47.69	1,32	.000
Time	(T)	4.05	1,32	.027
S · T		3.23	2,64	.046

overall status effect, $F(1,32) = 47.69$, $p < .000$, was also found between the elite and non-elite groups. This result was expected due to the different levels of basketball expertise between the groups. A significant time main effect was also observed, $F(2,31) = 4.05$, $p < .05$.

Observation of the PSS mean scores over time, revealed a slight difference in the PSS scores between the EI and EC groups. PSS means indicated that the EI group performed slightly better over time, than the EC group. The EI group performed consistently on the PSS test over the practice period, as demonstrated by their mean shooting performance score of 22.2 pts at T2 to 22.0 pts at T3. Closer analysis of the means revealed that the EI group were able to maintain their shooting performance between T3 ($\bar{x}$ = 22.0 pts) to T5 ($\bar{x}$ = 22.0 pts). The EC group slightly increased their mean performance level over the 12 day practice phase with a mean score of 19.0 pts at T2 to 20.0 pts at T3. The EC group did not retain their PSS performance scores over the retention period showing a decrease in mean shooting performance from 20.0 pts at T3 to 18.4 pts at T5, however this decrement was not statistically significant.

The NEI group slightly improved their mean shooting performance scores on the PSS test from a mean of 13.0 pts at T2 to 14.9 pts at T3. They were also able to maintain their shooting performance levels over the retention period, with a score of 15.5 pts at T5.

The NEC group improved on the PSS test from T2 ($\bar{x}$ = 12.7 pts) to T3 ($\bar{x}$ = 13.4 pts). They were also able to maintain their shooting performance on the PSS test over the retention period from a mean of 13.4 pts at T3 to 13.5 pts at T5.

Investigating the within-subjects effects for shooting on the PSS test, a status by time interactive effect was observed, $\underline{F}(2,64) = 9.0$, $\underline{p} < .000$, indicating that elite and non-elite groups performed differently over time, regardless of condition. No other main or interactive effects were observed indicating that regardless of condition all groups improved from daily shooting practice.

Following the significant multivariate results, post hoc Scheffe analyses of the condition, status and time main effects for shooting performances on the PSS tests were performed. At T2 and T3, no significant differences were found between the MIT and control groups for either status level. Thus, for the elite and non-elite groups the two practice conditions (imagery and no imagery) produced equivalent performance increments. The NEI group differed significantly from the EC group at T2 and T3 as would be expected, due to their differing level of ability. However, at T5 this significant difference between the two groups was no longer apparent.

For the second dependent variable, measured by the TSS test, four between-subjects effects (condition, status, time, and a status by time interaction) were revealed (see

Table 5

Doubly Repeated Measures MANOVA on the Mean TSS Performance Scores Over Time for all Subjects (N = 36), Summary Statistics

		MANOVA Values		
Effects		*F*	*DF*	*p*
Condition	(C)	6.24	1,32	.018
Status	(S)	31.13	1,32	.000
Time	(T)	3.70	2,31	.035
S · T		6.86	2,31	.003

Table 5). Homogeneity of variance was again satisfactory, as measured by Box's M test ($p = .557$).

Significance was found for an overall condition effect, $F(1,32) = 6.24$, $p < .05$, an overall status effect, $F(1,32) = 31.13$, $p < .000$, and an overall time effect $F(2,32) = 3.70$, $p < .05$ on the TSS shooting performance scores. Post hoc Scheffe analyses for shooting performances at T1, T4, and T5, revealed no significant differences between the imagery or control groups for either status level (elite and non-elite). However, the post hoc Scheffe analysis for the TSS1 score indicated that the MIT and control groups for both status levels did not differ significantly. This result demonstrated that the EI and EC groups were statistically equal in performance before the introduction of MIT as were the NEI and NEC groups.

Investigating the within-subjects effects for shooting performances on the TSS test a time main effect was found, $F(2,64) = 4.38$, $p < .05$. A status by time interaction also occurred on the TSS tests, $F(2,64) = 7.63$, $p < .001$. An examination of the means revealed that the non-elites improved more over time, than the elites. Post hoc Scheffe analyses revealed that there were no significant differences between scores on the TSS test at T1, T4 or T5. This indicates that statistically no significant differences were found between the pretest, posttest and retention tests for shooting performances on the TSS tests.

A repeated measures MANOVA analyzing the differences between T2, T3 and T5 on the PSS test revealed no significant main or interactive effects, although a condition by status interaction was approaching significance, $\underline{F}(1,32) = 4.01$, $\underline{p} = .54$, between the PSS1 and PSS2 difference scores. A significant status effect $\underline{F}(1,32) = 4.81$, $\underline{p} < .05$, was observed for the difference scores between groups on PSS1 (T2) and RPSS (T5). Examination of the difference scores between groups (Table 9) indicate that the EC group dropped in shooting performance, whereas both the NEI and NEC groups increased their mean shooting performance scores over time.

An examination of the mean difference scores to measure improvement between T1, T4 and T5, on the TSS test (see Table 10) revealed a significant status effect, $\underline{F}(1,32) = 12.84$, $\underline{p} < .001$, between T1 and T4. Evaluation of the mean differences between T1 and T4 revealed that the NEI and the NEC groups improved more than the EI or EC groups. This is illustrated by observing the mean differences for both status levels (see Table 10). The EI group remained relatively stable in performance from T1 with a mean shooting performance score of 27.6 pts to a mean of 27.1 pts at T4. The EC group suffered a decrement in mean shooting performance from 22.8 pts at T1 to 19.2 pts at T4. The NEI and NEC groups increased their performances between T1 and T4, as demonstrated by their mean scores of 13 pts to 16.5 pts and 11 pts to 13.3 pts respectively.

A significant status effect was also identified between

Table 9

Difference in Mean Scores on the PSS Test Over Time for all Groups

	Mean Differences Between Time		
Group	T2 & T3	T3 & T5	T2 & T5
Elite Imagery	-0.15	0.09	-0.24
Elite Control	0.94	-1.50	-0.61
Non-elite Imagery	1.90	0.57	2.50
Non-elite Control	0.66	0.13	0.79
Mean	0.84	-0.23	0.60

Table 10

Difference in Mean Scores on the TSS Test Over Time for all Groups

	Difference Between Time		
Group	T1 & T4	T4 & T5	T1 & T5
Elite Imagery	-0.56	1.00	0.40
Elite Control	-3.50	2.30	-1.20
Non-elite Imagery	3.50	1.00	4.50
Non-elite Control	2.30	2.10	4.40
Mean	0.44	1.60	2.00

T1 and T5 on the TSS test, $F(1,32) = 9.27$, $p < .005$. By examining the difference in mean scores, the NEI and NEC groups improved more than the EI and EC groups, between T1 and T3.

Examination of the post hoc Scheffe analyses at T1 for shooting performances on the TSS test, revealed that there was a significant difference between the EC and the NEI and NEC groups $F(3,32) = 10.3$, $p < .01$, as would be expected due to their different status levels. However, at T4 and T5, there were no significant differences between the three groups. Observation of group means show that both the NEI and NEC groups improved in shooting performance on the TSS test over time, however this improvement was not significant. Overall, no significant differences emerged for any of the groups over time. Examination of group mean scores demonstrated changes in performance over time but these changes were not statistically significant. The NEI group improved their performance from a mean score of 13 pts at T1 to 17.5 pts at T5. The NEC group also improved from a mean score of 11 pts at T1 to 15.4 pts at T5. The EC group on the other hand, suffered a decrease in performance on the TSS test from a mean score of 22.7 pts at T1 to 19.2 pts at T4. However, after the retention period their performance increased to a mean score of 21.5 pts at T5.

As a measure of shooting consistency, F-max tests were performed on the shooting variances of each group over the

Table 11

Variance Scores for all Groups on the PSS Test Over the Practice Phase

Practice Session	Elite Imagery	Elite Control	Non-elite Imagery	Non-elite Control
P1	11.2	28.0	25.0	13.0
P2	9.5	5.3	31.3	17.6
P3	19.9	9.0	36.0	13.7
P4	12.9	23.0	28.0	20.2
P5	12.2	13.7	15.2	8.4
P6	11.2	12.0	28.0	16.8
P7	17.6	26.0	12.2	15.2
P8	8.4	10.9	22.0	16.0
P9	12.9	13.7	23.0	15.2
P10	13.7	7.8	18.5	7.3
P11	16.0	9.6	26.0	19.4
P12	12.2	10.9	23.0	14.4

12 practice sessions (see Table 11). Independent t-tests on the mean variances for each group revealed that no signifi cant differences were found between the EI and EC groups over the 12 practice sesisons. A significant difference did emerge between the NEI and the NEC groups. Variances showed that the NEI group shot more consistently over the practice period than the NEC group ($p < .05$).

Mean imagery questionnaire scores and standard deviations for the four groups are listed in Table 8 (see Appendix P). Table 6 contains the intercorrelations of mean performance scores on the two shooting skills and total test scores from the imagery questionnaires, for the MIT groups only ($n = 18$). Correlational analyses using the Bonferroni stepwise procedure between the shooting performance scores and the scores on the imagery ability tests, demonstrated no significant relationships at the $p < .05$ level.

Table 7 contains the intercorrelations between the total posttest scores from the imagery questionnaires for all subjects. The multistage Bonferroni correlation matrix test performed on the intercorrelations between total posttest scores and the imagery ability questionnaires for all subjects ($N = 36$), revealed that all relationships except one were significant ($p < .05$).

Table 6

Intercorrelations Between Mean Performance Scores on the Two Shooting Skills and the Total Test Scores on the Imagery Ability Questionnaires, for Elite and Non-elite Imagery Subjects (*n* = 18)

		2	3	4	5	6
1	TSS average performance score	.906*	.207	-.237	-.164	.005
2	PSS average performance score		.143	-.348	.024	.473
3	QMI			-.541*	.637*	.586*
4	VIC				-.502*	-.308
5	MIQ-V					.442
6	MIQ-K					

* $p < .05$

Table 7

Intercorrelations Between Total Posttest Scores on the Imagery Ability Questionnaires for All Subjects (N = 36)

		2	3	4
1	QMI	$-.575^{*}$	$.461^{*}$	$.456^{*}$
2	VIC		$-.420^{*}$	$-.296$
3	MIQ-V			$.659^{*}$
4	MIQ-K			

* $p < .05$

CHAPTER V

DISCUSSION AND CONCLUSIONS

In this chapter, the results are discussed according to the hypotheses being tested as outlined in Chapter I. Discussions which relate to a number of the hypotheses are presented at the conclusion of this chapter.

Relationships to other studies and implications for imagery in sport, as well as recommendations for future research are included.

The following hypotheses (1.1, 1.2, 1.3, and 2) relate to all subjects in the MIT and control groups.

Hypothesis 1.1 Basketball players instructed in the use of MIT will show a greater increase in shooting performance at the end of 12 practice sessions, as compared to basketball players not instructed in MIT.

The mean shooting performance scores over time for all subjects ($\underline{N}$ = 36) collapsed over status levels on the PSS test are graphically illustrated in Figure 1.

In examining data from the repeated measures MANOVA conducted on MIT and control subjects over the 12 practice sessions, no significant condition effect emerged for the PSS test. The hypothesis that the MIT group would show a greater increase in shooting performance compared to a matched control group, therefore, was not supported as MIT did not appear to facilitate shooting performance during the

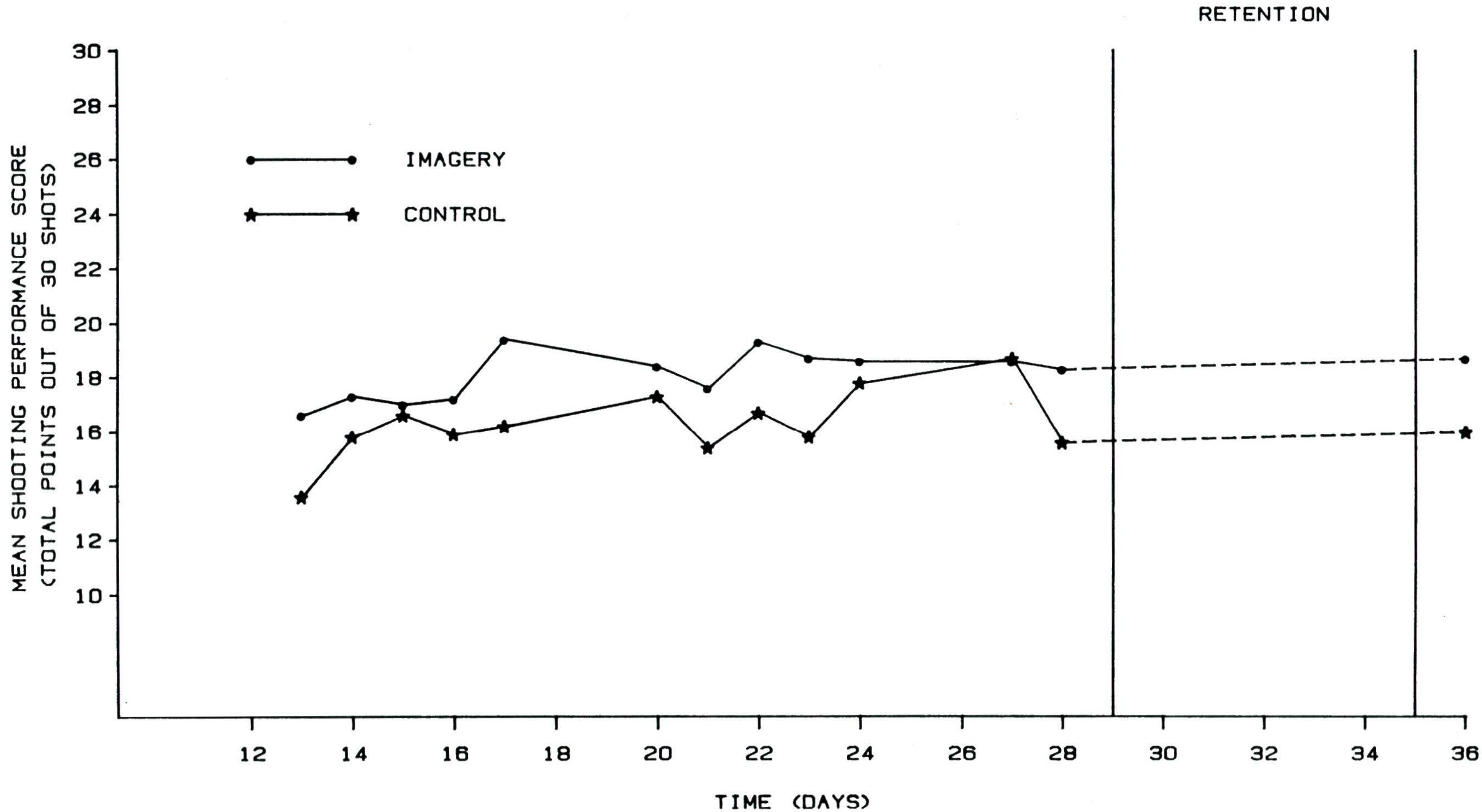


FIGURE 1. MEAN PERFORMANCE SHOOTING ON THE PSS TEST OVER TIME FOR MIT AND CONTROL GROUPS

practice period. Although no significant main effect emerged, the direction in performance curves indicating some improvement on the repeated measures factor occurred, and therefore, an inspection of the group means is of value.

