THE EFFECT OF IMAGERY ON TACKLING PERFORMANCE IN RUGBY

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ABSTRACT

The purpose of this study was to investigate the effect of imagery training plus physical practice, on the tackling performance of rugby players during competitive games. Data were collected from 74 male rugby players who were placed into one of three positional groups, comprising 'Tight Five', 'Back Row and Halfback', and 'Outside Back' players. Before implementing the training program, a series of games was videotaped and baseline measures of tackling performance obtained. The experimental design employed a 3 X 3 Latin square in which all groups received all treatment conditions, with the treatment order counterbalanced to control for carry over effects. After each two-week training period under one condition, a further series of games was videotaped and new baseline measures established. Analysis of the data was conducted using a series of repeated measures MANOVAs for the subjects who were involved in all treatment and testing conditions. A series of one-way ANOVAs with repeated measures, and multiple paired t tests were conducted using the data for all subjects. No significant between-group or between-condition differences were found for the a priori design, however, Tight Five players showed a mean improvement in tackling performance of 24% following the Mental Imagery plus Physical Practice condition. The a priori findings for Tight Five players, and the post-hoc findings for junior division team players, and players under twenty years of age, suggested that tackling training that involved the use of mental imagery was more effective than purely physical practice. The combination of mental imagery and physical practice was the most effective training method for these players. It was concluded that mental imagery for tackling can be as effective as physical practice in terms of transfer to game performance, and had the added advantage of having no risk of physical injury. It was also suggested that imagery may elevate players' feelings of self-efficacy and confidence to perform, and therefore may be able to mediate improved performance and satisfaction.

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DEDICATION

To my family, who

have always supported

and encouraged me

CHAPTER 1

INTRODUCTION

Imagery has been widely accepted by researchers and sport practitioners as having the potential to enhance both skill acquisition and performance (Weinberg, 1982). Indeed, highly successful athletes have causally linked imagery rehearsal to their successes. Figure skater Brian Orser, world champion in 1987 and a silver medallist at the 1984 and 1988 Winter Olympics stated that "going through it mentally is almost like having an extra practise. I visualize the figures and recreate the feeling of the turns. I actually go through the motions". Orser felt that his imagery training helped his routines unfold as cleanly in the competition as they had in his imagination (Orlick, 1986, p. 121).

Despite the anecdotal support, results from empirical research are equivocal. Several studies have shown that imaging makes little contribution to motor-skill performance (Mumford and Hall, 1985; Eby, 1986), while other studies have demonstrated that imagery rehearsal enhances motor-skill performance (Richardson, 1967; Weinberg, 1982; Feltz and Landers, 1983). The way in which this positive effect is produced remains obscure. Paivio (1985) suggested that imagery has both a motivational and a cognitive function. The cognitive effects of imagery have been attributed to the covert practice of skills or strategies, whereas the motivational role of imagery lies in the capacity of the performer to symbolically represent behaviours associated with a goal or situation. According to Paivio (1985), it is this motivational role which contributes more to imagery's effect on performance.

The principle of transfer is implied in any investigation of the effect of imagery rehearsal on motor performance. Schmidt (1988, p.371) defined this principle as "the gain (or loss) in the capacity for responding in one task as a result of practice or experience on

some other task". With regard to motor skills, Singer (1980) claimed that transfer of learning would most likely occur when the two tasks were more similar in terms of both task components and performance conditions.

Transfer of physical training to performance incorporates a similar principle. The degree of transfer would vary depending upon the relevance and relative importance of the training to performance, and to what extent the training has been specific (Sale and Norman, 1982). In many sports, however, the lack of available facilities, environmental constraints, or danger from injury has meant that specificity of training is not always possible.

Little research to date has investigated the effect of imagery rehearsal on the transfer of physical training to performance, although studies by Johnson (1982) and Kohl and Roenker (1980; 1983) have indicated that this may be a useful technique for creating such an effect. Suinn (1983) has suggested that the use of imagery during training sessions would create psychological conditions that are similar to the performance situation, and this would support the use of imagery training in enhancing actual performance. Indeed, for maximum effectiveness, Weinberg (1982) advocated the use of imagery in conjunction with physical skills practice. If used in this manner, it was proposed that imagery may provide performers with a focus for their training, and enhance their goal orientation.

Anecdotal evidence from the training and testing of the Canadian Olympic Ice-Hockey team in 1986 and 1987 suggested a possible facilitating effect of mental imagery training on the transfer of peak power changes from off-ice training to on-ice testing (H. Wenger, personal communication, 1987). Empirical research is required to test for these effects within sport.

Rugby, because of the potential danger from injury, provides a suitable area for study. Specifically, the successful performance of the skill of tackling in rugby, although

involving a degree of technical expertise, has often been described by coaches as primarily a matter of motivation (O'Neill, 1982; Robertson and Osborne, 1984). Replication of the exact tackling conditions during a game is not always possible during training sessions. This requires the use of non-specific drills incorporating the use of tackling bags or one's own teammates. In many cases, specific tackling practice is not carried out at all.

If imagery has both a motivational and cognitive function in enhancing performance, as suggested by Paivio (1985), and if imagery rehearsal has an effect on the transfer of physical training to performance, then the skill of rugby tackling can be seen to be an ideal vehicle for the study of this phenomenon. To date, no studies have investigated the effect of imagery rehearsal on performance in rugby.

Purpose of the Study

The primary intent of this study was to investigate the effect of imagery training, applied in conjunction with tackling practice during scheduled rugby practice times, on the tackling performance of players during competition rugby games.

The mental imagery utilized during the training sessions focused on the visual, kinesthetic, and emotional dimensions experienced when performing tackles during league rugby games.

Hypotheses

Hypothesis 1: There will be no difference between the tackling success rates during competition rugby games, of subjects who have completed training involving physical tackling practice alone, and the same subjects following training utilising a combination of mental imagery and physical tackling practice.

Hypothesis 2: There will be no difference between the tackling success rates during

competition rugby games, of subjects who have completed training involving physical tackling practice alone, and the same subjects following training utilising mental imagery training alone.

Hypothesis 3: There will be no difference between the tackling success rates during competition rugby games, of subjects who have completed training involving mental imagery alone, and the same subjects following training utilising a combination of mental imagery and physical tackling practice.

Hypothesis 4: There will be no difference between the tackling success rates during competition rugby games, of sub-units of players described as `Tight Five', `Back Row and Halfback', and `Outside Back' players.

Definition of Terms

Mental Practice - The symbolic rehearsal of a physical activity in the absence of any gross muscular movement (Richardson, 1969).

Mental Imagery - The mental rehearsal of a motor performance in conditions where the auditory, visual or kinesthetic qualities of movement may be experienced (McIntyre, 1987).

Tackle - A tackle occurs when a player carrying the ball in the field-of-play is held by one or more opponents so that while he is so held he is brought to the ground or the ball comes into contact with the ground. If the ball carrier is on one knee, or both knees, or is sitting on the ground, or is on top of another player who is on the ground, the ball carrier is deemed to have been brought to the ground (International Rugby Football Board, 1988-89). A complete outline of the criteria for determining a successful tackle is included in Appendix H.

Attempted Tackle - An attempted tackle occurs when the prospective tackler is perceived by the observer to have made contact with the ball-carrier with more than one

hand in an attempt to bring him to the ground. The tackler was judged to be in a position to control the ball-carrier in the tackle. A complete outline of the criteria for determining an attempted tackle is included in Appendix H.

Tackling Performance - The percentage of attempted tackles that are successfully completed by an individual under study. This percentage is expressed as a ratio.

Tight Five Players - those who occupy the forward playing positions of hooker, loosehead prop, tighthead prop, right lock and left lock.

Back Row and Halfback Players - those who occupy the forward playing positions of openside flanker, blindside flanker and number eight, and those players who occupy the back playing positions of scrumhalf and flyhalf.

Outside Back Players - those who occupy the back playing positions of inside centre, outside centre, left wing, right wing and fullback.

CHAPTER II

REVIEW OF LITERATURE

This chapter presents a current review of the imagery literature. The topics to be reviewed include a definition of imagery, an overview of imagery research, theories of imagery, a theoretical framework within which to study imagery, transfer of training, research into imagery with open and closed skills, and variables to consider when investigating imagery.

Definition of Imagery

Although defined in numerous ways by many investigators, mental imagery has generally been conceptualized as being a component of a much broader term known as mental practice. Richardson (1969) has defined mental practice as "the symbolic rehearsal of a physical activity in the absence of any gross muscular movement". As Suinn (1983) suggests, this may include any form of covert practice, and would encompass simply thinking or talking oneself through a motor action. Mental imagery, however, which has often been used synonymously in the motor skills literature with such terms as visuo-motor behaviour, visualization, and mental rehearsal, has been defined by Denis (1985, p. 45) as "a psychological activity which evokes the physical characteristics of an absent object (either permanently or temporarily absent from our perceptual-field)". The distinction between mental practice and mental imagery is that the latter is a more narrow term, in which imagery is the dominant experience used to achieve the rehearsal of the task (Suinn, 1983).

Because mental imagery encompasses more than just mental pictures, that is, it is a multi-sensory experience, this study will adapt the definition utilised by McIntyre (1987),

and refer to it as "the mental rehearsal of motor performance in conditions where the auditory, visual or kinesthetic qualities of movement may be experienced".

Overview of Mental Practice and Imagery Research

A great many studies have been conducted as to the effects of mental practice and imagery upon motor performance. Although the results have been equivocal, the trend of research findings is that mental practice procedures are associated with improved performance. A number of major reviews of the mental practice research have been conducted, and all have reiterated the trend towards mental practice techniques improving performance (Richardson, 1967; Corbin, 1972; Feltz and Landers, 1983).

However, far from being exceptional in their performance enhancing effects, the reviews by Richardson (1967), Corbin (1972), and Feltz and Landers (1983), revealed that overall, mental practice groups performed significantly better than no practice groups, but not as well as physical practice groups. The combination of mental practice with physical practice seems to be the most effective in terms of mental practice application (Oxendine, 1969; Corbin, 1972; White, Ashton and Lewis, 1979; Weinberg, 1982).

Studies which have specifically focused on the relationship between imagery and performance have also produced equivocal findings. Positive performance increments as a result of imagery training were revealed in studies by Hamilton and Fremouw (1985), and Zeigler (1987), using basketball players, but studies by Mumford and Hall (1985) and Eby (1986), found no evidence to indicate improved performance due to imagery training.

Theories of Imagery

A number of theories of imagery have been proposed. Although none have gained general acceptance, all have suggested that imagery is a beneficial technique for improving

motor performance. Paivio (1985) has suggested that the lack of consensus on a theoretical explanation of the imagery construct has been responsible for much disagreement regarding the methods to be used in psychologically preparing athletes.

Four of the most influential theories will be reviewed in this section. These are; The Gross Framework Theory, The Psychoneuromuscular Theory, The Attention- Arousal Set explanation, and The Symbolic Perceptual Theory.

Proposed by Lawther (1968), the Gross Framework Theory is based upon the idea that the performer must conceptualise the entire task in order to improve performance. Imagery would assist the performer to acquire an overall impression of the skill or task, rather than emphasising the details of the movements involved in the skill. Corbin (1972) suggests that this theory may show that mental practice is more advantageous to novice performers in gaining an overall impression of basic skill requirements. However, doubts have been cast on the benefits of this kind of mental rehearsal for novices because these performers could not readily comprehend the complexities of the skill that produce the resultant skilled performance. With an elite athlete, on the other hand, improvement is more probable if, during imagery training, attention is drawn to critical performance cues rather than the overall sequence (McIntyre, 1987).

The Psychoneuromuscular Theory, which was originally proposed by Carpenter (1894) as the ideo-motor principle, is supported in the literature through studies by Jacobson (1931), Suinn (1976), Bird (1984), and Harris and Robinson (1986). It proposes that subthreshold muscular contractions occur during imagery, in the muscle fibres to be utilised by the individual during actual performance. Kinesthetic feedback is thus provided, to help form perceptual discriminations and possibly then improve performance (Corbin, 1872).

Harris and Robinson's (1986) study used EMG traces, and found that during imagery,

muscle innervation between sites or paired limbs appeared to be specific to the muscle group necessary for task execution. Further to this, Hale (1982) found that an internal imagery perspective produced substantial localised neuromuscular activity, whereas external imagery did not. This implies that imagery which more totally involves the individual in visual and kinesthetic experiences is more likely to result in more localised neuromuscular outflow than just visualizing the outcome (Hale, 1982). However, other researchers believe that imagery is associated with a general increase in muscle action potentials from almost all muscle groups, thus indicating the presence of non-localized neuromuscular activity during imaginal rehearsal (Feltz and Landers, 1983).

Imagery is seen from the Attention Arousal Theory perspective as serving to prepare the performer for action, both physically and mentally. This is achieved through the general increase in muscle action potentials which occurs throughout the body when imaging a skill, thereby causing an increase in the arousal level of the performer (Schmidt, 1982).

Mental preparation is facilitated by imagery focusing attention onto task relevant factors, reinforcing specific details, and consequently eliminating disrupting thoughts (Rushall, 1979). The performer becomes physically prepared through imagery providing greater efference to the muscles and therefore priming them for action (Feltz and Landers, 1983). This theory may have application for elite athletes by functioning as a psyching-up strategy for upcoming performances (Weinberg, 1982).