Both the imagery and control groups showed similar performance trends over time. The availability and use of skill specific imagery prior to skill execution did not produce significantly different results between the two groups. However, group means suggest that the MIT group were slightly more successful in their shooting performances, even though the increments in performance were not significantly greater than the control group.

Hypothesis 1.2 Basketball players instructed in the use of MIT will maintain their PSS performance levels seven days after practice is completed, compared to basketball players not instructed in the use of MIT who will show a decrement in PSS performance over the retention period.

PSS performance scores between T3 and T5 for MIT subjects revealed a slight positive increment in performance, demonstrating a maintenance in shooting performance over the seven day retention period. The same direction in the data existed for the control group, although performance shooting scores were slightly lower over time than the MIT group. No significant difference between the MIT and the control groups emerged over the seven day retention period in the PSS test.

Control subjects did maintain shooting performance levels over the seven day retention period. Therefore, the hypothesis that the control groups' shooting performance would deteriorate compared to the MIT group after the seven day retention period was not supported. Perhaps the retention period should have been prolonged, as it may be that seven days may not have been an adequate length of time to allow for group differences to emerge. Further research is required before conclusions can be made regarding this question.

Hypothesis 1.3 Transfer of training from the PSS to the TSS task, and the retention of that transfer (RTSS) will be greater for subjects instructed in the use of MIT, as compared to the control group.

After the completion of the 12 practice sessions of the PSS skill, both the MIT and the control subjects were tested under a time pressured situation using the TSS test, where subjects were asked to score as many points as possible in 60 secs. The transfer of shooting performance from one condition to another condition was anticipated to produce a measure of the facilitation effect of MIT on learning.

On the TSS test (see Figure 2), the MIT group improved from T1 ($\bar{x}$ = 20.3 pts) to T4 ($\bar{x}$ = 21.8 pts). However, the control group suffered a slight decrement in their mean shooting performance. Although slight, this result suggests that MIT may have some effect in aiding the transfer of the

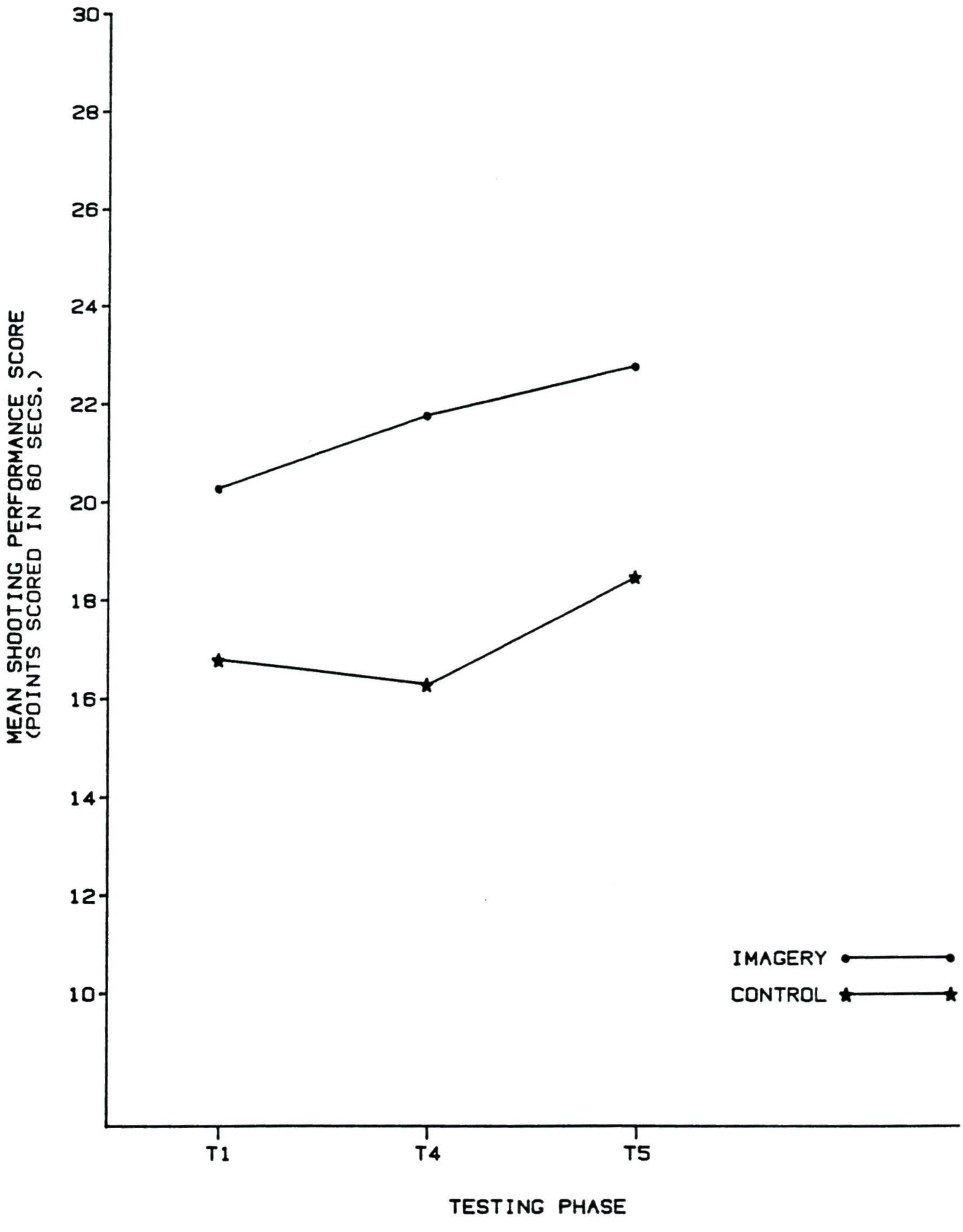


FIGURE 2. MEAN PERFORMANCE SHOOTING SCORES OVER TIME ON THE TSS TEST OVER TIME FOR IMAGERY AND CONTROL GROUPS

PSS skill into a time pressured condition, whilst maintaining shooting performance levels. However no support for the superiority between the MIT and control groups emerged in this study.

The MIT subjects did maintain their time pressured shooting performance levels from a mean shooting score of 21.8 pts at T4 to 22.8 pts at T5 for the TSS test. However a significant increase did not eventuate. Similarly, the control subjects were able to maintain their shooting performance in the TSS test from T4 ($\bar{x}$ = 16.3 pts) to T5 ($\bar{x}$ = 18.5 pts). It appears that some transfer may have occurred from the PSS skill training over the 12 practice sessions, however, no statistical significance was found between the groups.

Hypothesis 2 Basketball players instructed in the use of MIT will show greater consistency over the 12 practice sessions than will players not instructed in the use of MIT.

Over the 12 practice sessions, variance scores for all MIT and control subjects were calculated from their shooting performance scores. Due to the large amount of variability in shooting performance between the status levels, it was not appropriate to pool the variances to investigate whether a significant difference emerged between conditions (imagery versus control).

In general, a considerable amount of variability in performance was exhibited between the groups over the 12 practice sessions. Further discussion of shooting consistency will be addressed for both status levels in specific hypotheses which follow.

The following hypotheses (3.1, 3.2, 3.3, and 4) address comparisons between the MIT and control groups for elite female basketball players.

Hypothesis 3.1 Elite basketball players instructed in the use of MIT will show a greater increase in shooting performance at the end of 12 practice sessions, as compared to elite basketball players not instructed in the use of MIT.

No significant condition effect was found between the EI and the EC groups on the PSS scores over the 12 practice sessions. Even though there was a difference in the PSS performance scores between the EI and EC groups at practice session one, this difference was not statistically significant. Furthermore, post hoc Scheffe analyses confirmed that the EI and EC groups did not differ in the PSS1 (T2) or PSS2 (T4). However, examination of group means indicate that over the practice period the EI group performed at a higher performance level on every day except one, although these differences were not significant.

As elite basketball players are already highly proficient at shooting, ceiling levels were expected over the 12 day practice period. During this time the mean shooting performance scores for the EI group increased, providing some support that MIT may enhance performance when skill specific imagery is used prior to shooting. It would appear however, that 12 days practice combined with the utilization of immediate skill specific imagery may not be an adequate length of time to gauge imagery's contribution as a performance variable.

Another explanation for the findings is that there appears to be difficulty in training elite athletes in new mental preparation strategies (Eby, 1986). Elite athletes tend to be very meticulous in their preparation and mental routine prior to performance. Epstein (1980) contends that some individual's performances may be negatively effected by imposed routines instead of aided by MIT, and this may result in greater variability.

Anecdotal evidence (see Appendix Q) suggested that some elite performers found immediate imagery prior to shooting interfered with their own concentration procedures. This is supported by Cratty (1984) and Nideffer (1976) who found that some elite athletes responded negatively to the use of imagery in sport. As mentioned previously, MIT may need to be conducted over a longer period of time to become compatible with a player's mental approach and for the subjects to accept the use of mental imagery.

Hypothesis 3.2 Elite basketball players instructed in the use of MIT will maintain their PSS performance levels seven days after training is completed, compared to the elite control group who will show a decrement in PSS performance over the retention period.

No significant difference in scores emerged between the two elite groups. When comparing the mean PSS2 score with the RPSS score, it is shown that the EI group were able to maintain their PSS shooting performance level over the seven day retention period. The EC group however, were unable to maintain their PSS shooting performance levels over the retention period. The performance of the EC group dropped from T3 ($\bar{x}$ = 20.5 pts) to T5 ($\bar{x}$ = 18.4 pts). This result may indicate the potential of MIT as a learning variable.

Hypothesis 3.3 Transfer of training from the PSS to the TSS task, and the retention of that transfer (RTSS) will be greater for elite basketball players instructed in the use of MIT, as compared to the elite control group.

Figure 4 illustrates the changes over time for the EI and EC groups for the TSS test. As the EC group's performance was equal to the performance and maintenance of the EI group's performance over the six day retention period, Hypothesis 3.3 is rejected.