Under the Symbolic Perceptual Theory, imagery effectiveness is accounted for by cognitive processing of the symbolic coding of the skill. An integral part of this theory is the concept of propositional networks. Sometimes called motor programs (Keele, 1977), generalised schema (Schmidt, 1975), or conceptual representations (Carroll and Bandura, 1982), propositional networks refer to information, including imaginally based

information, that is coded in memory in an abstract form rather than as separate mental pictures or verbal representations (Bird and Cripe, 1986).

The theory proposes that during imagery rehearsal of a motor skill, a propositional network is retrieved from long-term memory, and information concerning the skill is coded symbolically. In this manner, alterations can be made to the network. These alterations can subsequently be used as a basis for sending efferent outflow to the muscles, which should result in response corrections to overt performance (Bird and Cripe, 1986).

The degree of coding is dependent upon the stages of the learner involved, and on the cognitive demands of the task. For example, in the early stages of learning a skill, it has yet to be automated, and necessarily requires a large amount of cognitive activity (Schmidt, 1988). A number of studies have found that imagery enhances learning in these early stages (Wrisberg and Ragsdale, 1979; Minas, 1980). The importance of imagery as a facilitator of performance has also been shown to increase as the cognitive demands of the skill increase (Schmidt, 1988).

All of these theories provide partial explanations for the effect of imagery on performance, but there remains a need for a theoretical framework which could direct further research (Weinberg, 1982; Feltz and Landers, 1983; Paivio, 1985).

Theoretical Framework for the Study of Imagery

Paivio (1985) has proposed a general analytic framework from which to determine the effectiveness of imagery techniques. His model can be conceptualised in a 2 X 2 classification which suggests that "imagery plays both a motivational and a cognitive role in mediating behaviour, each one operating at either a general or a specific level (1985, p. 235)".

The general motivational level of the model applies to the degree of physiological

arousal generated by an image, and the affect or emotion that might accompany it (Paivio, 1985). In contrast, the specific motivational level refers to more specific behaviours or goal oriented responses, and the arousal levels that emerge when these images are evoked.

Imagery techniques that are designed to reduce anxiety and tension, increase self-confidence, and optimise arousal by eliminating negative thoughts and increasing positive ones, all bear testimony to the fact that many people, especially coaches and sport psychologists, believe that imagery has a strong motivational function (Paivio, 1985). In support of this, Feltz and Landers (1983) suggested that improvements in performance as a result of mental practice could be due to optimising tension levels for a given task. Indeed, Geoff Courtnall, a former winger for the NHL's Edmonton Oiler ice-hockey team, attributed much of his increased goal scoring performance to the use of mental imagery. After imagining himself playing and scoring goals one hour prior to every game, he reported feeling "in control" whenever he went onto the ice during a game (G. Courtnall, personal communication, July 9, 1988).

The general cognitive level of the model refers to the imaging of strategies associated with performance, whereas the specific cognitive function emphasizes individual and specific skills. Most experimental studies incorporating mental imagery have been directed at this specific level, with imagery training intended either to strengthen correct responses or eliminate incorrect ones, or both (Paivio, 1985).

Transfer of Training

According to Schmidt (1988, p. 371) "transfer is usually defined as the gain (or loss) in the capability for responding in one task as a result of practice or experience on some other task". The principle relies on the contention that, given the right conditions, what is learned in one context can be carried over to another context (Adams, 1987).

In general, there are two types of transfer; between activities or lateral transfer, and within activities or vertical transfer. Lateral transfer concerns the influence of learning capabilities from one task to another, whereas vertical transfer concerns subordinate tasks being prerequisites for higher order learning in the same activity (Singer, 1980). An example of lateral transfer would be the transfer of capabilities from racquetball to the learning of tennis. With tackling in rugby, vertical transfer would be demonstrated through learning the correct body positioning and head alignment when approaching a tackle bag, prior to learning the whole task.

A number of conditions affect the amount of transfer that is possible, and the most important of these is the similarity between tasks. Singer (1980) suggests that the greatest amount of transfer will result from a greater resemblence between task elements and their respective stimuli and responses. If imagery can create psychological conditions that are similar to performance situations during training sessions, and if, as Suinn (1983) suggests, during imagery a person experiences sensory-motor sensations that reintegrate reality experiences, then mental imagery techniques are useful for goals of increasing transfer to competition (Suinn, 1985). In support of this, Schmidt (1988) reports that mentally practising a skill can produce large positive transfer to skill in the actual task.

The concept of negative transfer should not be ignored in this discussion. Magill (1989) described negative transfer as occurring when experience with a previous skill interferes with the learning of a new skill, but emphasized that negative transfer effects would normally only be seen in specific aspects of an activity. For example, having learned to tackle in football and then transferring that skill to rugby would most likely result in overall positive transfer, however, negative transfer may occur in specific aspects of the skill such as head placement and body positioning in the tackle. Mentally rehearsing the skill may help to eliminate these negatively transferring aspects and facilitate positive

transfer to the actual skill.

The amount of practice will also effect the amount of transfer. In general, more practice with a task that can positively influence performance on another task will result in performance improvements (Singer, 1980). Results from the mental practice literature, however, have suggested that an optimal level exists at which mental practice is most effective (Corbin, 1972), and that negative effects are likely to result from over extended mental practice sessions (Denis, 1985). Vincent (1968) suggested that performance may also be facilitated through experience with elements or components of a task.

An individual's motivation to transfer skill or knowledge gained from one situation to another is a further consideration, as is the method of training. An example of this would be whether massed or distributed practice, or part versus whole practice is more efficient in facilitating transfer. These concepts would apply equally to imaginal rehearsal and physical practice.

Hall (1982) described massed practice as occuring when trials or practice sessions are continuous, whereas distributed practice means that some time interval occurs between trials. Most studies have found that some form of distributed practice is superior to massed practice, according to Hall (1982).

Learning or practising a task using the whole method involves the presentation of the entire task to the subject. In contrast, the part method involves the independent practice of smaller units of the task, which are then combined to form the complete task. The results of studies which have investigated the relative effectiveness of these methods are equivocal, and therefore few conclusions can be drawn (Hall, 1982). Further analysis of the findings from the various studies has led to the suggestion that if the task components are relatively independent of one another, it is better to practice each component separately. In contrast, it may be more efficient to use the whole method if the task involves some synchrony

amongst it's components (Briggs and Waters, 1958). This is because the integration of the parts is integral to optimal performance of the task, and the practice of these parts in isolation neglects this integrative aspect (Singer, 1980; Hall, 1982).

The intent of transfer will also affect the amount of such transfer, in that "if the instructor indicates the elements common to two tasks and provides the basis for insight and understanding, the learner will probably make greater use of what has been learned on the prior task when it comes time to perform a second related task" (Singer, 1980, p. 471).

Research into Imagery with Open and Closed Skills

Most of the research into the relationship between imagery and performance has been concerned with closed skills. According to Poulton (1957), a closed skill is one that is performed in an environment where the critical cues for the performance of the skill are static or fixed in one position. Examples of closed skills would include gymnastics, bowling or darts. In contrast, an open skill is one that is performed in an environment where the conditions under which the skill is performed are continually changing position in space (Marteniuk, 1976). Basketball, tennis, football and rugby would be examples of sports made up largely of open skills.

Most of the research into the effects of mental practice and imagery has focused upon closed skills. Of the 85 studies that Feltz and Landers (1983) analyzed, only ten investigated open skills. Although the effect sizes between open and closed skill studies were not significant, the trend was towards mental practice being more effective with closed skills. However both groups of studies demonstrated an overall positive effect of mental practice. McIntyre (1987, p. 24) postulated that "if imagery is effective as a learning variable, then it may have potent application for use in practising open skills and thereby, enhancing the transfer to game situations".

Variables to Consider when Investigating Imagery.

When testing for the effect of imagery on motor performance, a number of variables should be accounted for. Such variables include imagery style, imagery ability, task characteristics, skill level of the performer, and length of practice. Each of these will be addressed in turn.

Imagery Style.

Researchers have identified two distinct styles of imagery which have been labelled external and internal. Mumford and Hall (1985) describe the external imagery perspective as primarily visual, with the performers viewing themselves from a third person perspective, as if on film or video. Internal imagery, in contrast, is experienced from a first-person perspective, with the performers rehearsing the task from within the body. This should include the kinesthetic component of the movement as a part of the image, according to Epstein (1980).

The consensus in research to date has been that an internal imagery perspective is better in generating improvements in performance, although numerous studies have been unable to find any differences in imagery perspective (Mumford and Hall, 1985). McFadden (1982) suggested that in some sport tasks, it makes no difference which imagery perspective is utilised. Mumford and Hall (1985) suggested that with closed skill sports such as figure-skating or gymnastics where the field remains unchanged, a reliance on kinesthetic and proprioceptive feedback may be predominant. Thus, in order for performance enhancement, an internal imagery perspective should be more effective. However, for interactive sports such as tennis or rugby, where the field of action is constantly changing, they suggest that an imagery technique sensitive to essentially visual

adaptations would be more appropriate. This debate is ongoing, and until definitive research evidence regarding the effectiveness of one style over the other is forthcoming, the standpoint of "no difference" appears to be more appropriate.

Imagery Ability

A number of researchers have studied the influence of imagery ability on performance. Hall (1985) reviewed a number of studies which suggest that imagery ability can interact with instructions to use mental imagery to influence performance. However, this relationship has not always been shown in the literature, with some studies finding that subjects who report strong visual images showing increased performance compared with subjects reporting weak visual images (Housner and Hoffman, 1981; Ryan and Simons, 1981; Harris and Robinson, 1986). However, other studies have failed to demonstrate any relationship between imagery ability and performance (White, Ashton and Lewis, 1979; Eby, 1986).

One possible reason for the non-emergence of a consistent relationship between imagery ability and motor skill performance has been proposed by Hall, Pongrac and Buckolz (1985) who argue that many of the tests employed to measure imagery ability have not been concerned with movement.

Task Characteristics

Denis (1985) suggested that mental practice instructions have differential effectiveness on different kinds of motor skills. Specifically, tasks with high cognitive or symbolic elements have shown to be more condusive to performance improvements with mental imagery training than tasks which have low cognitive and high motor components (Wrisberg and Ragsdale, 1979; Feltz and Landers, 1983).

Skill Level

In her review of the literature regarding imagery, McIntyre (1987, p. 28) concluded that "the research evidence regarding the relationship between imagery, skill ability, and learning is not clear, and further study is needed to define this relationship". Studies that have been done however, report that the effectiveness of imagery is more likely to be enhanced if the performer has has prior exposure to the skill and is familiar in executing the task (Feltz and Landers, 1983). Studies by Mumford and Hall (1985) and Harris and Robinson (1986) support this notion, and their findings suggest that "more experienced athletes are better able to utilize benefits derived from mental imagery because they can internalize a more precise model (Mumford and Hall, 1985, p. 176)". However McIntyre's (1987) study found that mental imagery training did not enhance performance for elite female basketball players. Rather, the study showed support for the positive effect of imagery with non-elite players, in that these subjects displayed greater performance consistency after using mental imagery training. It is likely that a minimal level of experience in the task, however, is necessary for mental practice to produce positive performance effects.

Furthermore, mental practice may have negative effects uponperformance if it is introduced after insufficient experience in the task is obtained (Denis, 1985). This would occur because the subject's internal representation of the skill may still be incorrect or insufficiently elaborated. In contrast, mental practice should not have much impact if introduced too late in the learning procedure, since a well-formed internal representation of the task will already exist, and this should be more resistant to forgetting (Zecker,1982).

Evidence of the effects of differing and changing skill levels and stages of learning seems to be equivocal, however, it seems reasonable to monitor these variables

and take them into account when exploring the effects of imagery upon performance.

Length of Practice

Given the variability in the nature of tasks, skill level, imagery ability and style in the research into imagery thus far, it is not surprising that varying numbers and lengths of practice sessions incorporating mental imagery have been adopted. According to Corbin (1972), there may be an optimal level at which mental practice is most effective for skill learning. Supporting this notion, Denis (1985) suggested that over-extended mental practice sessions are likely to have some undesirable negative effects. Indeed, a study by Oxendine (1960) reported that subjects responded favourable and conscientiously to the suggestion of mental reharsal for three different motor skills, however, when up to 75% of the practice time was used in mentally rehearsing the skills, some subjects became impatient with the technique. Further, Denis (1985) has suggested that given the type of task, and an individual's cognitive style, there may be an optimal length for mental practice sessions.

Not many researchers are willing to define this optimal length, however, for given tasks. Five minutes was suggested by Twining (1949) as the longest time in which concentration could be maintained without a rest, although Feltz and Landers (1983) found that practice sessions under one minute and between 15 to 25 minutes produced the largest mental practice effects. In contrast, a study by Shick (1970) found that improved skill performance was manifested more effectively using three minute sessions rather than one minute sessions. As for much of the area, further research is necessary which controls for this variable (Weinberg, 1982).

CHAPTER III

RESEARCH METHODS

This chapter reports the research methodology and procedures that were used in the study. The selection of subjects, setting, variables, limitations, instrumentation, training procedures, data collection procedures, observational reliability measures and statistical analyses are presented.

Selection of Subjects

Seventy four male rugby players from the University of Victoria Rugby Club volunteered to participate in the study. Due to injury, absenteeism from training sessions, or non-selection for games under analysis, the sample was reduced to thirty six players for the data analysis of those subjects who participated in all testing conditions.

The subjects included players from the first division (Vikings), second division (Norsemen and Saxons) and junior division (Jutes) teams.

All subjects received an informed consent form and information questionnaire, which was completed and returned to the researcher (see Appendices A and B).

Setting

All training sessions were held outdoors on the rugby playing fields of the University of Victoria. Initial training sessions were conducted on the practice playing field during daylight hours, but as darkness dictated, subsequent training sessions were conducted under lights on the main rugby field.

All games were videotaped either at the University of Victoria's home ground, or at the home ground of the opposing team, as designated in the league schedules.

Dependent Variable

The dependent variable in the study was the tackling performance of each individual under study as defined in Chapter 1.

Independent Variables

The independent variables were:

(a) the three positional groups, consisting of `Tight Five', `Back Row and Halfback', and `Outside Back' players. Subjects were placed into one of these three groups according to their playing position within the game of rugby.

(b) groups of subjects, established post-hoc, according to age, team, level of achievement, playing experience, and responses to questions on the Mental Imagery Questionnaire (see Appendix E).

(c) the three treatment conditions, consisiting of Mental Imagery, Mental Imagery plus Physical Practice, and Physical Practice conditions. These treatment conditions are outlined in the instrumentation section.

Limitations and Delimitations

1. The study was restricted to male university rugby players and therefore caution should be exercised in generalizing the findings to females, other sports, or other age groups.
2. The study was limited by the accuracy of the videotape observer in correctly identifying successful tackles, attempted tackles, and individual players.
3. The study was limited by factors such as the referee's decisions, the weather conditions for both testing andtraining periods, the ability and performance of the

opposition teams, and the application of team strategies, which may have affected individual scores for each testing condition.

Instrumentation

1. Information Questionnaire.

   This questionnaire yielded information regarding each subject's age, the team that they played for, their playing position, playing experience, and level of achievement in rugby (see Appendix B).

2. Treatment Condition Protocols.

   Standardized instructions for all three treatment conditions were formulated prior to administering the treatments. A detailed description of these protocols is shown in Appendix C. All of the treatment conditions involving mental imagery remained unchanged, however slight variations in the physical practice protocols during the final treatment sessions for each positional group were made. This was due firstly to variations in attendance at each training session, and also because of the different tackling demands for each positional group. This meant that in order to make the final session more relevant, simulated game situations were established. These varied according to positional group.

   While taking part in the treatment conditions that involved mental imagery, all subjects were encouraged to practice imaging outside of scheduled practice times. Subjects were asked to imagine themselves performing successful tackles during a game, as often as possible, preferably while they were in a relaxed state. The researcher suggested that immediately prior to sleeping at night, or just after waking up in the mornings were good times, although subjects were encouraged to experiment, in order to establish the most effective time and situation for them

to quiet themselves, relax, and image.

3. Follow-Up Questionnaire

   A questionnaire was developed by the author to provide information describing each subject's thoughts and feelings about the mental imagery training. This questionnaire also yielded information about how each subject's imagery progressed over the training periods, and how often and for how long they practiced imagery outside of the training sessions. The questionnaire was administered to all subjects following the completion of the final testing session (see Appendix D)

4. Mental Imagery Questionnaire.

   A six item written inventory was developed by the researcher, in which a 9-point Likert scale was used to reveal the subject's assessments of the amount of mental imagery that they used, how much they thought that imagery helped them with their tackling, and what type of imagery was used. Measures of the clarity, strength, and degree of control over their imagery were also assessed. The questionnaire was administered to all subjects following the completion of the final testing period (see Appendix E).

   The responses to each question were divided into either two or three groups, depending upon the number of subjects who responded to each item on the Likert scale. In this manner, groups were established in which comparable numbers of subjects appeared. The division of groups accoding to question number is detailed in Appendix F.

Training Procedures

One week before the first treatment session, a meeting was held with those players

who would be involved in the two treatment conditions that incorporated mental imagery training. The purpose of this meeting was to explain the intent of the study, and to introduce them to the concept of mental imagery. The players were shown sections of the videotape entitled "Visualization: What You See Is What You Get" (Botterill, 1985), in which mental imagery was introduced, and prominent Canadian sporting figures talked about the effectiveness of using the technique. All subjects were instructed not to communicate with players from the other training groups regarding their treatment sessions.

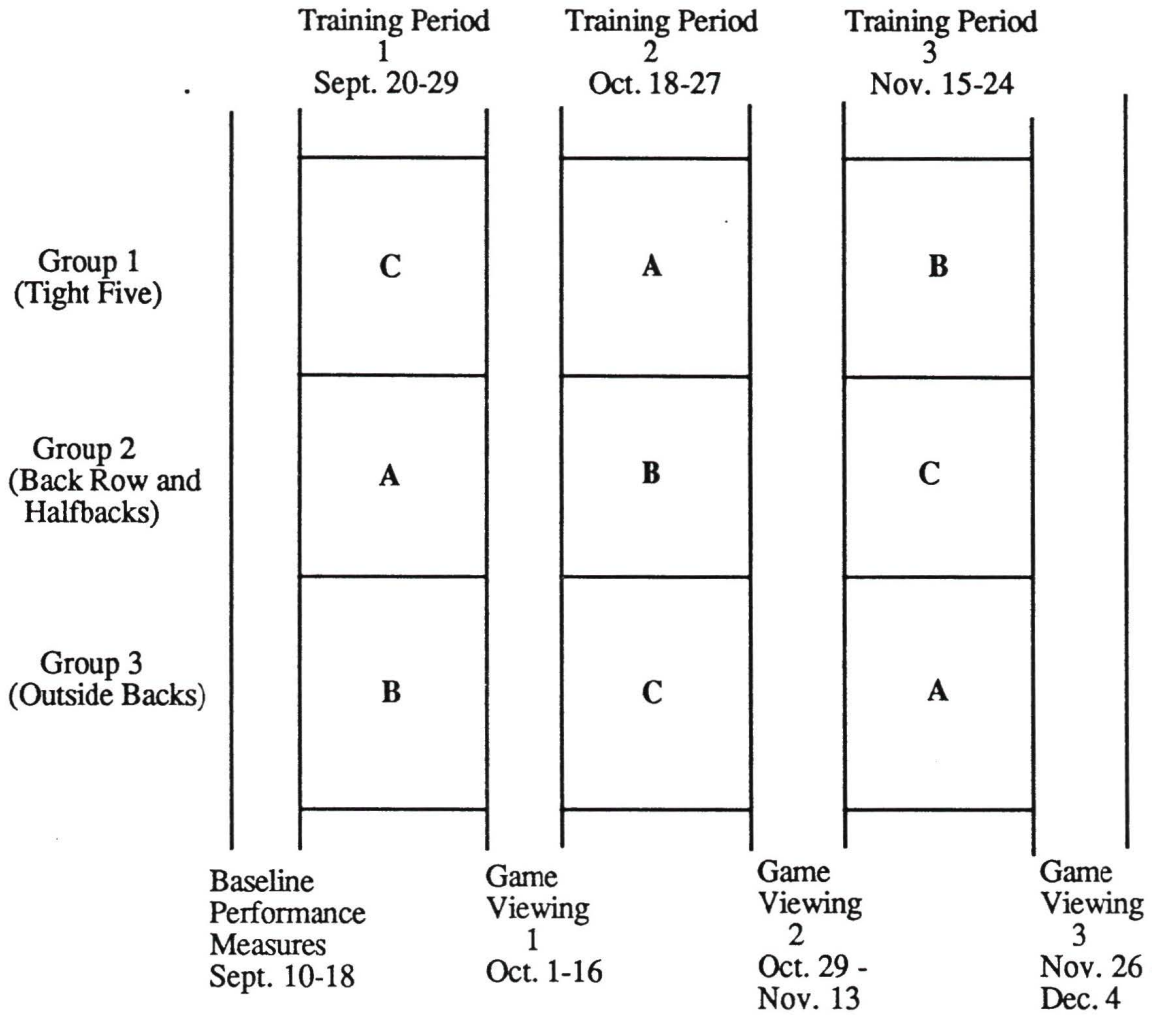
One week prior to the beginning of their first training session involving mental imagery, the third group of players attended a similar meeting to that conducted with the other two positional groups. The same videotape was shown and the concept of mental imagery discussed.

Prior to the initial treatment session, baseline measures of tackling performance were recorded. A VHS half inch video camera was used to film games in which the subjects participated. The camera operator was instructed to follow the ball at all times, and to focus only on those players in the immediate vicinity of the ball, in order to facilitate player identification.

After baseline measures had been obtained, the treatments were implemented. A 3 x 3 Latin Square design was employed, in which all groups received all levels of the treatment (see Figure 1). To control for carry-over effects, the order of treatments was counterbalanced (Elmes, Kantowitz and Roediger, 1985).

During scheduled practice times (two times per week), each group was exposed to one one of the treatment procedures for a period of ten minutes per practice. Each training session lasted for two weeks, which incorporated four scheduled practices. The nature of the practice sessions was such that three different activities operated simultaneously, and

Figure 1. Experimental Design



A = PHYSICAL PRACTICE
B = MENTAL IMAGERY TRAINING
C = MENTAL IMAGERY PLUS PHYSICAL PRACTICE

the groups rotated to a new activity every ten minutes. In this manner all three groups received their assigned treatment at each practice session.

Care was taken to ensure that the same amount of treatment time was given to each group. During any single practice, one group received five minutes of mental imagery training plus five minutes of physical tackling practice. Another group received ten minutes of physical tackling practice, while a third received ten minutes of mental imagery training.

Immediately prior to beginning the first training session with each group, the researcher reminded the players of the importance of tackling, and demonstrated the correct techniques to be used when practising both physically and mentally. At the beginning, and during each subsequent training session, these points were briefly reiterated (see Appendix G).

Following each two week training period, videotapes of all rugby games involving the University of Victoria teams were obtained. The three weekends immediately following the respective training periods were used for this task (see Appendix H)

Data Collection Procedures

A VHS half inch video camera was used to film all games involving the University of Victoria teams for the two week period immediately following each two week training session. In this manner, new baseline measures were established prior to implementing the next treatment condition. A reliable observer viewed each game and recorded the number of attempted and successful tackles made by each University of Victoria player, according to established criteria (see Appendix I). A Game Analysis Sheet was used to record the data for each game (see Appendix J). Success rates were expressed as ratios.

Reliability of Observations

To determine observational reliability, a trained observer and the researcher independently analysed five previously recorded international rugby matches. Inter-observer agreement was established at 93.8%.

To check for 'observer drift`, the observer re-analyzed one previously coded videotape, and established a rating of 91.7% for intra-observer agreement.

Data Analysis

Pre- and post-training session data were collected for each positional group and condition. Data from each testing session were collapsed to yield tackling success rates and improvement scores for each condition. Subjects were also grouped according to age, team, level of achievement, playing experience, and their responses to each questionnaire item from the Mental Imagery Questionnaire. Tackling success rates and improvement scores for each condition were calculated for each level of these subject groupings.

For those subjects involved in all testing conditions, a series of multivariate analyses of variance (MANOVAs) with repeated measures was conducted for both tackling success rates and improvement scores, to test for main effects and interactions between the groups and conditions. In addition, a series of one-way analyses of variance (ANOVAs) with repeated measures was conducted for each group to test for differences between conditions. Where appropriate, post-hoc t tests were conducted if any of the ANOVAs revealed significance.

Using the data for all subjects, a series of ANOVAs was conducted for tackling success rates and improvement scores at each testing condition, for all subject groupings. Also, in order to test for overall differences between the conditions, multiple paired t tests were conducted.

The performance of the paired t tests did not protect against Type 1 error, and as such, caution should be exercised when interpreting any significant results. Such results would only provide indications of relationships between variables.

CHAPTER IV

RESULTS

This chapter presents the results of the data analyses performed upon the tackling success rates and mean improvement scores over previous baselines (improvement scores) for all groupings of subjects. The results are divided into two sets; (a) subjects who appear in all testing conditions, and (b) all subjects. Descriptive data for both sets are reported initially, followed by the statistical analyses for each set of data. These are subdivided into results for the experimental analyses and post-hoc analyses.

Descriptive Results

The means and standard deviations of tackling success rates for the three positional groups at each testing condition are shown in Tables 1 and 2. Tables 3 and 4 report the means and standard deviations of improvement scores for these groups. Post-hoc categorization of subjects into groupings of age, team, level of achievement, and playing experience resulted in means and standard deviations for tackling success rates and improvement scores being calculated. These are reported in Tables 1 to 4.

The means and standard deviations of tackling success rates and improvement scores for subject groupings of the Mental Imagery Questionnaire are shown in Tables 5 to 8.

Figures 2 to 5 show the tackling success rates and improvement scores for the three positional groups at each testing period.