An examination of the mean scores from T1 to T4 revealed that the EI group maintained their shooting performance in the TSS test, whereas the EC group suffered a decrement in performance, dropping from a mean score of 22.8 pts at T1 to

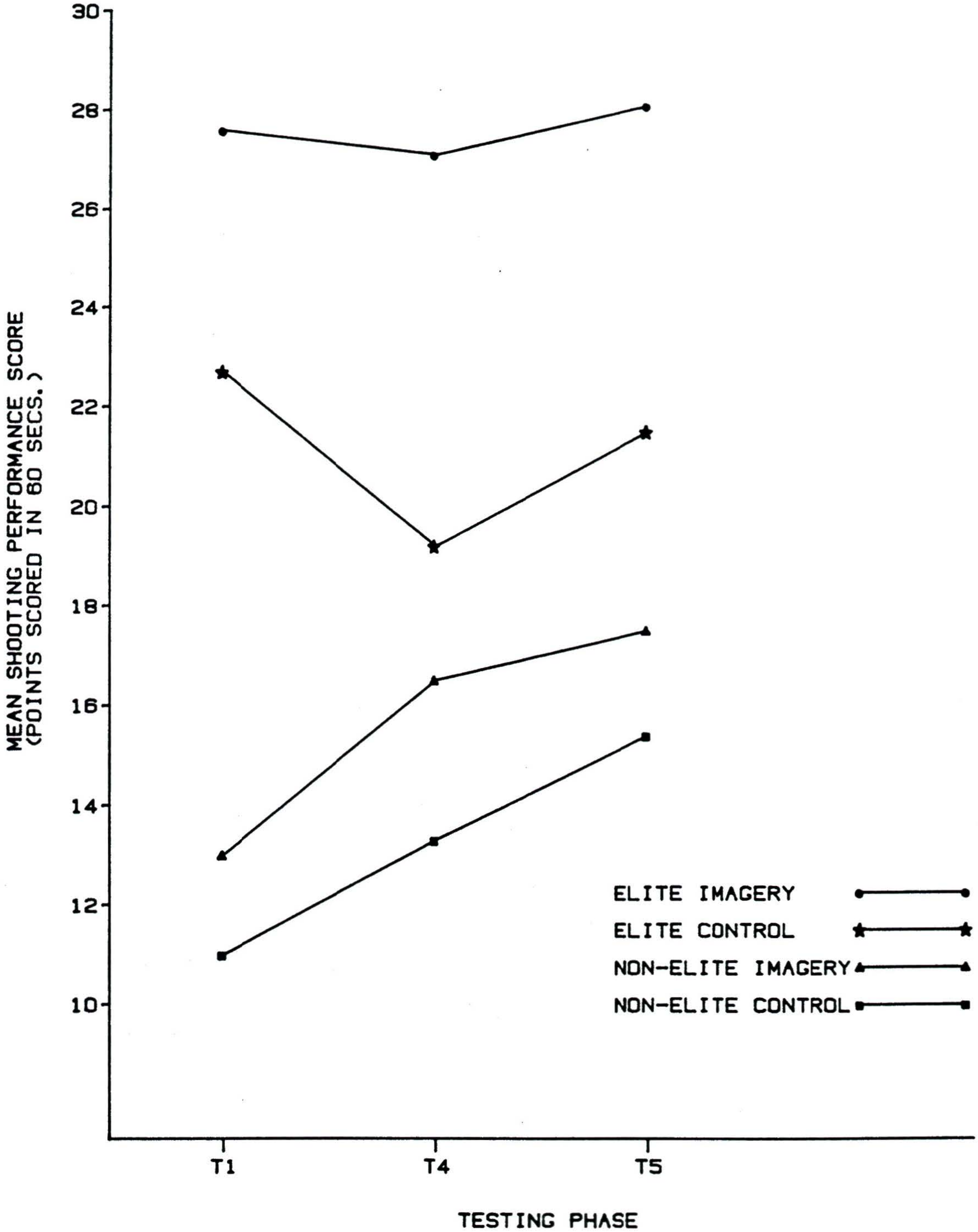


FIGURE 4. MEAN PERFORMANCE SCORES OVER TIME ON THE TSS TEST (IMAGERY VERSUS CONTROL FOR ELITE AND NON-ELITE SUBJECTS).

19.2 pts at T4. As an increase in shooting performance did not eventuate from the pretest to the posttest, it appears that TSS performance was not facilitated by transfer from the PSS condition.

The EI group improved their TSS scores from the practice period, indicating some transfer from the PSS to the TSS condition. The EI group's TSS mean performance scores were maintained over the retention period (T4 $\bar{x}$ = 27.1 pts; T5 $\bar{x}$ = 28.1 pts).

After the six day retention period, the EC subjects increased their mean shooting performance scores on the TSS test from 19.2 pts at T4 to 21.5 pts at T5. No significant differences in shooting performance for the EC group on the TSS2 and RTSS tests emerged between T4 and T5. This result may have occurred due to the short retention period, whereby significant forgetting or decrement in performance may not have occurred within the six day period.

Although no conclusive statement can be made regarding MIT's contribution to the performance of elite female basketball players, it appears that MIT may have aided in the transfer of the practiced skill to a time pressured condition. The EI group instructed in the use of MIT, were able to maintain their shooting performances when transferred to another condition.

Heil (1984), states that given the relatively brief nature of most mental training interventions, it is apparent that adequate care is typically not taken in generalizing skills from the context of autonomic and motoric 'quiet' in which they are ideally introduced, to the high demand context of competition.

This statement may be very applicable to the transfer of the PSS to the TSS in a pressured situation. In this research design, MIT was introduced and practiced in a relaxed, non-pressured condition, and its effects were tested in a high demand context of shooting in 60 secs in order to simulate transfer to a game situation. Further research is needed to analyze the effect of context on MIT, and the subsequent benefits of MIT on skill performance.

As no significant differences were found between the MIT and control groups at the elite level however, this study reports that MIT in general did not enhance the transfer of learning from the PSS to the TSS condition.

Hypothesis 4 Elite basketball players instructed in the use of MIT will perform more consistently over twelve practice sessions, than will the elite control group.

Results of F-Max tests, using the shooting variances of each group as an indication of shooting consistency and independent t-tests, showed that there were no significant differences in the consistency of set shooting in basketball between the EI and the EC groups over the twelve practice sessions. This result would suggest that MIT did not aid in stabilizing performances for the MIT subjects from day to day, compared to the EC group.

The following hypotheses (5.1, 5.2, 5.3 and 6), refer to effect of MIT on non-elite basketball players.

Hypothesis 5.1 Non-elite basketball players instructed in the use of MIT will show a greater increase in shooting performance at the end of 12 practice sessions, as compared to non-elite basketball players not instructed in MIT.

When comparing the NEI and NEC groups on the PSS skill over the 12 practice sessions, no significant differences were identified. Figure 3 demonstrates a similar performance curve on the PSS test for both groups, however the MIT group did perform at a slightly higher shooting average than did the control group.

There were no significant differences between the NEI and the NEC groups at T2 or T3 as established by post hoc Scheffe analyses. Examination of group performance means on the PSS skill over the 12 sessions suggest that performance increases were probably due to the daily physical practice of 30 set shots. Therefore, Hypothesis 5.1 is rejected as no evidence is provided for the effect of MIT as a mediator of shooting performance for non-elite basketball players.

Hypothesis 5.2 Non-elite basketball players instructed in the use of MIT will maintain their PSS performance levels seven days after practice is completed compared to non-elite basketball players not instructed in the use of MIT, who

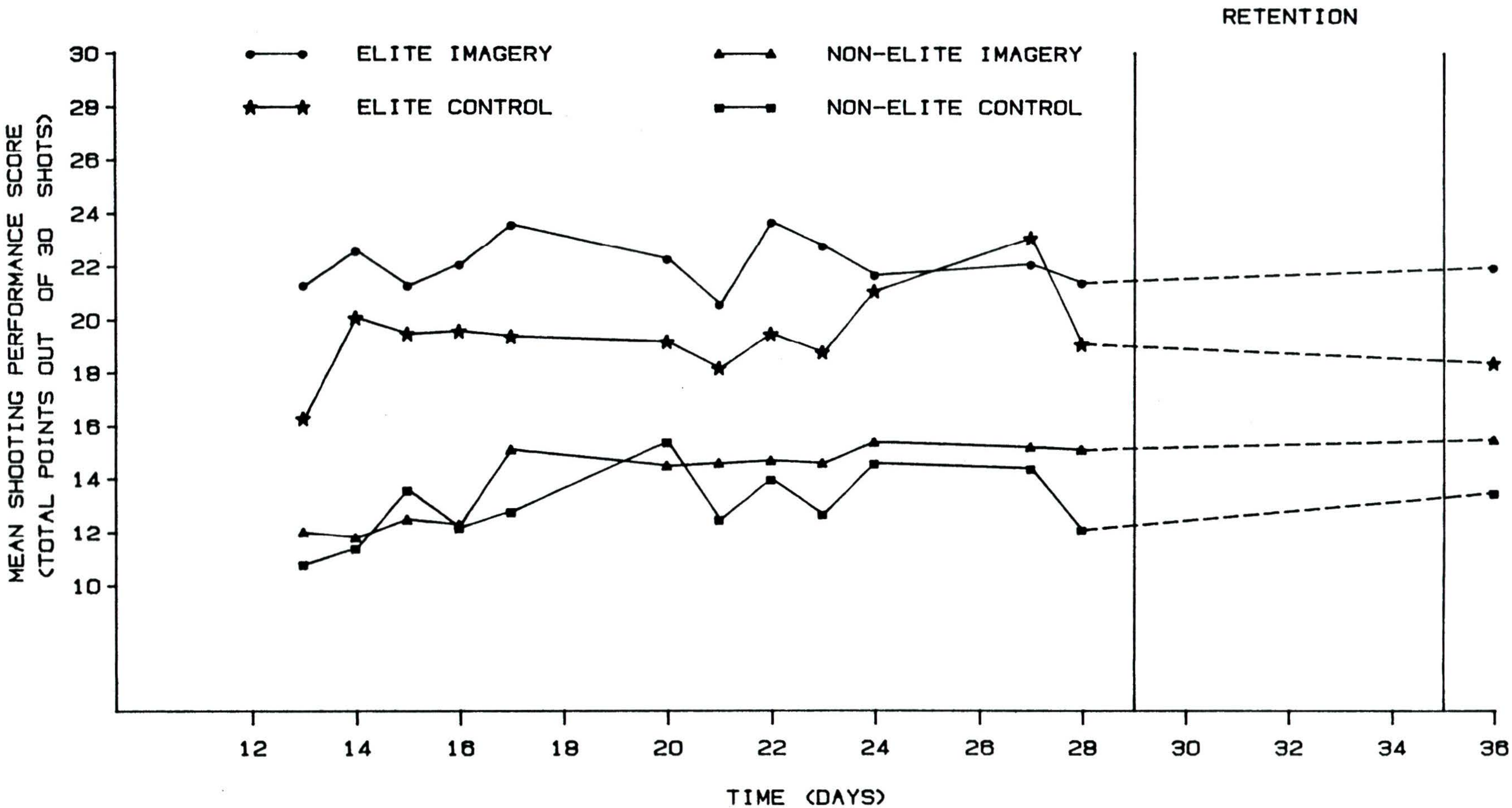


FIGURE 3. MEAN PERFORMANCE SCORES OVER TIME ON THE PSS TEST (IMAGERY VERSUS CONTROL FOR ELITE AND NON-ELITE SUBJECTS).

will show a decrement in PSS performance over the retention period.

Post hoc Scheffe analyses revealed no significant difference in shooting performances between PSS2 and RPSS for the NEI and NEC groups over the retention period. Figure 3 illustrates the direction in the data over the seven day retention period and suggests that the NEI group were able to maintain their shooting performances from T3 to T5. Similarly the NEC group's PSS performance scores were also maintained over the six day retention period.

It appears therefore, that MIT did not affect the maintenance of shooting performance over the seven day retention period for the NEI group, in comparison to a matched control group of the same status level.

There is no evidence from the retention test to support MIT as a learning variable, as no significant differences emerged between the two groups over the retention period. Therefore Hypothesis 5.2 is rejected.

Hypothesis 5.3 Transfer of training from the PSS to the TSS task, and the retention of that transfer (RTSS) will be greater for non-elite basketball players instructed in the use of MIT, as compared to the non-elite control group.

Both the NEI group and the NEC group were able to adequately transfer their shooting capabilities of daily shooting practice to the time pressured TSS test conducted in 60 seconds at T4 and T5. As both groups improved their mean shooting performances over time, it would appear that daily physical practice provided the necessary shooting skill and competence required when placed in a time pressured situation to maintain shooting performance.

The increase in the TSS skill was not only retained over the seven day period by the NEI group, but shooting performance increased slightly from T3 ($\bar{x}$ = 16.5 pts) to T5 ($\bar{x}$ = 17.5 pts), although no significant differences emerged between the two groups. The NEC group showed a similar shooting pattern over the retention period, increasing from a mean performance score of 13.5 pts at T4 to 15.4 pts at T5. This result would support the contention that some relatively permanent change may have occurred over time, which could be interpreted as learning. This increase is more likely due to the daily physical practice of 30 set shots during the 12 day practice period.

As there were no significant differences between the two groups on the TSS1, TSS2 or RTSS tests, Hypothesis 5.3 is rejected.

Hypothesis 6 Non-elite basketball players instructed in the use of MIT will show greater consistency over the 12 practice sessions than will non-elite players not instructed in MIT.

From the performance curves in Figure 3, it appears that the NEI group shot more consistently than the NEC group over the 12 practice sessions. The results of the F-Max tests and independent t-tests over the 12 practice days comparing the NEI and NEC groups, revealed that there was a significant difference in their shooting variance scores over time. The NEC group showed more variability in shooting performance on the PSS skill over the 12 practice sessions than the NEI group.

Therefore, this result provides some support for the premise that MIT may contribute to the consistency in shooting performance for non-elite basketball players (Eby, 1986). It is apparent that in early skill development, performance can vary considerably. The use of MIT for non-elite players may help augment the cognitive processing, thereby enhancing performance.

Hypotheses 7.1 and 7.2 examine the effect of imagery ability.

Hypothesis 7.1 Basketball players in the MIT groups with high imagery ability will show greater improvement in shooting performance than players with low imagery ability instructed in the use of MIT.

Table 6 contains the intercorrelations of mean performance shooting scores on the shooting skills and total test scores from the imagery questionnaires for the MIT group only (n = 18). For all analyses involving the questionnaire scores of the MIT groups, the pretest (prior to MIT) scores were used.

It can be observed from the correlation matrix (Table 6), that there were no significant correlations between shooting performance scores and imagery ability scores. Therefore, it would appear that individual differences in imagery ability did not affect shooting performance in either the PSS or TSS tests.

Hall & Buckolz (1983) and Ryan & Simons (1982) have found significant relationships between imagery ability and physical performance. Goss et al. (1985) and Numford & Hall (1985) also found positive relationships between imagery ability and motor skill learning. These findings may have been due to the fact that the sample was drawn from a heterogeneous population.