Results for subjects involved in all testing conditions

(a) Planned (a priori) design:

A MANOVA was conducted on the tackling success rates at each testing condition for

Table 1

Means and Standard Deviations of Tackling Success Rates for all Subject Groupings, Using Subjects Involved in all Testing Conditions

Group	N	Testing Condition			
		Baseline	Mental Imagery	Physical Practice	Combination (MI + PP)
POSITION					
Tight Five	10	.68(.35)	.82(.21)	.70(.39)	.84(.20)
Back Row & Halfbacks	13	.81(.28)	.82(.19)	.77(.22)	.80(.23)
Outside Backs	13	.74(.28)	.72(.17)	.73(.27)	.71(.24)
AGE					
Up to Twenty	17	.72(.24)	.81(.16)	.73(.33)	.89(.15)
Over Twenty	19	.77(.34)	.76(.21)	.75(.25)	.68(.24)
TEAM					
1st Division	10	.72(.35)	.83(.16)	.77(.28)	.69(.21)
2nd Division	14	.82(.32)	.71(.21)	.77(.19)	.72(.25)
Junior Division	12	.68(.21)	.83(.17)	.68(.38)	.91(.16)
LEVEL					
Club	16	.81(.26)	.77(.19)	.78(.24)	.81(.22)
Representative	20	.70(.32)	.80(.19)	.70(.32)	.75(.24)
EXPERIENCE					
Up to 4 Years	8	.55(.35)	.75(.21)	.79(.23)	.73(.28)
5 to 6 Years	16	.78(.22)	.79(.18)	.67(.32)	.83(.20)
Over 6 Years	12	.83(.31)	.79(.20)	.80(.27)	.73(.23)
OVERALL	36	.75(.29)	.78(.19)	.74(.28)	.78(.23)

Note. Standard deviations are in parentheses.

Table 2

Means and Standard Deviations of Tackling Success Rates for all Subject Groupings, Using all Subjects.

Group	Testing Condition			
	Baseline (n=55)	Mental Imagery (n=71)	Physical Practice (n=69)	Combination (MI + PP) (n=65)
POSITION				
Tight Five	.70(.36)	.82(.25)	.75(.34)	.83(.21)
Back Row and Halfbacks	.83(.25)	.81(.19)	.77(.19)	.79(.21)
Outside Backs	.71(.27)	.74(.18)	.74(.23)	.68(.28)
AGE				
Up to 18 Years	.74(.28)	.84(.18)	.67(.34)	.86(.26)
19 to 20 Years	.85(.25)	.74(.19)	.85(.15)	.75(.18)
21 to 22 Years	.70(.34)	.79(.24)	.79(.26)	.75(.24)
Over 22 Years	.79(.35)	.78(.25)	.71(.22)	.64(.25)
TEAM				
Vikings	.73(.29)	.83(.20)	.78(.24)	.74(.21)
Norsemen	.90(.21)	.78(.16)	.78(.18)	.74(.18)
Saxons	.69(.41)	.69(.30)	.81(.24)	.68(.26)
Jutes	.71(.27)	.85(.18)	.65(.36)	.89(.25)
LEVEL				
Junior	.69(.32)	.88(.17)	.64(.36)	.91(.30)
Club	.80(.31)	.76(.24)	.83(.18)	.70(.22)
Representative	.73(.30)	.79(.20)	.73(.28)	.77(.21)
EXPERIENCE				
Up to 4 Years	.55(.37)	.77(.20)	.80(.22)	.71(.34)
5 to 6 Years	.77(.28)	.79(.24)	.71(.30)	.79(.22)
Over 6 Years	.82(.26)	.80(.18)	.77(.27)	.77(.21)
OVERALL	.75(.30)	.79(.21)	.75(.27)	.77(.24)

Note. Standard deviations are in parentheses.

Table 3

Means and Standard Deviations of Improvement Scores for all Subject Groupings, Using Subjects Involved in all Testing Conditions.

Group	N	Testing Condition		
		Mental Imagery	Physical Practice	Combination (MI + PP)
POSITION				
Tight Five	11	.06(.46)	-.13(.45)	.24(.51)
Back Row and Halfbacks	13	.04(.23)	-.03(.19)	-.02(.20)
Outside Backs	13	-.02(.35)	.03(.37)	-.02(.24)
AGE				
Up to twenty	17	.11(.38)	-.14(.36)	.13(.19)
Over twenty	20	-.04(.30)	.04(.32)	.00(.44)
TEAM				
1st Division	10	.09(.26)	.02(.37)	-.04(.46)
2nd Division	15	-.13(.33)	.04(.22)	.05(.35)
Junior Division	12	.17(.36)	-.20(.42)	.15(.21)
LEVEL				
Club	17	-.04(.42)	-.02(.34)	.10(.34)
Representative	20	.08(.26)	-.06(.36)	.03(.36)
EXPERIENCE				
Up to 4 Years	8	.17(.26)	.03(.22)	.05(.25)
5 to 6 Years	17	.02(.40)	-.11(.41)	.09(.38)
Over 6 Years	12	-.06(.30)	.01(.32)	.03(.39)
OVERALL	37	.03(.34)	.04(.33)	
.06(.35)				

Note. Standard deviations are in parentheses.

Table 4

Means and Standard Deviations of Improvement Scores for all Subject Groupings, Using all Subjects.

Group	Testing Condition		
	Mental Imagery (n=56)	Physical Practice (n=53)	Combination (MI + PP) (n=52)
POSITION			
Tight Five	.01(.45)	-.12(.47)	.15(.51)
Back Row and Halfbacks	.06(.22)	-.06(.21)	.00(.25)
Outside Backs	.05(.36)	.06(.32)	-.08(.24)
AGE			
Up to 18	.17(.34)	-.20(.43)	.12(.25)
19 to 20	-.04(.31)	.04(.13)	-.02(.25)
21 to 22	-.01(.41)	.04(.38)	.01(.52)
Over 22	-.01(.29)	.07(.19)	-.12(.23)
TEAM			
Vikings	.07(.26)	.01(.35)	-.02(.45)
Norsemen	.04(.32)	.03(.17)	-.10(.20)
Saxons	-.19(.44)	.11(.25)	.01(.39)
Jutes	.19(.33)	-.21(.44)	.13(.26)
LEVEL			
Junior	.26(.34)	-.21(.50)	.14(.31)
Club	-.13(.42)	.08(.22)	-.06(.37)
Representative	.09(.26)	-.05(.35)	.04(.34)
EXPERIENCE			
Up to 4 Years	.13(.28)	.08(.25)	.02(.28)
5 to 6 Years	.05(.42)	-.11(.42)	.00(.39)
Over 6 Years	-.01(.31)	.00(.28)	.04(.34)
OVERALL	.04(.36)	-.04(.35)	.02(.35)

Note. Standard deviations are in parentheses.

Table 5

Means and Standard Deviations of Tackling Success Rates for Subject Groupings of the Mental Imagery Questionnaire, Using Subjects Involved in all Testing Conditions.

Question	N	Testing Condition			
		Baseline	Mental Imagery	Physical Practice	Combination (MI + PP)
1					
Extensive imagery use	21	.81(.22)	.83(.18)	.77(.25)	.74(.21)
Less extensive use	14	.66(.37)	.71(.18)	.74(.28)	.83(.26)
2					
Extensive tackling assistance	22	.67(.32)	.78(.18)	.77(.26)	.83(.22)
Less extensive assistance	13	.90(.19)	.78(.22)	.74(.26)	.67(.21)
3					
Internal imagers	11	.72(.32)	.78(.20)	.80(.30)	.71(.23)
Internal and External	12	.77(.30)	.76(.10)	.84(.13)	.86(.16)
Predominantly External	12	.78(.29)	.81(.25)	.65(.29)	.74(.27)
4					
Clear images	26	.76(.27)	.81(.20)	.74(.24)	.76(.23)
Less clear images	9	.75(.38)	.69(.15)	.81(.32)	.79(.23)
5					
Strong other sensations	23	.78(.24)	.81(.16)	.83(.13)	.80(.20)
Weaker sensations	12	.71(.39)	.74(.23)	.63(.38)	.71(.27)
6					
Easily controlled images	21	.68(.28)	.82(.19)	.79(.21)	.80(.24)
Less controllable images	14	.87(.29)	.73(.18)	.71(.32)	.73(.20)
OVERALL	35	.75(.30)	.78(.19)	.76(.26)	.77(.23)

Note. Standard deviations are in parentheses.

Table 6

Means and Standard Deviations of Improvement Scores for subject Groupings of the Mental Imagery Questionnaire, Using subjects Involved in all Testing Conditions.

		Testing Condition		
Question	N	Mental Imagery	Physical Practice	Combination (MI + PP)
1				
Extensive imagery use	21	.03(.35)	.02(.32)	-.06(.33)
Less extensive use	15	.01(.34)	-.06(.29)	.22(.33)
2				
Extensive tackling assistance	22	.07(.29)	-.03(.28)	.11(.32)
Less extensive assistance	14	-.06(.41)	.00(.35)	-.03(.39)
3				
Internal imagers	11	.00(.28)	.01(.40)	.02(.45)
Internal and External	13	-.09(.31)	.01(.17)	.20(.33)
Predominantly External	12	.16(.41)	-.06(.37)	-.06(.22)
4				
Clear images	27	.05(.35)	-.02(.28)	.04(.32)
Less clear images	9	-.06(.34)	.01(.40)	.12(.46)
5				
Strong other sensations	23	-.02(.25)	.03(.22)	.03(.29)
Weaker sensations	13	.08(.47)	-.10(.42)	.10(.45)
6				
Easily controlled images	22	.05(.29)	.03(.19)	.09(.37)
Less controllable images	14	-.03(.42)	-.09(.43)	.01(.34)
OVERALL	36	.02(.34)	-.02(.31)	.06(.35)

Note. Standard deviations are in parentheses.

Table 7

Means and Standard Deviations of Tackling Success Rates for Subject Groupings of the Mental Imagery Questionnaire, Using all Subjects.

	Testing Condition			
Question	Baseline	Mental Imagery	Physical Practice	Combination (MI + PP)
1				
Extensive imagery use	.83(.21)	.76(.20)	.75(.25)	.72(.24)
Less extensive use	.68(.35)	.80(.76)	.76(.26)	.81(.24)
2				
Extensive tackling assistance	.71(.29)	.76(.19)	.77(.24)	.76(.27)
Less extensive assistance	.84(.28)	.80(.19)	.75(.28)	.75(.21)
3				
Internal imagers	.75(.28)	.80(.19)	.75(.29)	.72(.27)
Internal and External	.75(.32)	.77(.16)	.81(.18)	.84(.18)
Predominantly External	.78(.28)	.78(.25)	.70(.29)	.72(.26)
4				
Clear images	.76(.28)	.78(.20)	.73(.25)	.74(.26)
Less clear images	.75(.32)	.78(.18)	.82(.27)	.82(.20)
5				
Strong other sensations	.79(.23)	.78(.18)	.79(.22)	.83(.18)
Weaker sensations	.71(.37)	.78(.21)	.71(.30)	.67(.28)
6				
Easily controlled images	.70(.30)	.81(.20)	.79(.22)	.77(.27)
Less controllable images	.83(.26)	.74(.18)	.72(.29)	.75(.21)
OVERALL	.75(.30)	.79(.21)	.75(.27)	.77(.24)

Note. Standard deviations are in parentheses.

Table 8

Means and Standard Deviations of Improvement Scores for Subject Groupings of the Mental Imagery Questionnaire, Using all Subjects.

Question	Testing Condition		
	Mental Imagery	Physical Practice	Combination (MI + PP)
1			
Extensive imagery use	.02(.358)	.05(.300)	-.05(.323)
Less extensive use	.05(.294)	-.11(.330)	.15(.361)
2			
Extensive tackling assistance	.05(.286)	.01(.274)	.05(.343)
Less extensive assistance	.02(.371)	-.07(.383)	-.01(.371)
3			
Internal imagers	.03(.265)	-.05(.411)	-.05(.429)
Internal and External	-.01(.333)	.00(.172)	.14(.319)
Predominantly External	.11(.391)	-.01(.345)	-.04(.257)
4			
Clear images	.05(.325)	-.02(.313)	.00(.330)
Less clear images	.01(.336)	-.01(.355)	.11(.413)
5			
Strong other sensations	.00(.277)	-.01(.278)	.04(.291)
Weaker sensations	.09(.385)	-.03(.383)	.00(.418)
6			
Easily controlled images	.08(.294)	.03(.225)	.06(.387)
Less controllable images	-.03(.365)	-.08(.410)	-.02(.297)
OVERALL	.04(.355)	-.04(.348)	.02(.347)

Note. Standard deviations are in parentheses.