In congruence with Eby's (1986) findings, this study reports that imagery ability had little influence on shooting performance. Most subjects in this study were classified as having high imagery ability as measured by the QMI, VIC and MIQ. This result may be due to the fact that the participants in the present study were a relatively homogeneous and movement oriented group and, therefore, differences in performance as a result of imagery ability were not evident.

A positive relationship between imagery ability and shooting performance may not have emerged in this study because the assessment of imagery ability may not be sensitive enough to detect individual differences. A 12 day practice period, as evidenced in this research paradigm may be too short in duration to develop competency in effectively integrating MIT with physical practice. However, no conclusions can be drawn as there were no comparative groups to determine a realistic measurement as to the effectiveness of the MIT program. The research paradigm may not have allowed the positive aspects of MIT to be manifest at the conclusion of the experiment.

Hypothesis 7.2 Movement specific imagery ability measured by the MIQ will not be related to general imagery ability measured by the QMI and VIC.

Relevant mean scores and standard deviations on the imagery questionnaires for the EI, EC, NEI and NEC groups are presented in Appendix N. Table 7 contains the intercorrelations between the total test scores from the imagery questionnaires for all subjects. The correlation matrix revealed that all correlations, except the correlation between the VIC and the MIQ-K were significant ($p < .05$).

Hall et al. (1985), proposes that imagery ability of movements is independent of general imagery ability. It has been reported that the MIQ is characterized by a stable internal structure and very respectable reliabilities. In support of Eby's (1986) findings however, the results of this study indicate that different aspects of imagery are related. Subjects appeared to score similarly on all three imagery questionnaires. High scores on one of the movement-specific, vividness, or controllability components rendered high scores on the other two aspects. This supports White & Ashton's (1976) findings that the QMI and VIC are significantly correlated with each other.

Rather than identifying specific components of imagery ability it may be more appropriate to measure an individual's ability to elicit images (Eby, 1986). Greater understanding of the formation of movement related images may enhance the mediation of physical performance via MIT. Heil (1984) suggests that without the precise measurement of the various dimensions of imagery ability in the context of empirical investigation, the critical parameters of mental training interventions can only remain subject to speculation.

General Discussion and Conclusions

The results of this study concur with Eby's (1986) findings, and fail to confirm the assertion by Oxendine (1969) and White et al. (1979) that a combination of mental and physical practice is more effective than physical practice alone.

A number of factors may have contributed to the lack of significant findings regarding the use of MIT as a performance mediator. The design of the study was set up to test the effects of MIT on shooting performance. It was anticipated that a significant difference would occur between the groups over the practice and retention phase.

The researcher hypothesizes that perhaps the 12 MIT practice sessions were not of an adequate number to allow for changes due to MIT to emerge. Possible explanations for the lack of support for MIT in the present study is that a difference between the two groups had not emerged up to this point and a great deal of variability in performance was evidenced over the practice period. For any effect on shooting consistency to have occurred, it may have been necessary to increase the imagery training and application periods in the experimental design. Due to the lack of training with skill specific imagery, the results may not be indicative of MIT's capacity as a consistency factor in performance. Eby's (1986) study on the effect of imagery in field hockey also found that improvement in performance after six sessions were still occurring for all subjects. Total treatment duration may have been too short to allow maximal effects. It may have been more appropriate to conduct a longitudinal study between two teams, one instructed in the use of MIT and the other employed as a control group.

Another explanation for the lack of significant findings may be that subjects had not learned to use MIT effectively. Heil (1984) contends that imagery is an ability (as opposed to a trait) and therefore, modifiable by training. He suggests that imagery should be 'drilled' regularly just as are essential physical skills. The research design employed in this study may not have provided the time necessary to develop the ability to use MIT effectively.

Some individuals may be less receptive to utilizing mental strategies as a performance mediator. Anecdotal evidence reported by Cratty (1984), demonstrated that elite athletes expressed some reluctance toward their exposure to imagery, and many felt that it was not needed or suited to them individually. They also expressed feelings of anxiety towards excessive amounts of time devoted to mental practice, which prevented them from adequately preparing themselves for competition. This may have been an important factor in the present study, as subjects in both status levels complained about the difficulty they had trying to cope with the new technique and still remain successful in their shooting performances. Due to the lack of training with skill specific imagery, some players felt that imagery inhibited their shooting performance. Further research is needed to ascertain whether imagery enhances or obstructs the mediation of performance.

McFadden (1982) recommends that the ideal time to introduce mental preparation strategies to aspiring athletes is around 15 years of age. He suggests that this is the time when athletes tend to be more receptive to new ideas and skills. Miller (1985) states that MIT programmes have produced spectacular results in terms of skill acquisition. He indicates that this has been particularly evident in young athletes, where emphasis is placed on the technique, not the conditioning of a skill. It may therefore, be more appropriate to perform a longitudinal study on younger athletes who are more receptive and adaptive to MIT.

Subject contamination may also have occurred between the MIT and control groups. This may be particularly true for such highly cohesive teams as the University of Victoria women's varsity basketball teams used as subjects in this study. Some EC and NEC players may have felt compelled to employ a mental strategy to improve daily shooting performance, and this may have masked the benefits of the MIT for the treatment subjects.

Unfortunately, this study coincided with the completion of the Canadian National Women's Varsity Basketball Championships, which the University of Victoria senior women's team won. The general motivation level of these players may have dropped considerably prior to participating in this study. The task, although short in duration, still involved time and concentration. As a result, some players may have become uninterested with the MIT task and the shooting skill, thereby reducing the receptivity to effectively use the imagery over the 12 day practice period.

The selected protocol for MIT was devised and based on the nature of the set shot skill. Another method of MIT and instruction period may not have been as appropriate as other methods such as video tapes and energizing to elicit the enhancement of shooting performance within this time frame. Imagery may be regarded as a skill in itself, so a player should be trained in imagery before any change in performance would be expected to occur.

Caution is required when interpreting and generalizing from the results of the current study because of the limitations in the research design. Clearer indications in the data may have emerged if the practice and retention phases of the study were extended as well as the training and application of skill specific imagery. Suinn (1984) suggests that better quality training and greater length of training could make a significant difference in the outcome.

It was the intention of this study to investigate the results of physically practicing a skill in conjunction with skill specific imagery in a situation where time was available for imagery rehearsal. The effect of physical plus imagery practice was assessed on the performance of the same skill in a simulated game situation, in which there would not be any time for the athlete to use imagery immediately prior to the performance of the skill. The logic behind this research strategy was based on the question of whether imagery had to be paired in time with the physical skill after practicing in this mode, in order to realize any benefits of imagery on skill performance. In many instances in the game of basketball the performer is time pressured to produce a skill and cannot take the time to use imagery. Therefore, the use of imagery in practice settings would only be useful for those skills or skill situations in which time is available for imagery immediately prior to the skill execution, as in free-throw or jump ball situations. The use of imagery is restricted to this mode unless it can be shown that imagery has a chronic effect on a skill, and the benefits of imagery in practice will be realized in other situations regardless of whether or not there is time for imagery prior to execution.

There are a number of situations in the game of basketball however, in which there is time for the use of imagery prior to skill execution (one-on-one, dribbling, shooting and blocking). Even in these situations as Heil (1984) points out, there is considerable pressure placed on the performer, and the imagery plus skill execution in the game situation is not the same as the imagery plus skill execution in practice, where skills are generally practiced in a quiet, non-pressured environment. Heil (1984) emphasizes the importance of the context in which imagery training is introduced and practiced. Principles of specificity of practice (Magill, 1984, 1985) would suggest that to attain the maximum benefits of mental imagery on performance, the practice environment should mirror the game environment as closely as possible.

To further ascertain whether MIT is useful in the learning and performance of sports skills, it is necessary to take into account the expertise of the performer, the task demands context, and the nature of the skill. Heil (1984) suggests that mental training interventions would be most effective if systematically integrated into practice and competition, on an ongoing basis in accordance with a carefully designed program.

Paivio's Theoretical Framework

From the results of this study, it appears that skill specific imagery does not benefit the learning, level of performance, or consistency of performance of set shooting in elite basketball players. However, skill specific imagery does appear to benefit the consistency of performance of set shooting in non-elite basketball players, but not the learning or level of performance of that skill.

Because there were neither short term or long term effects of MIT on elite performance, it does not seem that MIT, in this study, fulfills the skill-specific cognitive function as described in Paivio's (1985) model for the performer at the elite level. Some support for this function of imagery in a non-elite population is indicated, in that performance consistency of the non-elite players was effected positively. A possible explanation for this is that since the non-elite basketball players have not automated the skill of set shooting and therefore, the control of this action would likely still lie at a cognitive level, imagery, as a cognitive process, may be operating to strengthen the correct response. Therefore, the best response possible by the performer, at this stage, is produced on a consistent basis. This is a tentative explanation and further research is necessary to elucidate more clearly the effects of MIT on performance. Suinn (1983) and Hall & Buckolz (1983) emphasize the role of imagery in mediating the learning and performance of motor skills, and therefore, the value of imagery as a performance enhancer should not be completely refuted on the basis of this study's results.

The findings of this study do not preclude the role of imagery as a motivating factor in performance as suggested in Paivio's (1985) theoretical framework. Because of the experimental situation, and due to the fact that this study took place directly after the completion of the competitive season of the elite performers and during the final weeks of a university term for all the subjects, the level of commitment to the study by the subjects may have been low. This is in contrast to the commitment to goal attainment typically seen in elite performers during their preparation for competition, and perhaps the level of commitment to succeed by a non-elite performer within the context of a skill development program. It is suggested that investigation of the motivational function of imagery should be examined in context-specific environments as suggested by Heil (1984).

The present study provides direction for future research based on the theoretical applications of imagery and by integrating sport-specific findings into Paivio's (1985) analytic framework, within which to study the constructs of motor performance. Some recommendations for future research are offered.

Recommendations for Future Research

The results of this study are exploratory in nature. Further research is necessary to define the parameters of imagery and the variables which mediate motor performance. Several recommendations are offered.

1. To study the efficacy of imagery on motor performance, more stringent studies are required.
2. Variables which should be controlled when examining the relationship between imagery and sports performance include:
   (a) the characteristics of the sample;
   (b) the type of task;
   (c) imagery ability;
   (d) the length of the imagery training program; and
   (e) the duration of mental and physical practice.
3. To distinguish between learning and performance and to measure these components appropriately, the transfer and retention paradigm used in the present study should be employed.
4. Replication of this study is suggested using a larger sample population including males and females, and in a variety of sports performance skills.
5. It is recommended that the effects of imagery be examined when transferred from a practice environment to a competitive situation.

6. A single-subjects design as advocated by Wollman (1986) or an individualistic approach to a group design should be considered, in that they may allow for the detection of potent effects of MIT on performance in certain individuals, which may otherwise be masked in a non-significant group design.
7. Additional reliability and validity data should be provided for the imagery ability assessment questionnaires.

REFERENCES

Andre, J.C., & Means, J.R. (1986). Rate of imagery in mental practice: An experimental investigation. **Journal of Sport Psychology,** 8, 124-128.

Betts, C.H. (1909). **The distribution and functions of mental imagery.** New York: Columbia University Press.

Bird, A.M., & Cripe, B.K. (1986). **Psychology and Sport Behaviour.** St. Louis: Time Mirror/Mosby.

Bower, G.H., & Hilgard, E.R. (1981). **Theories of Learning.** Englewood Cliffs, NJ: Prentice-Hall Inc.

Chevalier, N. (1985). A symposium on: Imagery rehearsal in motor learning and human performance. **Canadian Journal of Applied Sport Sciences,** 10(4), 1S-3S.

Clark, L.V. (1960). Effect of mental practice on the development of a certain motor skill. **Research Quarterly,** 31(4), 560-569.

*Corbin, C.B. (1972). Mental practice. In W.P. Morgan [Ed.], **Ergonomic Aids and Muscular Performance** (pp. 93-118). New York: Academic Press.

Cratty, B.J. (1984). **Psychological Preparation and Athletic Excellence.** New York: Mouvement Publications Inc.

Denis, M. (1985). Visual imagery and the use of mental practice in the development of motor skills. **Canadian Journal of Applied Sport Sciences,** 10(4), 4S-16S.

Dewitt, D.J. (1980). Cognitive and biofeedback training for stress reduction of university athletes. **Journal of Sports Psychology,** 2, 288-294.

Eby, C.E. (1986). Effects of imagery as a mediator of performance in elite female field hockey players. Master's thesis, University of Victoria.

Epstein, M.L. (1980). The relationship of mental imagery and mental rehearsal to performance of a motor task. **Journal of Sport Psychology,** 2(3), 211-220.

Feltz, D.L., & Landers, D.M. (1983). The effects of mental practice on motor skill learning and performance: A meta-analysis. **Journal of Sport Psychology,** 5(1), 25-57.

Fitts, P.M., & Posner, M.I. (1967). **Human Performance.** Belmont, CA : Brooks/Cole.

Glass, V. (1977). Integrating findings: The meta-analysis of research. **Review of Research in Education,** 5, 351-379.

Gopher, D. (1984). The contribution of vision-based imagery to the acquisition and operation of a transcription skill. In W. Prinz & A.F. Sanders [Eds.], **Cognition and Motor Processes** (pp. 195-208). Berlin: Springer-Verlag.

Gordon, R. (1949). An investigation into some of the factors that favor the formation of stereotyped images. **British Journal of Psychology,** 39, 156-167.

Goss, S., Hall, C., Buckolz, E., & Fishburne, G. (1985). Imagery ability and the acquisition and retention of movements. Manuscript submitted for publication.

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

Hall, C., & Buckolz, E. (1983). Imagery and the recall of movement patterns. **Imagination, Cognition, and Personality,** 2, 251-260.

Hall, C. (1985). Individual differences in the mental practice and imagery of motor skill performance. **Canadian Journal of Applied Sport Sciences,** 10(4), 17-21.

Hall, C., Pongrac, J., & Buckolz, E. (1985). The measurement of imagery ability. **Human Movement Sciences,** 4, 107-118.

Hamilton, S.A., & Fremouw, W.J. (1985). Cognitive-behavioral training for college basketball free-throw performance. **Cognitive Therapy and Research,** 9(4), 479-483.

Harris, D.V., & Robinson, W.J. (1986). The effects of skill level on EMG activity during internal and external imagery. **Journal of Sport Psychology,** 8, 105-111.

Heil, J. (1984). Imagery for sport: Theory, research and practice. In W.F. Straub & J.M. Williams [Eds.], **Cognitive Sport Psychology** (pp. 245-252). New York: Sport Science Associates.

Hopkins, D.R., Schick, J., & Plack, J.J. (1984). **Basketball for boys and girls skills test manual.** American Alliance for Health, Physical Education, Recreation and Dance. Virginia.

Housner, L., & Hoffman, S.J. (1981). Imagery ability in recall of distance and location information. **Journal of Motor Behaviour,** 13, 207-223.

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

Kohl, R.M., Roenker, D.L., & Turner, P.E. (1985). Clarification of competent imagery as a prerequisite for effective skill imagery. **International Journal of Sport Psychology,** 16, 37-45.

Kosslyn, S.M. (1980). Image and mind (pp. 217-257). Cambridge MA: Harvard University Press.

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

Lawther, J.D. (1968). **The Learning of Physical Skills.** Englewood Cliffs, N.J.: Prentice-Hall.

Logan, G.D. (1985). Skill and automaticity: Relations, implications and future directions. **Canadian Journal of Psychology,** 39(2), 367-386.

McBride, E.R., & Rothstein, A.L. (1979). Mental and physical practice and the learning and retention of open and closed skills. **Perceptual and Motor Skills,** 49, 359-365.

McFadden, S. (1982). The relative effectiveness of two types of imagery rehearsal applied as psych-up strategies to improve skilled goal-tending performance. In J.H. Salmela, T.J. Partington, & T. Orlick [Eds.], **New Paths of Sport Learning and Excellence** (pp. 97-101). Ontario: Sport in Perspective Inc.

McGuigan, F.J. (1978). Covert functioning of the motor system. In G.E. Swartz & D. Shapiro [Eds.], **Consciousness and Self-Regulation: Advances in Research and Theory** (Vol. 2). New York: Plenum.

Magill, R.A. (1984). Influences on representing movement information. In W.F. Straub & J.M. Williams [Eds.], **Cognitive Sport Psychology** (pp. 175-188). New York: Sport Science Associates.

Magill, R.A. (1985). **Motor Learning: Concepts and Applications** [2nd Ed.]. Dubuque, IA: Brown.

Mahony, M.J. (1979). Cognitive skills and athletic performance. In P.C. Kendall & S.D. Hollan [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. (1973). Visual imagery differences in the recall of pictures. **British Journal of Psychology,** 64, 17-24.

Martens, R. (1982). Imagery in sport. Unpublished paper presented at the Medical and Scientific Aspects of Elitism in Sport Conference, Brisbane, Australia.

Miller, B. (1985). Motor imagery training and excellence in sport. Paper presented at the Australian Netball Conference, Canberra, Australia.

Minas, S.C. (1980). Acquisition of a motor skill following guided mental and physical practice. **Journal of Human Movement Studies,** 6, 127-141.

Mumford, P.B., & Hall, C. (1985). The effects of internal and external imagery on performing figures in figure skating. **Canadian Journal of Applied Sport Sciences,** 10(4), 171-177.

Myers, A., Schleser, R., & Montogomery Okwumabau, T. (1982). A cognitive behavioural-intervention for improving basketball performance. **Research Quarterly for Exercise and Sports,** 53, 344-347.

Nideffer, R.M. (1976). **The Inner Athlete.** New York: Cromwell.

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

Orlick, T., & Partington, J. (1986). Psyched: Inner views of winning. Coaching Association of Canada: Ontario.

Oxendine, J.B. (1969). Effect of mental and physical practice on the learning of three motor skills. **Research Quarterly,** 40, 755-763.

Paivio, A. (1985). Cognitive and motivational functions in human performance. **Canadian Journal of Applied Sports Science,** 10(4), 22S-28S.

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

Rawlings, E.I., & Rawlings, I.L. (1974). Rotary pursuit tracking following mental rehearsal as a function of voluntary control of visual imagery. **Perceptual and Motor Skills,** 38, 302.

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

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

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

Schmidt, R.A. (1982). **Motor Control and Learning: A Behavioral Emphasis.** Champaign, IL: Human Kinetics.

Shea, J.B. (1977). Effects of labelling on motor short-term memory. **Journal of Experimental Psychology: Human Learning and Memory,** 3, 92-99.

Sheehan, P.W. (1967). A shortened form of Betts' Questionnaire Upon Mental Imagery. **Journal of Clinical Psychology,** 23, 386-389.

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

Suinn, R.M. (1972). Behaviour rehearsal for ski racers. **Behavior Therapy,** 3, 519.

Suinn, R.M. (1983). Imagery and sports. In A.A. Sheikh [Ed.], **Imagery: Current Theory, Research, and Application** (pp. 507-534). New York: Wiley.

Suinn, R.M. (1984). Imagery and sports. In W.F. Straub & J.M. Williams [Eds.], **Cognitive Sport Psychology** (pp. 251-271). New York: Sport Science Associates.

Van Gyn, G.H., & Docherty, D. (1984). Developmental aspects of imagery for movement variables. A paper presented at the Canadian Psychomotor and Sport Psychology Conference, Kingston, Ontario.

Vealey, R.S. (1986). Imagery training for performance enhancement. In J.M. Williams [Ed.], **Applied Sport Psychology: Personal Growth to Peak Performance** (pp. 209-213). Palo Alto, CA: Mayfield Pub. Co.

Weinberg, R.S. (1982). The relationship between mental preparation strategies and motor performance: A review and critique. **QUEST,** 33(2), 195-213.

White, K., & Ashton, R., (1976). Correlation study of the relationship between Betts' QMI and Gordon's Test. Unpublished manuscript, University of Queensland, Australia.

White, K., Ashton, R., & Lewis, S. (1979). Learning a complex skill: Effects of mental practice, physical practice, and imagery ability. **International Journal of Sport Psychology,** 10(2), 71-78.

White, K., Sheehan, P.W., & Ashton, R. (1977). Imagery assessment: A survey of self-report measures. **Journal of Mental Imagery,** 1, 145-170.

Wollman, N. (1986). Research on imagery and motor performance: Three methodological suggestions. **Journal of Sport Psychology,** 8, 135-138.

Wrightsman, C.S., & Deaux, I.G. (1981). **Social Psychology in the 80's,** [3rd ed.]. Monterey, CA: Brooks/Cole.

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.

APPENDIX A

RELATED LITERATURE ON IMAGERY ABILITY

Imagery ability has been measured in the following dimensions:

Vividness. Vividness is a characteristic of the mental process, where activated representations are temporarily accessible to conscious inspection (Denis, 1985). Start and Richardson (1964) emphasized the importance of vividness and control of the image. They measured vividness or imagery on the performance of a gymnastic skill, but found no correlation between this aspect of imagery ability and performance. Since then Ryan and Simons (1982) concluded that vivid imagers benefitted more from mental practice than did poor imagers. Vividness is also an extremely difficult variable to measure and quantify.

Shea (1977) found that when subjects were given relevant labels they were better able to remember the movement. Two instructional strategies that increased vividness were: availability, the ease which the label evokes the image; and concreteness on the meaningfulness of the label.

Controllability. An individual's ability to form and manipulate their image is an indication of controllability and is considered an influential variable on performance. Richardson (1967) states that controllability refers to the ease with which an image can be altered or replaced by another. Research in this area suggests that besides generating images, it is also necessary to control them in order to further utilize the imagery process. Quick transformation of images are necessary for an individual who needs to interrupt one image in order to generate another (Denis, 1985). This is especially true in performance of open motor skills, where the athlete is required to concentrate and attend to various cues in the competitive situation.

Denis (1985) suggests that not only do images need to be generated and transformed, but they also should be persistent when required. He also indicates that a number of operations need to be performed on images, once generated. These include image scanning, image completion and image transformations, which contribute to the efficacy of visual imagery.

Several tests have been devised to measure the controllability component of imagery. These include the Gordon Test of Visual Imagery Control - Gordon (1949), and the revised Gordon Test of Visual Imagery Control (VIC) - Richardson (1969). <u>Exactness of Reference</u>

Not a lot of research has been conducted in the area of exactness of reference as an intrinsic characteristic of imagery. Paivio (1985) describes this property as the figural content of the image. He emphasizes the dimensions of the objects, the distances from the objects, the direction of the movement, and the object's magnitude. This is an important consideration, particularly when it involves a novice learning to perform a skill. Distortion in perception of a movement can greatly affect performance.

Paivio (1985) questions the use of imagery when distorted images are perceived, as opposed to images realistically referring to the correct target movement. If an individual generates an incorrect image, then it is likely that performance will deteriorate.

Imagery Perspective and Orientation

Another variable is the perspective and orientation of imagery. Internal or external perspectives when using imagery play an important role in constructing an image. People vary in their propensity to construct images in one sensory modality or the other. Many studies have tried to distinguish between internal and external imagery and their effectiveness towards enhancing performance.

Mahoney (1979) defines external imagery as when an individual perceives him/herself completing a task as an external observer. Internal imagery on the otherhand, involves the sensory perception and kinesthetic feel as viewed through the performer's eyes. A study by Epstein (1980), using dart-throwing as a motor skill, indicated no significant differences between internal and external imagery. McFadden (1982) investigated hockey goal tending performance and the effects of internal and external perspectives when using imagery. Both the internal and external imagery conditions produced significant performance gains, but no significant differences were found between the two perspectives. Mumford and Hall (1985) observed the effects of internal versus external imagery in figure skating. The results of their study revealed no significant differences in performance. Evidence was supported for senior skaters however, where greater improvement was manifest when using an internal perspective. Weinberg (1982) emphasizes that imagery perspective is dynamic and indicates that internal imagery positively correlates to performance.

Image orientation is particularly important in motor performance. A number of studies have investigated and measured visual imagery, however, most sports skills involve some kinesthetic quality. Hall (1985) suggests that in certain motor skills, kinesthetic imagery may be more beneficial.

Kinesthetic imagery involves feeling the movement and experiencing the sensations of the actual situation (Hall, 1985). If the performer can kinesthetically become a part of the image, and be aware of the environmental and muscular sensations required to complete the skill, then performance may be enhanced. Mahoney and Avener (1977) found that elite Olympic gymnasts used kinesthetic images more frequently than external visual. The MIQ was constructed to measure how a movement feels without actually performing the movement. However, the classification of individuals as kinesthetic imagers has proven inconsistent (Hall, 1985).

APPENDIX B

AAHPERD SPEED SPOT SHOOTING TEST

AAHPERD SPEED SPOT SHOOTING TEST

PURPOSE: To measure skill in rapidly shooting from specified positions and, to a certain extent, agility and ball handling.

EQUIPMENT: Standard inflated basketball, standard goal, stopwatch, tape for marking floors.

TEST/TARGET DIMENSIONS: Five floor markers (2 ft. long and 1 in. wide) should be placed on the floor. For upper elementary grades 5 and 6, the markers will be 9 feet from the backboard; for grades 7, 8, 9, the distance will be 12 feet from the backboard; for grades 10, 11, 12, and college, the distance will be 15 feet from the backboard. The distances for spots B, C, D must be measured from the center of the backboard; those for spots A and E must be measured from the center of the basket. (See Diagram 2.)

ADMINISTRATION: There will be 3 trials of 60 seconds each. The first is a practice trial and the next two are recorded. The performer may stand behind any marker designated for his/her age level. On the signal "Ready, Go!," the performer will shoot, retrieve the ball, dribble to and shoot from another designated spot. (One foot must be behind the marker during each attempt.) A maximum of four lay-up shots may be attempted during each trial, but no two may be in succession. The performer must attempt at least one shot from each designated spot.

VIOLATIONS/ PENALTIES:

- Ball-handling infractions (traveling, double dribble, etc.) **Shot following violation scored as zero points.**
- Two lay-ups in succession. **Second lay-up scored as zero points.**
- More than four attempts at lay-ups. **All excessive lay-ups scored as zero points.**
- Failure to shoot from each of the five designated spots. **Repeat trial.**

SCORING: The test administrator must record the spots at which shots are taken, as well as the number of attempted lay-ups. It is recommended that the recorder use a card such as

ABCDE	1234

and draw a line through the letter corresponding to the floor spot or the number indicating a lay-up.

Two points are awarded for each shot made, including lay-ups. One point is awarded for an unsuccessful shot that hits the rim from above either initially or after rebounding from the backboard. Add the total points for each legal shot for each of the two trials. The final score is the total of the two trials.