Figure 2. Tackling Success Rates of the Three Positional Groups for each Treatment Condition, at each Testing Period, Using Subjects Involved in all Testing Conditions. (n=36)

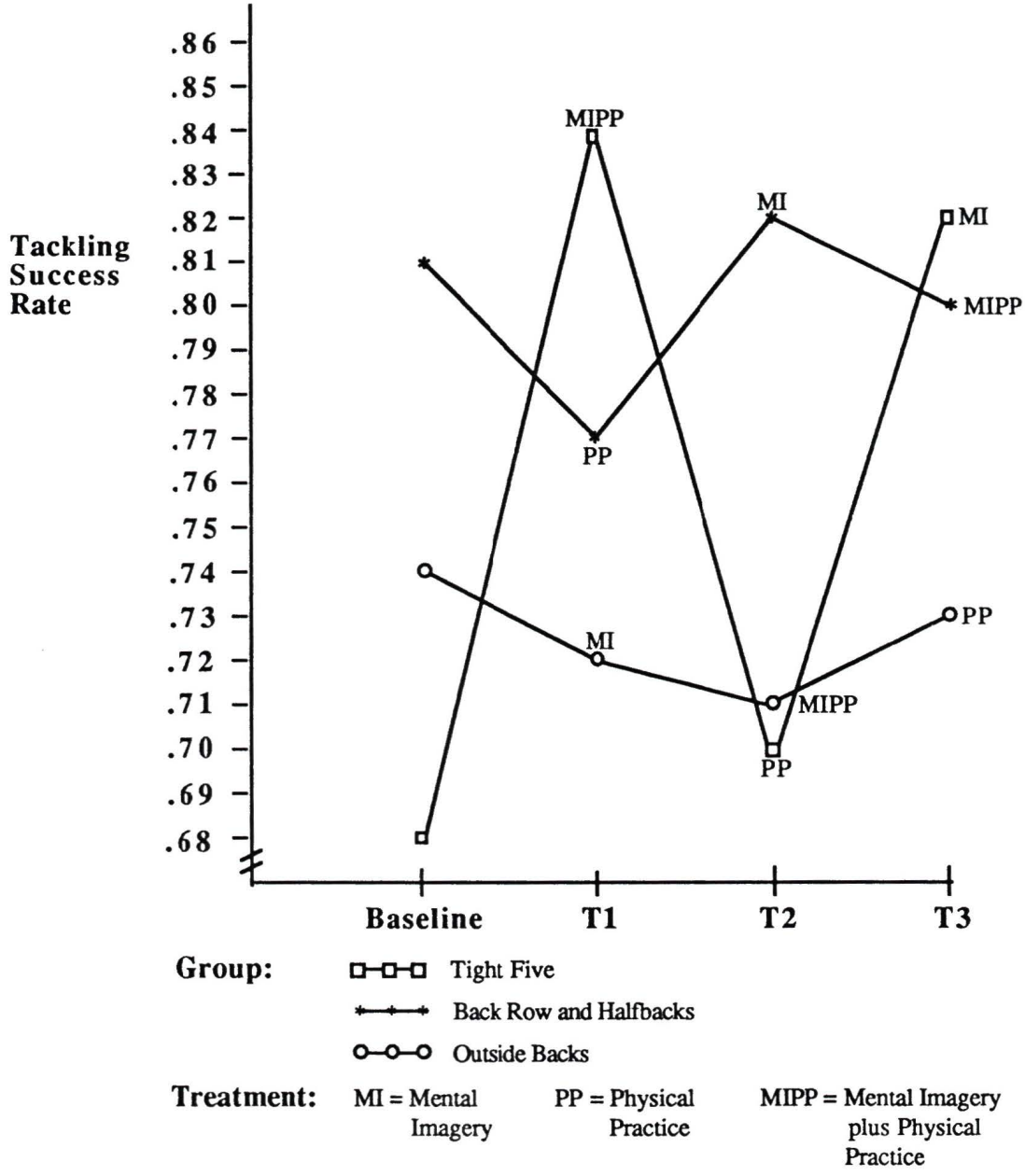


Figure 3: Improvement Scores of the Three Positional Groups for each Treatment Condition, at each Testing Period, Using Subjects Involved in all Testing Conditions. (n=37)

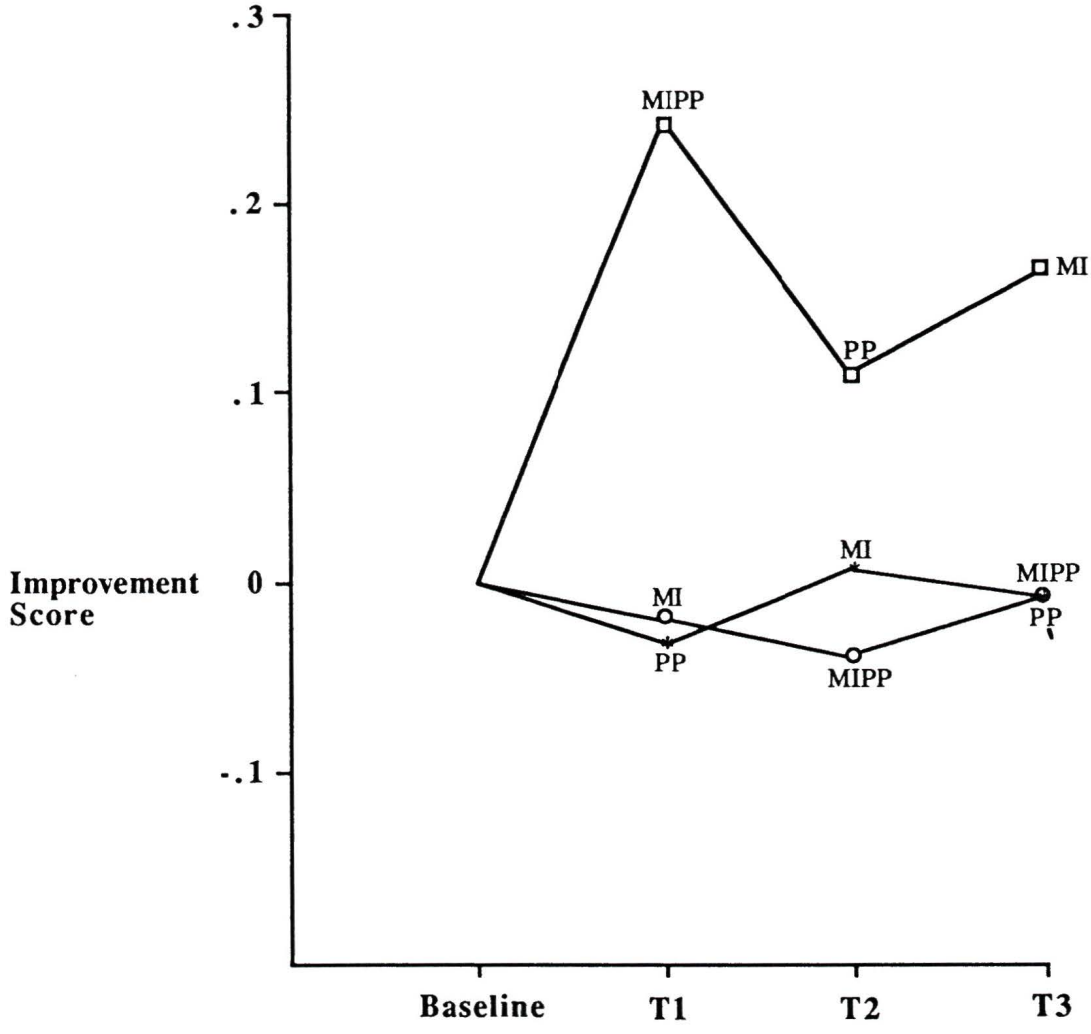
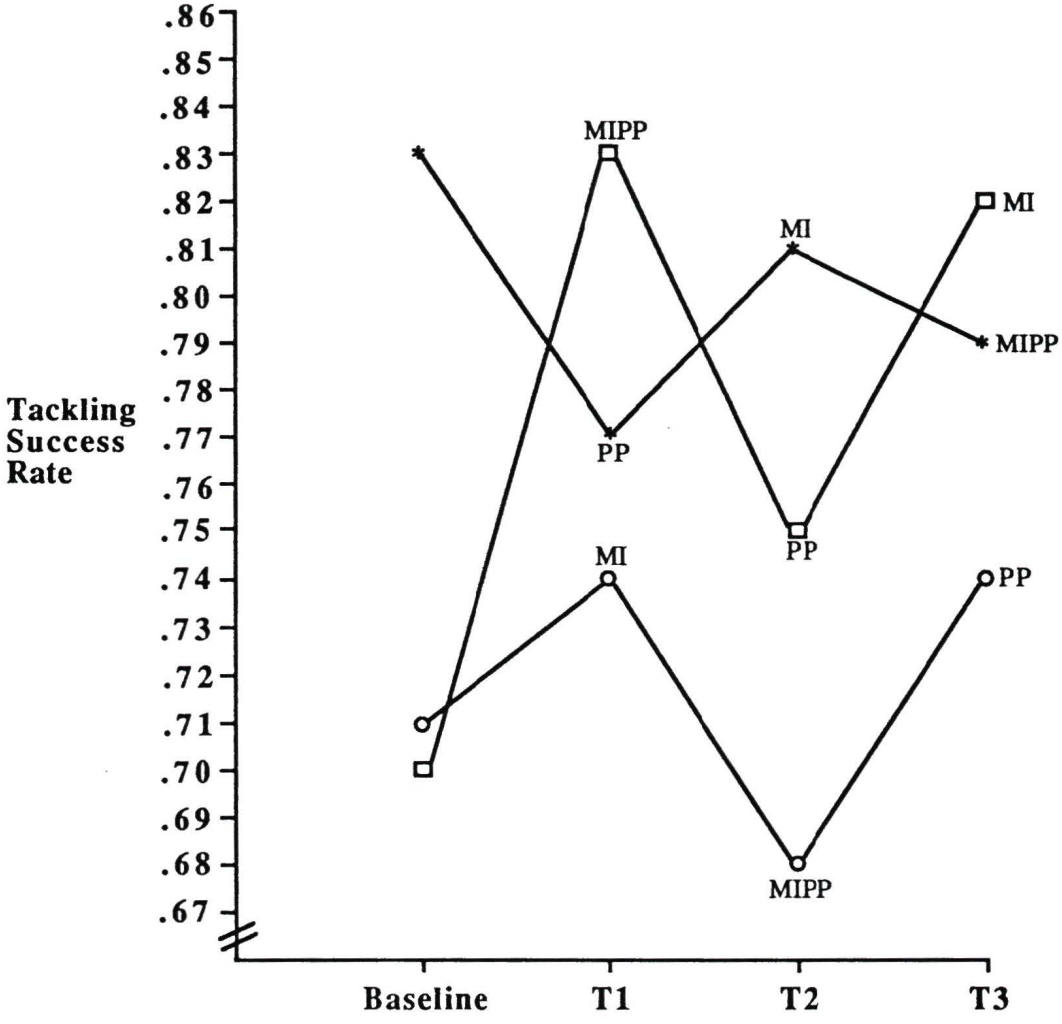


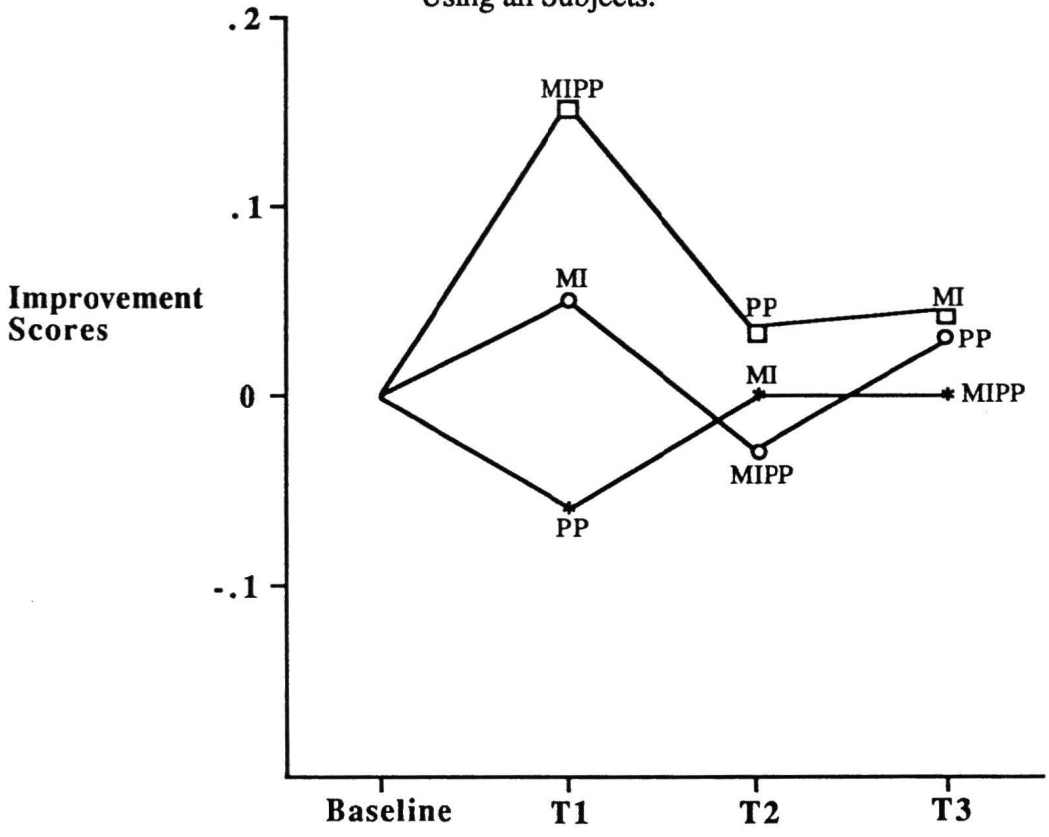
Figure 4: Tackling Success Rates of the Three Positional Groups for each Treatment Condition, at each Testing Period, Using all Subjects.



Group:
- Tight Five
- Back Row and Halfbacks
- Outside Backs

Treatment:
- MI = Mental Imagery
- PP = Physical Practice
- MIPP = Mental Imagery plus Physical Practice

Figure 5: Improvement Scores of the Three Positional Groups for each Treatment Condition, at each Testing Period, Using all Subjects.