SPEED SPOT SHOOTING

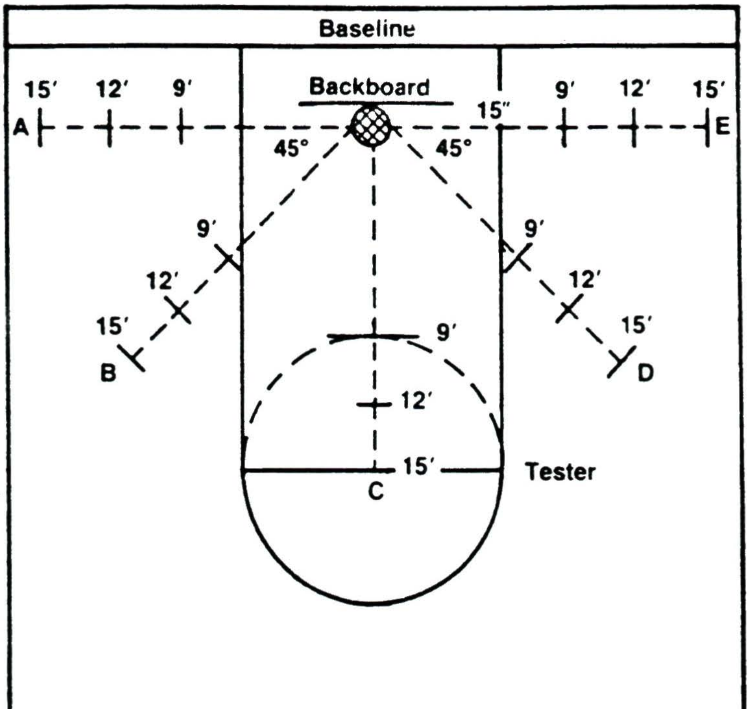


Diagram 2. Speed Spot Shooting.

APPENDIX C

Basketball Shooting Layout

SCORING:

1 pt = Successful shot through the ring.

0 pt = Ball does not go through the ring.

SUBJECT: ____________

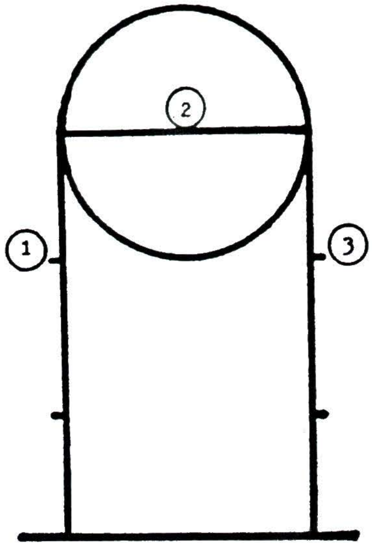
EXPERIMENTER: ____________

DATE: ____________

SESSION: PRETEST | |

POSTTEST | |

RETENTION TEST | |



LOCATION 1	LOCATION 2	LOCATION 3
1. ________	1. ________	1. ________
2. ________	2. ________	2. ________
3. ________	3. ________	3. ________
4. ________	4. ________	4. ________
5. ________	5. ________	5. ________
6. ________	6. ________	6. ________
7. ________	7. ________	7. ________
8. ________	8. ________	8. ________
9. ________	9. ________	9. ________
10. ________	10. ________	10. ________
SCORE: ______	SCORE: ______	SCORE: ______

TOTAL SCORE: ________

APPENDIX D

General Information Questionnaire

UNIVERSITY OF VICTORIA

P.O. BOX 1700, VICTORIA, BRITISH COLUMBIA, CANADA V8W 2Y2
TELEPHONE (604) 721-7211, TELEX 049-7222

INFORMATION QUESTIONNAIRE

NAME: ______________________________

ADDRESS: ______________________________

PHONE #: ______________

AGE: YEARS ________ MONTHS ________

BASKETBALL HISTORY:

POSITION PLAYED: ____________________ (CENTRE, FORWARD, GUARD)

PLAYING EXPERIENCE: ____________ (NUMBER OF YEARS PLAYED)

STARTING AT AGE: ______________

LIST ALL BASKETBALL TEAMS YOU HAVE PLAYED ON AND HOW WELL THEY FINISHED:

____

____

____

____

HOW MANY TIMES A WEEK DO YOU PRACTICE BASKETBALL, EITHER ON YOUR OWN OR WITH A TEAM:

____

____

____

____

APPENDIX E

Betts' Questionnaire Upon Mental Imagery

THE BETTS QMI VIVIDNESS OF IMAGERY SCALE*

INSTRUCTIONS FOR DOING THE TEST:

The aim of this test is to determine the vividness of your imagery. The items of the test will bring certain images to your mind. You are to rate the vividness of each image by reference to the accompanying rating scale, which is shown at the bottom of the page. For example, if your image is 'vague and dim' you give it a rating of 5. Record your answer in the brackets provided after each item. Just write the appropriate number after each item. Before you turn to the items on the next page, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging the vividness of each image. A copy of the rating scale will be available for easy reference on the table in front of you. Please do not turn to the next page until you have completed the items on the page you are doing, and do not turn back to check on other items you have done. Complete each page before moving on to the next page. Try to do each item separately independent of how you may have done other items.

RATING SCALE

The image aroused by an item of this test may be:

Perfectly clear and as vivid as the actual experience	Rating 1
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3
Not clear or vivid, but recognizable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only 'know' that you are thinking of the object	Rating 7

An example of an item on the test would be one which asked you to consider an image which comes to your mind's eye of a red apple. If your visual image was 'moderately clear and vivid' you would check the rating scale and mark '3' in the brackets as follows:

ITEM	RATING
5. A red apple	(3)

Now turn to the next page when you have understood these instructions and begin the test.

Think of some relative or friend whom you frequently see, considering carefully the picture that arises before your mind's eye. Classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

ITEM	RATING
1. The exact contour of face, head, shoulders and body	( )
2. Characteristic poses of head, attitudes of body, etc.	( )
3. The precise carriage, length of step, etc. in walking	( )
4. The different colors worn in some familiar costume	( )

Think of seeing the following, considering carefully the picture which comes before your mind's eye, and classify the image suggested by the following question as indicated by the degrees of clearness and vividness specified on the Rating Scale.

5. The sun as it is sinking below the horizon ( )

Think of each of the following sounds, considering carefully the image which comes to your mind's ear, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

6. The whistle of a locomotive ( )

7. The honk of an automobile ( )

8. The mewing of a cat ( )

9. The sound of an escaping stream ( )

10. The clapping of hands in applause ( )

Think of 'feeling' or touching each of the following, considering carefully the image which comes to your mind's touch, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

11. Sand ( )

12. Linen ( )

13. Fur ( )

14. The prick of a pin ( )

15. The warmth of a tepid bath ( )

Think of performing each of the following acts, considering carefully the image which comes to your mind's arms, legs, lips, etc., and classify the images suggested as indicated by the degrees of clearness and vividness specified on the Rating Scale.

16. Running upstairs ( )

17. Springing across a gutter ( )

18. Drawing a circle on paper ( )

19. Reaching up to a high shelf ( )

20. Kicking something out of your way ( )

Think of tasting each of the following, considering carefully the image which comes to your mind's mouth, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

21. Salt ( )

22. Granulated (white) sugar ( )

23. Oranges ( )

24. Jelly ( )

25. Your favorite soup ( )

Think of smelling each of the following, considering carefully the image which comes to your mind's nose, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

26. An ill-ventilated room ( )

27. Cooking cabbage ( )

28. Roast beef ( )

29. Fresh paint ( )

30. New leather ( )

Think of each of the following sensations, considering carefully the image which comes before your mind, and classify the images suggested as indicated by the degrees of clearness and vividness specified on the Rating Scale.

31. Fatigue ( )

32. Hunger ( )

33. A sore throat ( )

34. Drowsiness ( )

35. Repletion as from a very full meal ( )

*Note: As revised by Sheehan (1967).

APPENDIX F

Gordon Test of Visual Imagery Control

THE GORDON TEST OF VISUAL IMAGERY CONTROL*

INSTRUCTIONS FOR DOING THE TEST:

You have just completed a questionnaire that was designed to measure the vividness of different kinds of imagery. In this present questionnaire, some additional aspects of imagery are being studied.

The questions are concerned with the ease with which you can control or manipulate visual images. For some people this task is relatively easy and for others relatively hard. One subject, who could not manipulate his imagery easily, gave this illustration. He visualized a table, one of whose legs suddenly began to collapse. He then tried to visualize another table with four solid legs, but found it impossible. The image of the first table with its collapsing leg persisted. Another subject reported that when he visualized a table the image was rather vague and dim. He could visualize it briefly but it was difficult to retain by any voluntary effort. In both these illustrations the subjects had difficulty in controlling or manipulating their visual imagery. It is perhaps important to emphasize that these experiences are in no way abnormal and are reported as often as the controllable type of image.

Read each question, then close your eyes as you try to visualize the scene described. Record your answer by underlining 'Yes', 'No', or 'Unsure', whichever is the most appropriate. Remember that your accurate and honest answer to these questions is most important for the validity of this study. If you have any doubts at all regarding the answer to a question, underline 'Unsure'. Please be certain that you answer each of the twelve questions.

1. Can you see a car standing in the road in front of a house?	Yes	No	Unsure
2. Can you see it in colour?	Yes	No	Unsure
3. Can you now see it in a different colour?	Yes	No	Unsure
4. Can you now see the same car lying upside down?	Yes	No	Unsure
5. Can you now see the same car back on its four wheels again?	Yes	No	Unsure
6. Can you see the car running along the road?	Yes	No	Unsure
7. Can you see it climb up a very steep hill?	Yes	No	Unsure
8. Can you see it climb over the top?	Yes	No	Unsure
9. Can you see it get out of control and crash through a house?	Yes	No	Unsure
10. Can you now see the same car running along the road with a handsome couple inside?	Yes	No	Unsure
11. Can you see the car cross a bridge and fall over the side into the stream below?	Yes	No	Unsure
12. Can you see the car all old and dismantled in a car-cemetery?	Yes	No	Unsure

*Note: As revised by Richardson (1969).

APPENDIX G

Movement Imagery Questionnaire

MOVEMENT IMAGERY QUESTIONNAIRE*

By Craig Hall and John Pongrac

INSTRUCTIONS:

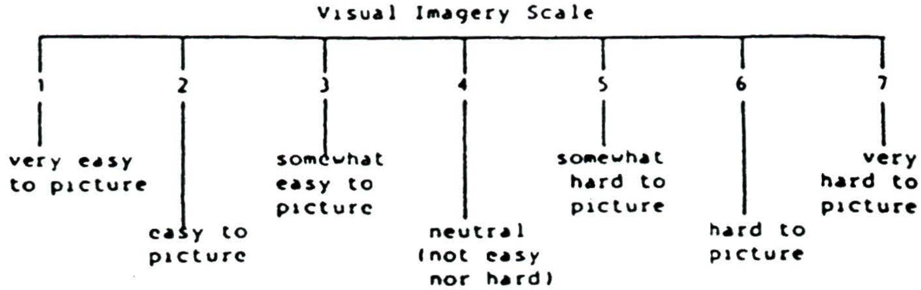
This questionnaire concerns two ways of mentally performing movements, which are used by some people more than others, and are more applicable to some types of movements than others. The first is the formation of a mental (visual) image or picture of a movement in your mind. The second is attempting to feel what performing a movement is like without actually doing the movement. You are requested to do both of these mental tasks for a variety of movements in this questionnaire, and then rate how easy/difficult you found the tasks to be. The ratings that you give are not designed to assess the goodness or badness of the way you perform these mental tasks. They are attempts to discover the capacity individuals show for performing these tasks for different movements. There are no right or wrong ratings or some ratings that are better than others.

Each of the following statements describe a particular action or movement. Read each statement carefully and then actually perform the movement as described. Only perform the movement a single time. Return to the starting position for the movement just as if you were going to perform the action a second time. Then depending on which of the following you are asked to do, either 1) form as clear and vivid a mental image as possible of the movement just performed, or 2) attempt to positively feel yourself making the movement just performed without actually doing it.

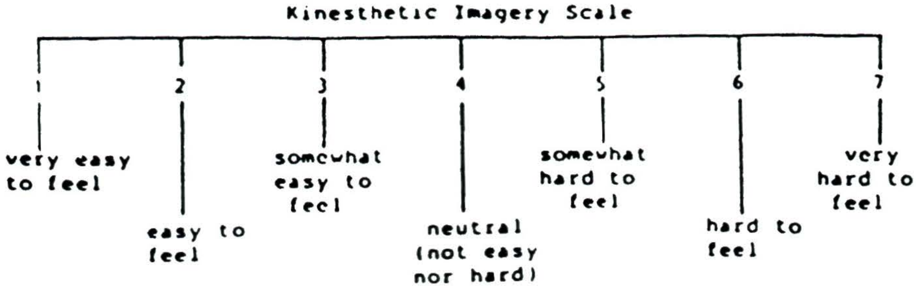
After you have completed the mental task required, rate the ease/difficulty with which you were able to do the task. Taking your rating from the following scale. Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating for any number of movements "imaged" or "felt" and it is not necessary to utilize the entire length of the scale.

RATING SCALES

Visual Imagery Scale



Kinesthetic Imagery Scale



1. STARTING POSITION: Make a fist with your dominant hand (the hand you write with) and then place this hand on the same shoulder (e.g. right hand on right shoulder) such that your elbow is pointing directly in front of you.

ACTION: (Be sure to read the entire action before attempting it).
Extend your elbow so that your hand leaves your shoulder and is straight in front of you parellel to the floor. Keep your hand in a fist. Make this movement slowly.