Group:
- Tight Five
- Back Row and Halfbacks
- Outside Backs

Treatment:
- MI = Mental Imagery
- PP = Physical Practice
- MIPP = Mental Imagery plus Physical Practice

the three positional groups. This procedure revealed no significant main effect for position or treatment condition ($F<1$), and no significant interaction between position and treatment condition ($F<1$).

Results of the MANOVA conducted on the improvement scores at each testing condition for the positional groups also revealed no significant main effect for position, $F(2,34) = 1.15$, $p>.05$, or treatment condition ($F<1$). There was no significant interaction between position and treatment condition ($F<1$).

(b) Post-hoc analyses:

The MANOVAs conducted on tackling success rates and improvement scores for each post-hoc grouping of subjects showed that the interaction of the subgroupings of "Team" and treatment condition for tackling success rates was the only significant result, $F(6,99) = 2.23$, $p<.05$. No significant main effects or interactions were found for the improvement scores.

Results of the MANOVAs that were conducted upon the tackling success rates and improvement scores for each grouping of question responses to the Mental Imagery Questionnaire are shown in Tables 9 and 10. For tackling success rates, significant interactions were found between treatment conditions and the questionnaire item "rating of performance benefits", $F(3,99) = 5.14$, $p<.01$, and between treatment conditions and the questionnaire item "controllability of images", $F(3,99) = 3.51$, $p<.05$. Significant main effects for "rating of performance benefits", $F(1,34) = 4.88$, $p<.05$, and "controllability of images", $F(1,34) = 7.23$, $p<.05$, for improvement scores were found. Examination of the means for each group showed that overall, those subjects who believed that imaging improved their tackling performance extensively, exhibited a significantly higher improvement score ($M = .15$) than those subjects who did not believe as extensively that imagery improved their tackling performance ($M = -.09$). Similarly, those subjects who

Table 9

Results of the MANOVAs Conducted Upon the Tackling Success Rates for Subjects Involved in all Testing Conditions, who were Grouped According to Responses to the Mental Imagery Questionnaire.

Question	Effect	F	p
1 Amount of Practice	Q1 Condition Q1 X Condition	1.02 - 2.05	
2 Rating of Performance Benefits	Q2 Condition Q2 X Condition	- - 5.14	.002**
3 Imagery Style	Q3 Condition Q3 X Condition	- - 1.10	
4 Clarity of Images	Q4 Condition Q4 X Condition	- - -	
5 Strength of Images	Q5 Condition Q5 X Condition	3.99 - -	.054
6 Controllability of Images	Q6 Condition Q6 X Condition	- - 3.51	.018*

** $p<.01$
* $p<.05$

Table 10

Results of the MANOVAs Conducted Upon the Improvement Scores for Subjects Involved in all Testing Conditions, who were Grouped According to Responses to the Mental Imagery Questionnaire.

Question	Effect	F	p
1 Amount of Practice	Q1 Condition Q1 X Condition	2.71 - 2.25	
2 Rating of performance benefits	Q2 Condition Q2 X Condition	4.88 - -	.034*
3 Imagery Style	Q3 Condition Q3 X Condition	- - 1.48	
4 Clarity of Images	Q4 Condition Q4 X Condition	- - -	
5 Strength of Images	Q5 Condition Q5 X Condition	- - -	
6 Controllability of Images	Q6 Condition Q6 X Condition	7.23 - -	.011*

* $p<.05$

were better able to control their images showed a significantly higher improvement score overall (M = .17), than those who were less able to control their images (M = -.11).

To test for differences between testing conditions for each positional group, a series of one-way ANOVAs was performed for tackling success rates and improvement scores. No significant differences were found.

Results for all subjects

(a) Planned (a priori) design:

None of the statistical procedures that were used yielded any significance between treatment conditions or positional groups.

(b) Post-hoc Analyses:

Using the data for all subjects involved in the study, a series of one-way ANOVAs was conducted for tackling success rates and improvement scores at each testing condition, for all post-hoc subject groupings. Results for tackling success rates revealed significance for the Mental Imagery Questionnaire item "strength of image", $F(1,52) = 6.14$, $p<.05$, on the mental imagery plus physical practice condition. Those subjects who reported strong other sensations with their imagery (n = 31) recorded a significantly higher tackling success rate (M = .83) than subjects (n = 23) who reported weaker other sensations with their imagery (M = .67).

Results for the improvement scores revealed significance for the mental imagery condition by levels of team, $F(3,52) = 2.87$, $p<.05$, and level of achievement, $F(2,53) = 4.64$, $p<.05$. Post-hoc t-tests revealed a significant difference between junior level players (M = .26, n = 8), and club level players (M = -.13, n = 19), $t(25) = 2.56$, $p<.05$. A significant difference was also found between the second division (Saxons) team (M = -.19, n = 12) and the junior division (Jutes) team (M = .19, n = 15), $t(25) = -2.49$, $p<.05$.

The mental imagery plus physical practice condition also showed significance for the subgroupings of the Mental Imagery Questionnaire item "amount of practice", although the direction of this difference was unexpected, $F(1,45) = 4.15$, $p<.05$. Those subjects who reported that they used imagery an extensive amount (n = 28) exhibited a significantly lower improvement score ($M = -.06$) than subjects (n = 19) who reported using imagery less extensively ($M = .15$).

To test for overall differences between the conditions, multiple paired t tests were conducted. No significant differences between the conditions were found for either tackling success rates or improvement scores.

Multiple paired t tests for tackling success rates between conditions for all levels of subject groupings were conducted. Significant differences existed between baseline ($M = .75$) and mental imagery plus physical practice conditions ($M = .89$), for those subjects (n = 20) twenty years of age and under, $t(19) = -2.13$, $p<.05$. There was also a significant difference between baseline ($M = .73$) and mental imagery conditions ($M = .88$) for first division team players (n = 14), $t(13) = -2.32$, $p<.05$. Junior division players (n = 14) exhibited a significant difference between baseline ($M = .70$) and mental imagery plus physical practice conditions ($M = .92$), $t(13) = -3.14$, $p<.01$.

Multiple paired t tests were also conducted for improvement scores between conditions for all levels of subject groupings. One significant difference was found, in which junior division team players (n = 14) showed greater improvement after Mental Imagery training ($M = .19$), than after Physical Practice ($M = -.22$), $t(13) = 2.27$, $p<.05$.

CHAPTER V

DISCUSSION

This chapter presents a discussion of the results with reference to existing research and theory.

Planned (a priori) design.

No significant differences between the treatment conditions or the positional groups were found. These results support the stated hypotheses and are in accordance with the findings of Mumford and Hall (1985) and Eby (1986) who found no evidence that imagery training improved performance.

Despite these non-significant results, some definite trends were revealed. Recognising that large standard deviations were apparent, the overall tackling performances of subjects who participated in all treatment and testing conditions improved by 5%, and for all subjects in general, the overall improvement was 2%. These figures were broken down to show the differences between the three conditions, and the positional groups. Following training in the Mental Imagery condition, the overall mean tackling success rate for all subjects was .78. This figure was the same for subjects involved in all testing conditions. By comparison, following Physical Practice, the overall mean tackling success rate for all subjects was .75, and .74 for subjects involved in all testing conditions. Although not significantly different from the Mental Imagery condition, these figures were lower. This was in contrast to the reviews by Richardson (1967), Corbin (1972), and Feltz and Landers (1983), who found that overall, mental practice alone was not as effective as physical practice. These results were compared with those following training in the Mental Imagery plus Physical Practice condition. This condition resulted in overall tackling success rates for all subjects of .77, and .78 for subjects involved in all testing

conditions. These results correspond closely with those for the Mental Imagery condition. The improvement scores for subjects who were involved in all testing conditions, however, show that subjects improved their mean tackling performance by 3% following Mental Imagery training, and 6% following training using Mental Imagery plus Physical Practice. This result supports the views of Oxendine (1969), White, Ashton and Lewis (1979), and Weinberg (1982), who reported that the combination of mental practice with physical practice was the most effective in terms of mental practice application.

The Physical Practice condition resulted in an overall mean performance decrement of 4% from the previous baseline, for subjects involved in all testing conditions. This directly contradicts the findings of Richardson (1967), Corbin (1972), and Feltz and Landers (1983), that mental practice alone was not as effective as physical practice.

The further breakdown of these results into the differences between conditions for each positional group revealed that the largest differences were exhibited by the Tight Five group of subjects. Subjects in this group who were involved in all testing conditions showed an overall mean improvement in tackling performance of 17% from the initial baseline to the final testing condition, compared with -1% for both of the other positional groups. However, using all subjects in the Tight Five group, the overall mean improvement was 4%, which was still higher than either of the other positional groups, who showed a mean performance decrement of 1%.

Both conditions involving mental imagery training proved to be more effective than the Physical Practice condition for Tight Five players. The overall mean improvement score for the Mental Imagery plus Physical Practice condition using Tight Five players involved in all testing conditions, was 24%, compared with 6% for the Mental Imagery condition, and -13% for the Physical Practice condition. These same conditions revealed corresponding improvement scores of 15%, 1%, and -12% for all Tight Five players. This

result differs from the Outside Back subjects, whose most effective treatment condition was Physical Practice, producing improvements in tackling performance of 3% for subjects involved in all testing conditions, and 6% for all subjects. The corresponding improvement scores for both divisions Outside Back players following Mental Imagery plus Physical Practice training were -2% and -8% respectively.

A number of reasons may account for these results. Following the establishment of baseline performance measures, it was shown that Tight Five players exhibited a lower tackling success rate when compared with Outside Back and Back Row and Halfback players. Thus, there was more scope for improving their performances. Moreover, there may have been a plateau effect for tackling success in the various positions, and the closer to maximum that a player's performance reached, the more difficult it may have been to improve.

The style and amount of tackles that Outside Back players were required to perform differed from that of Tight Five players, and this may have influenced the results. Typically, Outside Back players performed tackles in more open field play, and when the opposing players were moving faster, so there was a greater margin for error. Tight Five players, in contrast, were not expected to make as many tackles, and typically made tackles in a more confined area, for example, around rucks and mauls. This meant that they had more opportunities to successfully complete tackles because their typical opponents were not trying to elude them. Thus, their margin for error was less than that for Outside Back players. If a plateau effect for tackling existed, it would seem likely that this would have occurred earlier for Outside Back players than for Tight Five players. With this in mind, and recognising that baseline performance measures for Outside Back players were higher than for Tight Five players, their improvement scores in tackling performance should not have been as great. As is seen in Table 3, this was true fo those subjects involved in all

testing conditions.

In contrast to the other two positional groups, Back Row and Halfback players were required to perform a great deal of tackles of both types outlined earlier. Because this group's initial baseline performance measures were so high, their margin for improvement was less than for either Tight Five or Outside Back players.

This reasoning does not explain the fact that Tight Five players exhibited mean improvements in tackling performance following training involving mental imagery, and a mean decrement in performance following Physical Practice training. In keeping to the theoretical framework oulined by Paivio (1985), it is suggested that the training sessions incorporating mental imagery were effective on two levels. In general terms, the Tight Five players were less experienced at tackling than either of the other two groups of players, and thus the imagery may have contributed to improving their tackling technique, and therefore their performance. In this manner, the cognitive element of Paivio's framework would have been satisfied. In addition, the imagery may have had a motivating role in "psyching-up" these players for tackling. As outlined earlier, Tight Five players are neither expected nor required to perform as many tackles as the other two groups. Although required to be able to perform the skill, tackling is not of primary concern for this group of players, whereas it is seen to be an essential component of both Outside Back, and Back Row and Halfback players' game performance. Consequently, the focus on tackling provided by the imagery training would have been somewhat of a novelty compared to the usual practice requirements for Tight Five players, and thus they were more motivated to train and perform. In contrast, the majority of players from the other two groups may have felt that this element of their game was sufficiently developed, and thus not as much effort was placed into the training.

The result for the Tight Five group of players suggests that the concept of imagery

facilitating the transfer of physical training to actual game performance was demonstrated, in accordance with the views of Johnson (1982) and Kohl and Roenker (1980; 1983). If imagery training created the psychological effect of simulating the performance situation, as Suinn (1985) suggested it was able to do, then the training conditions created when using Mental Imagery plus Physical Practice would have been more similar to the actual performance situation than the conditions created when training in either the Physical Practice or Mental Imagery alone condition. As Singer (1980) has described, the more similar two tasks are in terms of task components and performance conditions, the better the transfer from one task to another. Taking Suinn's (1985) and Singer's (1980) comments into consideration, the Mental Imagery plus Physical Practice training condition was the most effective in facilitating the transfer of training to performance. The fact that the Physical Practice condition was followed by a small performance decrement may be indicative of the inability of this training condition to adequately simulate the actual performance situation. Physical practice typically requires players to tackle their own teammates, and although this may assist them in developing and practising the correct tackling technique, it does not recreate the environment or atmosphere of a real game. The motivation to tackle teammates is not as great than if they were actual opponents, and the simulated game conditions of many tackling drills usually do not include all the options that are available to the attacking players.

Although the mean differences between the tackling performances of Tight Five players following the three training conditions were seemingly large, no statistically significant differences between the conditions were reported. This was because the standard deviations for the two measures of tackling performance following each training condition were so great. Therefore, caution should be exercised when considering the suggested explanations for these mean differences. Other factors such as age, ability in

both tackling and imaging, tackling experience, style of imagery, and the amount of imagery practice, could have contributed to these variations. These factors were examined separately in the discussion of the post-hoc analyses.

Post-hoc Analysis.

(a) Subjects involved in all testing conditions.

The significant interaction that was found between treatment conditions and levels of Team for tackling success rates indicates that as the treatment conditions changed, the tackling success rates for the various teams changed to varying extents. As was seen in Table 1, different treatment conditions were more successful for different teams in terms of tackling performance. The first division (Vikings) team demonstrated the highest tackling success rate following training in the Mental Imagery condition, whereas the junior division (Jutes) team showed their highest tackling success rate following training in the Mental Imagery plus Physical Practice condition. The results for the junior division (Jutes) team indicate that the use of training methods involving mental imagery for tackling, were more effective than purely physical practice for this group of players. In comparison, Mental Imagery training alone was the most effective treatment condition for first division (Vikings) players, followed by Physical Practice and then Mental Imagery plus Physical Practice. Second division (Norsemen and Saxons) players showed that the Physical Practice condition was the most effective for them in terms of tackling performance.

Players from the first division (Vikings) team and the highly successful junior division (Jutes) team could be regarded as being more highly skilled at tackling than their counterparts from either of the second division teams. If this is true, then the increased effectiveness of menttal imagery training for more skilled performers would be demonstrated, in accordance with the findings of Mumford and Hall (1985) and Harris and

Robinson (1986). The seemingly incongruous result following the Mental Imagery plus Physical Practice condition, for first division (Vikings) players, however, is difficult to explain in these terms.

An alternative explanation for these results would be the differing amounts of effort that players from each team put into their training. Players from the junior division (Jutes) team may have found the training that involved purely physical practice somewhat intimidating because they were participating with older, larger and more experienced players. In contrast, the training that involved mental imagery rehearsal would have been a less intimidating prospect. More effort may therefore have been placed into this type of training, which in turn was transferred into the game situation. Second division players, however, may have felt that the Physical Practice condition was an opportunity to prove themselves to the other players that they were at least of equal ability to first division players. Thus, more effort may have been put into the Physical Practice condition than either of the conditions involving mental imagery, and then this was transferred to the game situations. The prospect of possible physical injury may have meant that established first division players did not put as much effort into the training conditions that involved physical tackling practice, as they did into the Mental Imagery training. If true, and the quality of their training was transferred to the game situation, then the trend of the results that were obtained for this group would be explained.

A significant interaction was shown to exist between the tackling success rates following the treatment conditions, and the groupings of the Mental Imagery Questionnaire item "rating of performance benefits". The means for each testing condition by levels of this item are shown in Table 5, and clearly illustrate this interaction. Although exhibiting a lower baseline tackling success rate than those players who believed that imagery helped them less extensively with their tackling, players who regarded imagery as helping them

extensively with their tackling, showed higher tackling success rates following all three treatment conditions, than did the other group. Overall, those players who believed that imagery helped their tackling performance extensively, demonstrated mean tackling success rates of up to 16% higher than initial baseline measures. This is in contrast to the players who believed that imagery helped them less extensively with their tackling. These players exhibited tackling success rates that were lower than initial baseline performance measures, following training in all three conditions.

The conditions that involved mental imagery training were shown to be most effective in terms of transfer to tackling success rates during games, for those players who believed that the use of imagery helped their tackling performance an extensive amount. Mental Imagery plus Physical Practice resulted in a mean success rate of .83 for this group, compared with .78 for Mental Imagery, .77 for Physical Practice, and .67 for baseline performance. By comparison, none of the tackling success rates following any of the training conditions approached the mean baseline performance of .90 for those subjects who believed that imagery did not improve their tackling extensively. The results for this group following training in the Mental Imagery, Physical Practice, and Mental Imagery plus Physical Practice conditions were .78, .74, and .67 respectively.

These results suggest that a belief in the positive effects of imagery training may translate to a positive effect on performance, which would support the views of Howe, Barber, McKenzie and Steinbrink (accepted for publication) that imagery may have a mediating role in enhancing performance. The use of imagery to produce greater feelings of self-efficacy and competence may have encouraged the players to approach tackling with more confidence. These increased feelings of self-efficacy and competence are well-tested affective responses that have been shown to mediate improved performance and satisfaction (Howe, Barber, McKenzie and Steinbrink, accepted for publication).

A smaller but significant interaction was found between the treatment conditions and the subgroupings of the Mental Imagery Questionnaire item "controllability of images", for tackling success rates. This interaction was similar to that with the subgroupings of "rating of performance benefits" in that overall, those subjects who believed their images to be easily controllable, exhibited higher tackling success rates following the training conditions, than baseline performances. The opposite effect was evidenced for those subjects who believed that they had less easily controllable images.

Controllability of images is one factor which contributes to imagery ability, and according to Weinberg (1982; p. 201), "individuals who can construct clear, vivid, controllable images would most benefit by the use of mental practice". The results from this study seem to fit well into Weinberg's scenario, although they do not concur with the findings of White, Ashton and Lewis (1979), Epstein (1980), and Eby (1986), who failed to demonstrate any relationship between imagery ability and performance. Each of these studies, however, investigated tasks that could be termed 'closed skills', whereas tackling performance in rugby is clearly an open-skill task in that the conditions under which the skill is performed are continually changing position in space (Marteniuk, 1976). It may be that the ability to control one's image of an open skill would contribute to the effective performance of that skill, as these results suggest.

The results of the MANOVAs that were conducted upon the improvement scores for each testing condition by levels of the items on the Mental Imagery Questionnaire, showed that significant main effects existed for subgroupings of the items "rating of performance benefits" and "controllability of images". These results fit well into the existing discussion because those subjects who either believed that imaging improved their tackling extensively, or who were better able to control their images, exhibited significantly higher overall improvement scores than those subjects who rated lower on these items.

(b) All Subjects

The results of the series of one-way ANOVA's that were conducted for tackling success rates and improvement scores at each testing condition, for all pre- and post-hoc subject groupings, revealed several significant findings. Using tackling success rates, a significant difference was demonstrated between those subjects who reported experiencing strong "other than visual sensations" with their imagery (M = .83), and those whose "other sensations" were rated as being weaker (M = .67) for the treatment condition Mental Imagery plus Physical Practice. This result suggests that those subjects who were better able to integrate the kinesthetic and auditory experiences of physically tackling another player into their imagery, were more successful in transferring the effects of those images into game performance. These stronger "other sensations" would have meant that while they were training, subjects were more accurately able to reproduce the conditions for tackling that would occur during a game, thus facilitating the transfer to actual game performance (Singer, 1980).

A significant difference was found to exist between junior division team players and players from the second division Saxons team, on the improvement scores recorded following the Mental Imagery condition. Junior team players improved their mean tackling performance (M = .19), whereas the Saxon team players experienced a mean decrement in performance (M = -.19). Similarly, junior players who had not played at any higher level of competition demonstrated a significantly higher improvement score (M = .26) following the Mental Imagery condition, than players who had not played at any higher level than senior club competition (M = -.13). This group of club level players mainly included second division players. As mentioned previously, a number of explanations may account for these results. Mumford and Hall (1985) suggested that more skilled performers would

demonstrate greater effectiveness of mental imagery training. The junior players responsible for these results could be regarded as more highly skilled performers than their second division club level counterparts, and thus the results lend support to Mumford and Hall's (1985) findings.

In addition, junior players may have placed more effort into the training involving mental imagery rehearsal than the second division club level players, who may have concentrated their efforts on physical tackling practice, to the detriment of the mental imagery training. A more complete account of the suggested reasons for these conclusions has been outlined above.

These suggestions also help to explain the significant difference that was found between the Mental Imagery condition ($\underline{M}$ = .19) and Physical Practice condition ($\underline{M}$ = -.22) for junior division team players.

The significant difference that was obtained between the subgroupings of the Mental Imagery Questionnaire item "amount of practice" for the improvement scores following the Mental Imagery plus Physical Practice condition, seems incongruous. Those players who reported using imagery an extensive amount, recorded a significantly lower improvement score ($\underline{M}$ = -.06) than those who used imagery less extensively ($\underline{M}$ = .15). Corbin (1972) suggested that an optimal level exists at which mental practice is most effective, and according to Denis (1985), over-extended mental practice sessions are likely to produce some negative effects. If this is true, then those subjects who reported extensive imagery use, may have experienced negative effects brought about through over-extended practice of their mental imagery outside of the training sessions for this condition. In comparison, those players who reported using imagery less extensively, may have actually practised a more optimal amount of imagery for this condition, which was transferred to a positive performance effect.

For junior team players, and those players twenty years of age and under, a significant difference was found between Baseline and the Mental Imagery plus Physical Practice condition for tackling success rates. No other significant differences between the conditions were found, for these groups of players. First division team players, however, displayed a significant difference in tackling success rates between Baseline and the Mental Imagery condition. These results all lend support to the view that mental imagery has a positive effect on performance (Richardson, 1967; Corbin, 1972; Feltz and Landers, 1983). The results further suggest that for the skill of tackling, training that involves the use of mental imagery, whether alone or in combination with physical practice, is as effective as physical practice, which is in conflict with the findings of these same authors.

The threat of physical injury from performing tackles, even in the practice situation, may have meant that the motivation to perform this type of training was less than that for training involving mental imagery rehearsal. This may help to account for these findings.

Although no statistically significant results were revealed between the testing conditions, some of the trends that were evidenced for various groups of subjects suggest that the concept of transfer of training to performance was illustrated. Some groups of subjects demonstrated improvements in tackling performance of up to 24% following training in the Mental Imagery plus Physical Practice condition, which suggests that the combination of these two training methods is ideal for these groups of players. Specifically, Tight Five players, junior division team players, and those players under twenty years of age, demonstrated the highest tackling success rates and improvement scores following this condition. Similarly, these same groups of players experienced the highest tackling success rates and improvement scores following training in the Mental Imagery condition, and were generally the worst performers following training in the Physical Practice condition. It seems that for these players, the mental imagery rehearsal

was able to create psychological conditions that were similar to the performance situation, without the physical threat of injury, and this effectively facilitated the transfer of this type of training to actual game performance. This finding lends support to Schmidt's (1988) belief that mentally practising a skill can produce large positive transfer to skill in the actual task.

The results of the statistical analyses that were conducted upon the tackling success rates and improvement scores for the subgroupings of the Mental Imagery Questionnaire item "clarity of image" showed no significant difference between subjects who reported experiencing clear images, and those whose images were less clear. Similarly, the amount of rugby playing experience, and imagery style, was shown to make no statistical difference to either tackling success rates or improvement scores following any of the treatment conditions. An examination of the means for tackling success rates and improvement scores for these subgroupings revealed no obvious trends, which suggested that neither clarity of images, playing experience, nor imagery style, played a major role in the transfer of training to game performance.

The findings regarding imagery style are in accordance with the views of Mumford and Hall (1985) who were unable to find any differences in imagery perspective. Indeed, as McFadden (1982) has suggested, it may make no difference which imagery perspective is utilised.

Anecdotal reports from the Follow-up Questionnaire provided insights into the player's thoughts and feelings regarding the imagery training. These included statements such as, "It is valuable to one's confidence in making tackles", and, "A very useful technique for practising skills. Also of even greater use in pre-match mental attitudes, 'psych-up`, (and) game preparation". With the exception of one subject, all players felt that the imagery training was a worthwhile and helpful experience. In supporting these

views, all players reported on the Mental Imagery Questionnaire that they felt imagery had helped to improve their tackling to some extent. Although many of these anecdotal reports were refuted by the empirical results of the study, they are consistent with the views of Howe, Barber, McKenzie and Steinbrink (accepted for publication) who suggested that imaging a skill may elevate an athlete's feelings of self-efficacy and confidence to perform. It may also facilitate an increased satisfaction with performance, which would be likely to correlate highly with an athlete's perception of improved performance. This was evidenced by all except one of the subjects in the study.

In summary, these findings show that the use of training involving mental imagery rehearsal for tackling in rugby, can be as effective as physical tackling practice in terms of transfer to game performance. While not advocating the replacement of physical practice with mental imagery, the findings suggest that coaches would be able to use mental imagery training as part of a planned schedule to improve tackling. Players could be instructed or encouraged to use tackling imagery as a complement to physical tackling practice.

Because it involves no risk of physical injury, and can be practised outside of scheduled training times, mental imagery can be regarded as having some definite advantages over physical practice. Injured players may be able to use the technique to facilitate their return to form after recovery, and players would be able to use imagery as an adjunct to physical practice.

The results suggest that for Tight Five players, junior division team players, and players under twenty years of age, tackling training that involves the use of mental imagery is more effective than purely physical practice. The combination of mental imagery and physical practice was the most effective training method for these players.

A belief in the positive effects of imagery, the ability to control images, and the

presence of strong "other sensations" are suggested as factors which are likely to facilitate performance improvements in tackling following imagery rehearsal. In addition, anecdotal evidence from the Follow-Up Questionnaire supports the view that imagery elevates player's feelings of self-efficacy and confidence to perform, and therefore may be able to mediate improved performance and satisfaction.

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APPENDIX A

Informed Consent Form

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

SCHOOL OF PHYSICAL EDUCATION

1988.

INFORMED CONSENT

Players

I, _____ have been advised of the purpose of the research being undertaken by Dr. Bruce L. Howe and Mr. Alex D. McKenzie. I fully understand the intent of the study, and I also understand that I can withdraw at any time.