MENTAL TASK: Assume the starting position (exactly as described above). Form as clear and vivid a mental image as possible of the movement just performed. DO NOT PERFORM THE MOVEMENT. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

2. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

3. STARTING POSITION: Stand with your feet slightly apart and your hands at your sides.

ACTION: Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

4. STARTING POSITION: Stand with your feet slightly apart and your arms at your sides.

ACTION: Jump upwards and rotate your entire body to the left such that you land in the same position in which you started. That is, rotate to the left in a complete (360 degree) circle.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

5. STARTING POSITION: Extend the arm of you nondominant hand straight out to your side so that it is parellel to the ground, palm down.

ACTION: Move your arm forward until it is directly in front of your body (still parellel to the ground). Keep your arm extended during the movement and make the movement slowly.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

6. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your left leg as high as possible keeping the leg extended (do not bend your left knee). At the same time keep your support (right) leg straight. Now lower your left leg so you are once again standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

7. STARTING POSITION: Stand with your feet slightly apart and your arms fully extended above your head.

ACTION: Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or your hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

8. STARTING POSITION: Make a fist with your nondominant hand. Extend your arm above your head keeping your hand in a fist. Keep your other arm at your side.

ACTION: Swing your extended arm straight down to your side as rapidly as possible. Keep your arm extended and your hand clenched.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

9. STARTING POSITION: Stand in front of the floor (exercise) mat with your feet together and your arms at your sides.

ACTION: Perform a front somersault (roll) on the mat and finish in a standing position.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ____________________

10. STARTING POSITION: Make a fist with your dominant hand (the hand you write with) and then place this hand on the same shoulder (e.g. right hand on right shoulder) such that your elbow is pointing directly in front of you.

ACTION: Extend your elbow so that your hand leaves your shoulder and is straight in front of you parellel to the floor. Keep your hand in a fist. Make this movement slowly.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ____________________

11. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so you are once again standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to perform this mental task.

RATING: ____________________

12. STARTING POSITION: Stand with your feet slightly apart and your hands at your sides.

ACTION: Bend down low and then jump straight up in the air as high as possible with both arms extended above your head. Land with your feet apart and lower your arms to your sides.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ____________________

13. STARTING POSITION: Stand with your feet slightly apart and your arms at your sides.

ACTION: Jump upwards and rotate your entire body to the left such that you land in the same position in which you started. That is, rotate to the left in a complete (360 degree) circle.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ____________________

14. STARTING POSITION: Extend the arm of your nondominant hand straight out to your side so that it is parellel to the ground, palm down.

ACTION: Move your arm forward until it is directly in front of your body (still parellel to the ground). Keep your arm extended during the movement and make the movement slowly.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ____________________

15. STARTING POSITION: Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your left leg as high as possible keeping the leg extended (do not bend your left knee). At the same time keep your support (right) leg straight. Now lower your left leg so you are once again standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ____________________

16. STARTING POSITION: Stand with your feet slightly apart and your arms fully extended above your head.

ACTION: Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or your hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ____________________

17. STARTING POSITION: Make a fist with your nondominant hand. Extend your arm above your head keeping your hand in a fist. Keep your other arm at your side.

ACTION: Swing your extended arm straight down to your side as rapidly as possible. Keep your arm extended and your hand clenched.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

18. STARTING POSITION: Stand in front of the floor (exercise) mat with your feet together and your arms at your sides.

ACTION: Perform a front somersault (roll) on the mat and finish in a standing position.

MENTAL TASK: Assume the starting position. Form as clear and vivid a mental image as possible of the movement just performed. Now rate the ease/difficulty with which you were able to do this mental task.

RATING: ______________________

APPENDIX H

Consent Forms

UNIVERSITY OF VICTORIA
P.O. BOX 1700, VICTORIA, B.C., CANADA V8W 2Y2
TELEPHONE (604) 721-8373 TELEX 049-7222

SCHOOL OF PHYSICAL EDUCATION

TO WHOM IT MAY CONCERN RE STUDY ON THE EFFECT OF IMAGERY TRAINING ON THE LEARNING AND PERFORMANCE OF SHOOTING IN BASKETBALL:

The intent of this study undertaken by Dr. G. Van Gyn and Miss B. McIntyre, has been explained to me and I give my permission for subjects to be recruited from the women's University of Victoria varsity basketball teams and the PE 120 class.

NAME: ______________________________

SIGNATURE: ______________________________

DATE: ______________________________

UNIVERSITY OF VICTORIA
P.O. BOX 1700, VICTORIA, B.C., CANADA V8W 2Y2
TELEPHONE (604) 721-8373 TELEX 049-7222

SCHOOL OF PHYSICAL EDUCATION

INFORMED CONSENT

(PLAYERS)

I, ____ have been advised of the purpose of the research, being undertaken by Dr. G. Van Gyn and Miss B. McIntyre. I fully understand the intent of the study, and I also understand that I can withdraw at any time.

NAME: ______________________________
(Please Print)

SIGNATURE: ______________________________

DATE: ______________________________

UNIVERSITY OF VICTORIA
P.O. BOX 1700, VICTORIA, B.C., CANADA V8W 2Y2
TELEPHONE (604) 721-8373 TELEX 049-7222

SCHOOL OF PHYSICAL EDUCATION

TO WHOM IT MAY CONCERN RE STUDY ON THE EFFECT OF IMAGERY TRAINING ON THE LEARNING AND PERFORMANCE OF SHOOTING IN BASKETBALL:

I have been informed of the intent of the above study to be conducted by Dr. G. Van Gyn and Miss B. McIntyre. I am aware that it will be conducted in the University of Victoria gymnasium between the 16th of March and the 8th of April, 1987. Permission is granted for the use of this venue as timetabled, and the use of basketball equipment.

NAME: ______________________________

SIGNATURE: ______________________________

DATE: ______________________________

APPENDIX I

TIME LINE

TIME LINE

DAY	TIME		TESTING PHASE	TEST
1		T1	PRETEST 1	**TSS1**
2				
3				
4				
5				
6				
7				
8		T1	PRETEST 2	**TSS1**
9				
10			MIT + IMAGERY	**QMI, VIC & MIQ**
11			ABILITY ASSESSMENT	(IMAGERY GROUP ONLY)
12				
13	P1		START PRACTICE PHASE	
14	P2			
15	P3			
16	P4			
17	P5		PRACTICE PHASE I	
		T2		**PSS1** = P1 TO P6 AVERAGE PSS SCORE
18				
19				
20	P6			
21	P7			
22	P8			
23	P9			
24	P10			
			PRACTICE PHASE II	
25		T3		**PSS2** = P7 TO P12 AVERAGE PSS SCORE
26				
27	P11			
28	P12		FINISH PRACTICE PHASE	
29		T4	POSTTEST	**TSS2**
30				
31				
32				
33				
34				
35				
36		T5	RETENTION TEST	**RPSS & RTSS**
			IMAGERY ABILITY ASSESSMENT	**QMI, VIC & MIQ** (ALL SUBJECTS)

APPENDIX J

Standardized Imagery Instructions

STANDARDIZED INSTRUCTIONS FOR MENTAL IMAGERY SESSION

EXPERIMENTER:

This study is investigating the effects of motor imagery training on elite and non-elite female basketball players. You have been placed in the imagery group, to ascertain whether or not imagery can be used to improve shooting performance and/or enhance the learning of shooting skills.

I am going to ask you to form some mental images that are related to basketball shooting. This technique is called mental imagery and can be done at any time on your own. Firstly, I want you to realize that there are different ways to image, and the way you form images is very important. To generate an image in your mind, you should attend to as much detail as possible. Try to make your image as visual as possible by including other senses. For example, listen for the sound of the ball bouncing on the gym floor, or try to feel the muscular movements of your arms and legs.

As I describe the scene to you, I want you to focus as clearly as possible to generate a realistic and accurate image. This will become easier with practice, but at the moment your goal is to form an image of the scenes I describe to you as clearly as possible.

You may want to close your eyes, although it is not necessary to do so. When you are forming the images of shooting the basketball, make sure the shot is successful. If not, open your eyes immediately and restart your image, because negative thoughts may carry over to negative actions. Always try to finish your imagery session with a successful shot.

Begin your routine at the free throw line. Notice everything you do, seeing it perfectly, just the way you want it to be, and just the way it should be done. If you make a mistake while visualizing your performance, go back, rewind, slow down the image in your mind and do it over again, correctly, perfectly, exactly as you know you can do it. Feel yourself releasing the ball, off the fingers and follow the ball through the ring - with perfect control and confidence. Guide yourself through the whole event with perfection. See yourself as being successful.

Be aware of how it feels, what it looks and sounds like to succeed to achieve your goal. Allow yourself to experience achievement and success completely and fully by seeing, hearing and feeling it all.

Be strong, relaxed, confident, smooth and centered. If during the visualization process, you reach a point in your performance when you usually have trouble or self doubt, that is the time to use these key words or your own affirmations. Before visualizing your shot, form an image of yourself standing at the free-throw line with the ball in your hands. See the basketball in your hands, bounce it on the floor, take a deep breath, relax, watch the front of the ring as the ball swishes through perfectly - remember you are focussed. (10 second pause).

Let's do that again. See the ball in your hands...bounce it on the floor...take a deep breath...relax...watch the front of the ring as the ball swishes through perfectly - remember you are focussed. (10 second pause).

During practice it may be helpful to concentrate on the following cues, as you step up to take your shot:

1. Relax,
2. Concentrate on the ring,
3. Shoot the ball in one motion. (5 second pause).

Again, relax...concentrate on the ring...shoot the ball in one motion. (5 second pause).

This routine will help you refocus and concentrate on your goal and let go of the negative energy and distractions into which you may slip.

For the next few minutes I want you to simply practice shooting by forming images. Run through the skill as many times as you wish until you feel comfortable with your image. Go ahead and start going through the skill, until I tell you to stop. (2 minute pause).

Let the image slowly slip away and become aware of your body sitting in the chair...breathe in...exhale...feel your easy effortless breathing...remember your feelings of accurate and controlled shooting...knowing that you hit your shots perfectly. You can recall these images and feelings any time you choose.

Visualization is most effective when used at least once a day, at a time when you are relaxed and undisturbed for at least 20 minutes. You may find just before bed is a good time. On the other hand, it may be the worst time if visualization excites and energizes you. Be willing to experiment for a short time, to find the most effective time and situation each day to quiet yourself, relax and visualize.

It is also important to remember to complete your log sheets each day, describing any physical practice or mental imagery that you do. It is imperative that other subjects are not aware that your participation in this study is any different from theirs. The non-imagery group will be informed that the study is investigating their shooting performance in basketball as a result of daily shooting practice.

Do you have any questions? Testing will start on Monday the 16th of March. I look forward to seeing you then, and thank you very much for your participation.

APPENDIX K

LOG SHEETS (IMAGERY AND CONTROL GROUPS)

LOG SHEET

NAME: ______________________________ Log Sheet #: ______

BASKETBALL ACTIVITIES
- Describe the activity, date, time

DATE/TIME **ACTIVITY DESCRIPTION**

____

____

____

____

____

____

____

IMAGERY PRACTICE
- Describe the date, time, and what it is that you imaged. Add comments you may have about your imaging, e.g. clearness, who or what was involved in your image, whether you had control over your image, etc.

DATE/TIME **CONTENTS AND COMMENTS YOU MAY HAVE ABOUT IMAGING**

____

____

____

____

____

____

____

____

LOG SHEET

NAME: ______________________________ Log Sheet #: _______

BASKETBALL ACTIVITIES:

- Describe the activity, date and time

DATE/TIME **ACTIVITY DESCRIPTION**

____

____

____

____

____

____

APPENDIX L

Basketball Shooting Questionnaire

BASKETBALL SHOOTING QUESTIONNAIRE

1. Do you feel you have a good shooting style? YES NO
2. Do you think that you shoot consistently? YES NO
3. What would your shooting percentage be from the free-throw line (i) during a game? ______%
   (ii)during practice? ______%
4. What would your shooting percentage be from with in the key
   (i) during a game? ______%
   (ii)during practice? ______%
5. Would you like to improve your shooting style?
6. What areas would you like to work on specifically, to help your shooting style? ______________________________

   ____

   ____

   ____

   ____

7. In a game, which shot do you use more often:
   a. Jump shot
   b. Set shot
   c. Hook shot ______
   d. Free-throw
   e. Fast break shooting
   f. Three point shots.
8. Do you like to be informed of your shooting percentage at;
   a. Half time
   b. After the game ______
   c. Not at all.
9. Do you think about your body position when shooting? YES NO
10. Are you balanced when taking your shots? YES NO
11. Is your direction of force going to the basket (horizontal) or up and down on the spot (vertical)? ______
12. Do you shoot in one motion? YES NO
13. What do you aim for when shooting? ______________________________

    ____

14. Do you use the backboard to aid your judgement when shooting? YES NO
15. How old were you when you started to play basketball? ______
16. Who taught you to shoot a basketball? ______________________________

    ____

APPENDIX M

FOLLOW-UP QUESTIONS

UNIVERSITY OF VICTORIA

SCHOOL OF PHYSICAL EDUCATION

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FOLLOW-UP QUESTIONNAIRE FOR THE STUDY ON THE EFFECT OF IMAGERY ON THE LEARNING AND PERFORMANCE OF SHOOTING IN BASKETBALL BY ELITE AND NON-ELITE BASKETBALL PLAYERS.

Thank you for participating in this study. Your physical testing on basketball shooting performance is now over. To complete your file, I will be needing you to fill out some forms.

Attached are three questionnaires for your completion. Please do them immediately. The questionnaires will take about 20 mins. It is imperative that you do not discuss these questionnaires with anybody else since there are several other people who are still being tested. Please place your name, the date, and the starting time on the top of each questionnaire.

And finally, please answer the following:

How much did you know about the study? ____________________

____

____

____

Did you know what group other players were in? e.g. Imagery or control? __________

If you were in the control group, describe:

Whether you were aware of what the mental preparation group was doing? If so, did you try the technique on your own?

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If you were in the imagery group, describe:

What you thought of imagery and how your imagery progressed? How did you feel about doing the imagery and did you do it faithfully? Also did you do any imagery during the past week? i.e. since your last testing session?

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Again, thank you very much for your cooperation in this study. Results will follow shortly.

APPENDIX N

DATA ANALYSIS

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TITLE THESIS
DATA LIST FREE/STATUS CONDTION IMAAP ST1 AT1 T2 T3
               T4 T5 T6 T7 T8 T9 T10 T11 AT2 ST2
               ST3 AT3 QMIPRE QMIPOST VICPRE VICPOST
               MIQVPRE MIQVPOST MIQKPRE MIQKPOST
MISSING VALUES QMIPRE TO MIQKPOST (0)
VARIABLE LABELS
    STATUS 'ELITE OR NON_ELITE'
    CONDITION 'IMAGERY OR CONTROL'
    QMIPRE 'QMI PRE-TEST"
    QMIPOST 'QMI POST-TEST'
    VICPRE 'VIC PRE-TEST"
    VICPOST 'VIC POST-TEST'
    MIQVPRE 'MIQV PRE-TEST"
    MIQVPOST 'MIQV POST-TEST'
    MIQKPRE 'MIQK PRE-TEST"
    MIQKPOST 'MIQK POST-TEST'
    AT 'PRACTICE SET SHOOTING'
    ST 'TRANSFER SET SHOOTING'
BEGIN DATA
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91 78 15 22 17 19 22 16
1 1 1 32 20 24 20 20 23 22 18 23 25 24 28 21 32 33 23
87 68 18 23 15 11 17 11
1 1 2 32 26 28 24 26 29 26 24 28 29 27 25 25 35 37 29
108 96 8 20 17 19 23 16
1 1 2 28 23 23 21 18 18 21 24 23 21 22 21 19 28 24 23
102 92 22 24 16 23 17 20
1 1 1 19 24 23 21 20 25 24 20 22 24 20 21 20 17 30 21
76 54 21 18 12 12 11 9
1 1 2 28 22 24 25 27 26 24 27 27 25 26 25 26 28 30 23
109 133 18 20 11 10 25 16
1 1 1 27 16 20 21 20 21 17 16 20 20 16 14 15 20 20 18
83 38 19 22 14 9 12 9
1 1 2 21 20 21 24 22 20 22 18 25 20 18 22 22 22 22 20
109 88 23 21 17 18 23 20
1 1 1 23 17 17 13 19 24 18 15 20 17 19 19 20 27 23 18
79 49 24 24 18 9 20 9
1 2 1 34 13 19 21 20 22 19 21 19 18 20 27 22 23 28 21
101 0 14 0 14 0 14 0
1 2 1 26 18 19 21 21 23 22 13 19 24 21 25 19 21 24 22
71 0 22  0 13 0 22 0
1 2 1 28 20 23 20 25 23 28 26 25 23 24 23 22 32 33 23
85 0 22 0 9 0 9 0
1 2 2 23 25 22 18 23 23 23 21 24 20 25 20 20 18 20 18
128 0 14 0 30 0 33 0
1 2 2 23 19 24 21 20 20 18 22 19 20 22 26 24 23 21 20
106 0 18 0 31 0 32 0
1 2 1 16 14 17 21 08 13 15 15 16 15 21 18 14 08 12 13
106 0 16 0 14 0 14 0
1 2 1 18 18 19 20 20 19 20 21 21 21 23 26 19 20 24 18
60 0 23 0 12 0 11 0
1 2 2 20 6 18 12 18 15 15 15 15 16 18 21 17 13 16 13
109 0 21 0 18 0 29 0
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1 2 2 17 14 20 22 22 17 13 10 18 13 16 22 15 15 16 18
97 0 20 0 19 0 16 0
2 1 1 24 17 22 25 23 23 25 20 19 23 22 21 20 20 21 17
51 37 23 24 10 9 14 12
2 1 2 14 14 11 16 15 15 14 12 10 10 20 16 17 17 20 19
89 51 24 24 17 10 24 11
2 1 1 11 17 12 10 12 14 13 13 13 18 13 17 17 17 15 14
84 84 21 24 12 13 14 17
2 1 2 10 6 7 8 9 15 10 12 14 16 18 7 15 12 19 19
93 67 24 24 19 15 22 13
2 1 1 9 10 5 14 13 18 14 15 19 18 16 16 15 12 11 14
54 50 23 23 10 9 12 9
2 1 2 8 8 12 8 7 10 8 9 6 13 8 12 9 14 15 11
112 105 9 16 27 13 30 13
2 1 2 9 8 12 7 12 15 12 15 18 8 11 12 9 11 11 12
90 68 21 20 10 14 23 19
2 1 1 5 8 7 8 5 10 14 18 14 10 16 12 11 16 21 14
58 41 22 24 11 9 10 10
2 1 1 27 20 19 17 15 16 21 18 20 16 15 24 23 30 25 20
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2 2 2 16 13 15 20 16 13 16 19 18 10 16 14 12 17 23 16
108 0 18 0 29 0 27 0
2 2 2 17 15 9 14 16 17 19 15 17 11 20 19 17 19 18 17
68 0 22 0 20 0 20 0
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2 2 1 8 11 13 12 9 14 10 6 8 10 13 14 10 11 16 15
95 0 22 0 9 0 9 0
2 2 1 10 14 14 15 17 11 13 12 14 19 15 16 12 20 15 10
117 0 18 0 11 0 11 0
2 2 2 12 7 11 14 8 9 22 12 14 11 14 13 12 7 18 12
51 0 22 0 17 0 18 0
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71 0 24 0 18 0 16 0
2 2 1 7 12 7 14 11 9 10 12 16 15 13 18 13 12 11 14
85 0 24 0 14 0 16 0
2 2 1 12 13 19 16 15 17 19 16 18 15 17 20 17 16 21 14
89 0 22 0 9 0 19 0
END DATA
FINISH
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APPENDIX O

TABLE OF MEAN PERFORMANCE SCORES OVER TIME FOR ALL GROUPS ON THE TWO SHOOTING SKILLS

Table 2

Means and Standard Deviations for Shooting Performances on the PSS Test Over Time for all Groups

			Testing Phase		
Group	*n*		T2	T3	T5
Imagery elite	9	*M*	22.2	22.0	22.0
		SD	2.8	3.2	3.4
Control elite	9	*M*	19.0	20.0	18.4
		SD	3.1	2.9	3.6
Imagery non-elite	9	*M*	13.0	14.9	15.5
		SD	4.6	3.5	3.2
Control non-elite	9	*M*	12.7	13.4	13.5
		SD	2.7	3.0	2.2

Table 3

Means and Standard Deviations of the TSS Performance Scores Over Time for all Groups

	Testing Time					
Group	Pretest T1 (TSS1)		Posttest T4 (TSS2)		Retention T5 (RTSS)	
Imagery elite	27.6	(6.2)	27.1	(6.4)	28.1	(6.0)
Control elite	22.7	(5.8)	19.2	(6.8)	21.5	(6.5)
Imagery non-elite	13.0	(7.5)	16.5	(5.8)	17.5	(4.8)
Control non-elite	11.0	(3.7)	13.3	(4.7)	15.4	(5.3)

APPENDIX P

MEAN SCORES AND STANDARD DEVIATIONS FOR ALL GROUPS ON THE IMAGERY QUESTIONNAIRES

Table 8

Mean Imagery Questionnaire Scores and Standard Deviations for the Four Groups

Questionnaire		Group			
		Elite Imagery (n=9)	Elite Control (n=9)	Non-Elite Imagery (n=9)	Non-Elite Control (n=9)
QMI[a]	M	77.3	95.8	77.5	84.5
	SD	29.0	20.7	20.9	20.5
VIC[b]	M	21.5	18.9	21.2	21.0
	SD	2.0	3.5	4.7	2.6
MIQ-V[c]	M	15.2	17.8	13.9	16.2
	SD	2.4	7.8	6.0	6.3
MIQ-K[c]	M	18.8	20.0	19.9	17.0
	SD	4.9	9.2	7.6	5.2

[a]low scores represent vivid imagery
[b]high scores represent controlled imagery
[c]low scores represent high imagery ability with movement

APPENDIX Q

ANECDOTAL REFERENCES

ANECDOTAL REFERENCES

In personal communications during the testing phases, feedback on the daily log sheets, and in the follow-up questionnaire, many players responded with either negative and/or positive comments regarding the use of MIT and skill specific imagery prior to shooting. Several athletes expressed feelings of frustration as MIT interfered with their concentration and normal routine. Many players reported that when they employed imagery prior to each shot, unwanted skill deficiencies or errors would occur.

The reports from the players, revealed marked individual variations in accommodating to skill specific imagery. Their reports provide useful feedback and implications as to how skill specific imagery may be employed to produce optimal performance.

A number of case studies are presented, which reflect the players' positive and negative responses to MIT in this study:

1. Beneficial aspects of MIT, as reported by players.

Case Study #1: Subject - I.D.: EI

- AGE: 21 years and 10 months
- STATUS: Elite
- PERFORMANCE: Improved over time

"My imagery became clearer the more I did it. I came in to shoot and wasn't doing very well - so I used the imagery and it worked. Maybe it was because I concentrated harder on my shooting form."

Case Study #2: Subject - I.D.: SI

- AGE: 27 years and 5 months
- STATUS: Elite
- PERFORMANCE Improved over time

"I found imagery was beneficial to my performance as I concentrated much more on my shooting style and technique. I started to associate with the feeling of the movement and it has improved my shooting success. I will continued to use it."

Case Study #3: Subject - I.D.: 7I

- AGE: 29 years
- STATUS: Non-elite
- PERFORMANCE: Fluctuated over time

"I felt that imagery improved my performance over the testing period. It got clearer and easier to control. I felt that it did help me."

Case Study #4: Subject - I.D.: 11I

- AGE: 22 years and 8 months
- STATUS: Non-elite
- PERFORMANCE: Improved over time

"My images are getting clearer, very relaxing and I seem to be getting more confident in my shooting."

Case Study #5: Subject - I.D.: MI

- AGE: 20 years and 7 months
- STATUS: Elite
- PERFORMANCE: Fluctuated over time

"I found the more I concentrated on imaging the image, the more baskets I got. When I didn't practice imagery before each shot, then I usually missed. I thought the imagery helped me. It helped most when I concentrated right before the shot."

Case Study #6: Subject - I.D.: KI
- AGE: 22 years and 4 months
- STATUS: Elite
- PERFORMANCE: Improved over time

"The imagery seemed to get better throughout the two weeks - clear pictures - it helped my shooting."

2. <u>Detrimental aspects of MIT, as reported by players</u>.

Case Study #7: Subject - I.D.: 1I
- AGE: 20 years
- STATUS: Non-elite
- PERFORMANCE: Fluctuated over time

"I felt the imagery helped a lot in my shot, but I felt it hindered my shooting when I imaged right before the shot. I seemed to lose my concentration."

Case Study #8: Subject - I.D.: 5I
- AGE: 26 years and 20 months
- STATUS: Non-elite
- PERFORMANCE: Fluctuated over time

"I couldn't concentrate. The ball wouldn't go in, no matter how hard I tried. I'm having problems imaging right before my shot."

Case Study #9: Subject - I.D.: 7I

- AGE: 29 years
- STATUS: Non-elite
- PERFORMANCE: Fluctuated over time

"I had limited control, and my 'video-tape' kept breaking. My image doesn't feel the same as the actual shot, and I can't maintain visualization throughout the shot. I worked on 'marrying' my feeling imagery with the visual imagery - not much luck because it almost feels like they are mutually exclusive."

Case Study #10: Subject - I.D.: II

- AGE: 21 years and 10 months
- STATUS: Elite
- PERFORMANCE: Decreased over time

"It is the first time I've done imagery, and found it difficult to focus clearly. I found imagery, right before my shot almost distracted me, as my arm tensed, therefore producing flat shots."

Case Study #11: Subject - I.D.: KI

- AGE: 21 years and 4 months
- STATUS: Elite
- PERFORMANCE: Improved over time

"I don't have a lot of control, and I couldn't get a clear image of myself. I couldn't mentally see or feel the ball in my hands. I'm having trouble today keeping control of the image, and I'm not making my shots - very frustrating."

Case Study #12: Subject - I.D.: 9I

- AGE: 21 years and 5 months
- STATUS: Elite
- PERFORMANCE: Fluctuated over time

"I have trouble concentrating on one single image. I had difficulty in seeing the image clearly and seeing the ball in my image. I'm trying to control the image, but I see another picture of the ball rolling around the rim or bouncing off. I was not always in control - sometimes the ball went other places than I wanted when imaging - I find it intimidating."

VITA

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Educational Institutions Attended, with Dates of Entering and Leaving:

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Degrees Awarded, with Dates and Names of Institutions:

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Title of Thesis:

EFFECTS OF IMAGERY ON THE LEARNING AND PERFORMANCE OF BASKETBALL SHOOTING OF ELITE AND NON-ELITE FEMALE BASKETBALL PLAYERS

Author [redacted]

(Signature)

BRONWYN K. MCINTYRE

July 24, 1987