Name: _____
(please print)

Signature: _____

Date: _____

APPENDIX B

Information Questionnaire

INFORMATION QUESTIONNAIRE

Name: _____

Address: _____

Phone Number: _____

Age: Years _____ Months _____

Vikings ____

Norsemen ____

Saxons ____

Jutes ____

Rugby History

Position played: _____

Playing experience: _____ (number of years played)

Starting at age: _____

List all rugby teams for which you have played and how well they finished.

_____

_____

_____

_____

_____

Highest team played for:

_____

APPENDIX C

Treatment Condition Protocols

TREATMENT CONDITION PROTOCOLS

1: MENTAL IMAGERY CONDITION

Experimenter: In this drill, you will be playing touch rugby using our normal rules. However, whenever you come in to make a touch on the ball-carrier, I want you to imagine that you are actually tackling that player. To generate an image in your mind, you should attend to as much detail as possible. Try to make your image as clear as possible by including other senses. For example, try and feel the contact and listen to the sound that is made. Make the image as realistic and as accurate as possible. This will become easier with practice. Also, remember to make the image successful, in other words, be aware of how it feels, what it looks and sounds like to successfully tackle that player.

Is everybody clear as to what they are to do. (Pause)

Remember, you will be playing ordinary touch rugby, except that every time you come in to make a touch on the ball-carrier, you will imagine that you are actually making a tackle on that player. Now, let's begin.

(Play begins. Three times during the session, at a time when a touch has just been made, the experimenter calls play to a halt.)

Experimenter: Stop! (Player's name), ...I want you to imagine that you have actually tackled (Ball-carrier's name). I would like everybody else to also imagine what it would be like for you to have made that same successful tackle. Concentrate on that image now. (Pause)

(At the conclusion of the session, the experimenter instructs the players to practice imaging tackling as often as possible, in a relaxed state each day, or when they find themselves thinking about rugby.)

Experimenter: I would like each of you to practice imagining yourself making a

successful tackle, as often as possible, in a relaxed state each day. You may find that lying in bed just before going to sleep, or just after waking up is a good time. Be willing to experiment for a short time, to find the most effective time and situation to quiet yourself, relax, and visualise. Remember to make sure that each of your imagined tackles is successful. Negative thoughts may carry over to negative actions. Always try to finish with a successful image.

Please remember that it is very important that the players in the other groups are not aware of the instructions that have been given to you. Please do not communicate any details of this session to any of the players in the other two groups.

2: MENTAL IMAGERY PLUS PHYSICAL PRACTICE CONDITION.

1. Touch Rugby (2.5 minutes) - as described in the instructions for the Mental Imagery session, except that only one guided imagery step was performed.

2. Physical Practice drill (2.5 minutes) .

Experimenter: Now I would like you to get into groups of five or six, with one person kneeling (or standing) on the goal line facing the other members of the group, who will be lined up one behind the other, about five metres away. The player facing the group will be the tackler, and each member of the group will jog towards him and be tackled. The tackler will tackle first to one side and then the other, so that those players in his group will alternate the sides to which they run. Once all members of the group have been tackled and run through to the other side of the tackler, the last player to be tackled becomes the tackler, and the previous tackler joins the end of the line to become another "tacklee".

Let's begin (Players form groups and perform the drill for 2.5 minutes)

3. Touch Rugby with imagery (2.5 minutes).

4. Physical Practice Drill (2.5 minutes).

3: PHYSICAL PRACTICE CONDITION.

(a). TIGHT FIVE AND OUTSIDE BACK PLAYERS.

Session 1: Drill 1 (5 minutes).

Players are placed into groups of five or six. One tackler kneels (or stands) on a line facing the other members of the group who are lined up one behindthe other. Each group member in turn, jogs towards the tackler, who tackles them. The tackler first tackles to one side and then the other, so that the players being tackled alternate the sides to which they run. Once all members of the group have been tackled and have run through to the other side of the tackler, the last person to be tackled becomes the tackler, and the previous tackler joins the end of the line.

Drill 2 (5 minutes).

Players are in pairs. One player is designated as the ball carrier, and the other as the tackler. Starting side by side, and at a signal from the ball carrier, who walks as fast as possible towards a line 10 metres away, the tackler must tackle the ball carrier before he reaches this line. If successful, the players turn around and do the same thing on the way back, except that the tackler begins one step behind the ball carrier. If successful again, on the third time, the tackler begins two steps behind the ball carrier. Once three tackles have been completed, the players switch roles.

Session 2: Drill 1 (3 minutes).

As in Drill 1 for Session 1.

Drill 2 (3.5 minutes).

A series of 10 metre grids are established, and players are placed into teams

of three. One team faces the other in the grid, with one ball per grid. The attacking players, who are on their knees, attempt to score a try over the opposing team's goal line. The opposing players, also on their knees, must tackle the attacking players, and attempt to obtain the ball. Rugby tackling rules apply. Once a try has been scored, the ball is turned over to the other team, and play begins again from the halfway mark.

Drill 3 (3.5 minutes).

As in Drill 2, except that the players are now standing, and are only able to walk. Tackles must be made between the hip and the knee of the ball carrier.

Session 3: Drill 1 (3 minutes).

As in Drill 2 for Session 2.

Drill 2 (3 minutes).

As in Drill 3 for Session 2.

Drill 3 (4 minutes).

10 to 12 players are jogging freely within a 10 metre grid. Half of the players are carrying contact pads held against their legs, either in the front or to the side. Players without the contact pads are free to tackle any player holding a contact pad, making sure that they drive into the pad with their shoulder, and ensure that their arms wrap around the legs of the person with the pad. When a successful tackle is completed, the players switch roles.

Session 4: Drill 1 (10 minutes).

The final drill involves full contact and is played at full pace. Players are placed into groups of three, with at least three groups operating in the one drill. One team of three is designated the attacking team, one is designated the defensive team, and the other team is neutral. This drill is performed

across the field, between the 22 metre line and the goal line, with the attacking team starting from in line with the goalposts. The attacking team has possession of the ball and is given two opportunites to score a try over the opposition's goal line (the touchline). If tackled, the attacking player must play the ball between his legs to restart play. Once two breakdowns have occurred, the teams switch roles, with the attacking team becoming the defensive team, the neutral team becomes the attacking team, and the previously defensive team becomes neutral. The teams rotate in this fashion.

(b) BACK ROW AND HALFBACK PLAYERS.

Sessions 1, 2 and 3 are the same as those for Tight Five and Outside Back players.

Session 4: Drill 1 (10 minutes).

This is a formation drill designed to simulate defense from a scrum or lineout. The drill operates within a grid, e.g. between the 22 metre line and the goal line as in Session 4 for Tight Five and Outside Back players. Players are placed into teams of three. An attacking team lines out in backline formation, with th experimenter acting as scrumhalf. A defensive team of tacklers stands beside the experimenter. When the ball is passed by the experimenter to the attacking team, who are attempting to score a try, the defensive team are able to move, and must prevent the try from being scored by tackling the ball carrier. As soon as the ball carrier is tackled, or a try is scored, the teams change positions.

APPENDIX D

Follow-Up Questionnaire

FOLLOW-UP QUESTIONNAIRE FOR THE STUDY ON

THE EFFECT OF IMAGERY ON TACKLING PERFORMANCE IN RUGBY

Thank you for participating in this study. Your training and testing is now over. To complete the study, I will need you to fill out two forms.

Attached to this sheet is a questionnaire for your completion. Please fill it out immediately. It is imperative that you do not discuss this questionnaire with any of the other players. Please put your name, the date, and the starting and finishing time on the top of the questionnaire sheet. And finally, please answer the following:

1. While you were involved with the training sessions involving mental imagery training:

   (a) What did you think of imagery?

   (b) How did your imagery progress over the training sessions?

   (c) How did you feel about doing the imagery?

   (d) Did you practice imagery at any time outside of the training sessions?

   How often?

   For how long?

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

Sincerely yours,

[redacted]

APPENDIX E

Mental Imagery Questionnaire

MENTAL IMAGERY QUESTIONNAIRE

1. How much mental imagery did you use with regard to tackling?

   None at all 1 2 3 4 5 6 7 8 9 An extensive amount

2. Do you think that imagery helped you with your tackling performance?

   Not at all 1 2 3 4 5 6 7 8 9 An extensive amount

3. If you used imagery to "see" yourself run through your tackling skills, did you see yourself from the outside (as if watching a video) or from the inside (as if you were actually inside yourself performing)?

   Inside view 1 2 3 4 5 6 7 8 9 Video view

4. How clear were your images?

   Very unclear 1 2 3 4 5 6 7 8 9 Crystal clear

5. How strong were the other sensations associated with your imagery?

   No other sensations 1 2 3 4 5 6 7 8 9 Strong sensations

6. When you tried to imagine yourself tackling in rugby, was it easy or difficult for you to control the "feeling" or picture?

   Very difficult 1 2 3 4 5 6 7 8 9 Very easy

APPENDIX F

Groupings of Mental Imagery Questionnaire Items

GROUPINGS OF THE MENTAL IMAGERY QUESTIONNAIRE ITEMS

Question 1: Amount of Practice.
- Group 1: Subjects who responded with ratings of 7 to 9 on the Likert scale and were labelled "Extensive imagery use".
- Group2: Subjects who responded with ratings of 1 to 6 on the Likert scale and were labelled "Less extensive imagery use".

Question 2: Rating of Performance Benefits.
- Group 1: Subjects who responded with ratings of 7 to 9 on the Likert scale and were labelled "Extensive tackling assistance".
- Group 2: Subjects who responded with ratings of 1 to 6 on the Likert scale and were labelled "Less extensive assistance".

Question 3: Imagery Style.
- Group 1: Subjects who responded with a rating of 1 on the Likert scale and were labelled "Internal Imagers".
- Group 2: Subjects who responded with ratings of 2 to 5 on the Likert scale and were labelled "Internal and External Imagers".
- Group 3: Subjects who responded with ratings of 6 to 9 on the Likert scale and were labelled "Predominantly External Imagers".

Question 4: Clarity of Images.
- Group 1: Subjects who responded with ratings of 7 to 9 on the Likert scale and were labelled "Clear Images".
- Group 2: Subjects who responded with ratings of 1 to 6 on the Likert scale and were labelled "Less Clear Images".

Question 5: Strength of Images.
- Group 1: Subjects who responded with ratings of 6 to 9 on the Likert scale and were labelled "Strong other sensations".
- Group 2: Subjects who responded with ratings of 1 to 5 on the Likert scale and were labelled "Weaker sensations".

Question 6: Controllability of Images.
- Group 1: Subjects who responded with ratings of 7 to 9 on the Likert scale and were labelled "Easily Controlled Images".
- Group 2: Subjects who responded with ratings of 1 to 6 on the Likert scale and were labelled "Less Controllable Images".

APPENDIX G

Key Factors for Tackling

KEY FACTORS FOR TACKLING

Experimenter:

(a) INTRODUCTION TO TACKLING. Tackling is one of the most important aspects of the game of rugby. It is not just a defensive skill, but can also be a very effective means of attack. If a tackle is made behind the opposition's advantage line, it sets up an ideal counter-attack situation. Therefore, all players need to be aware of this, and strive to make tackles behind the advantage line. If the opposition are allowed to move over the advantage line, the more the tackle becomes defensive. First tackles are extremely important; a missed tackle can turn a defensive position into an attacking one for the opposition.

The aim of any tackle is to halt the opposition's progress by stopping the man with the ball, and putting him on the ground so that he is unable to get a pass away. To do this, a positive approach is essential. Half-hearted attempts usually result in the tackler being brushed aside, and tentative tackles often lead to injury.

(b) TYPES OF TACKLES AND HOW TO PERFORM THEM.

1. Side-on tackle. The tackler approaches the ball-carrier from the side, and only increases speed on the last two or three strides. The tackler must judge the distance between himself and the ball-carrier, and time his run to intercept that player. A low body position is essential, with the head placed to the side of the ball-carrier (the only time when a high tackle is needed is if the ball-carrier is about to score). ball-carrier. The target area on the ball-carrier is ideally between the hips and the knees, and when contact is made, the tackler must drive into the ball-carrier with his shoulder, using his legs to create that drive.

The force of the shoulder on the legs of the opposition player should bring him down, and the tackler will often end up on top of the ball-carrier. Remember to hold on with the arms when making the tackle.

2. Front-on tackle. This occurs when the ball-carrier runs straight at the tackler, who takes a low body position. As the ball-carrier comes into the tackle, the tackler places his head to one side, grips the opponent's knees with his arms, goes back with the momentum of the ball-carrier, and rolls him so that he finishes on top of the tackled player.

3. Tackle from behind. This is essentially the same as a side-on tackle, except that it is made from a different starting position. The tackler should approach the ball-carrier slightly from the side, and aim a little higher, so as to avoid being hit by the ball-carrier's feet. This tackle requires a very firm grasp of the opposing player, and just as in the side-on tackle, the tackler places his head to one side, hits with the shoulder, and drives with the legs.

APPENDIX H

Schedule of Training and Vidoetaping Sessions

SCHEDULE OF TRAINING SESSIONS AND VIDEOTAPE ANALYSIS.

SAT	10 SEPTEMBER	GAME VIEWING 1.
SUN	11 "	
SAT	17 "	
SUN	18 "	
TUE	20 SEPTEMBER	TRAINING SESSION 1.
THURS	22 "	
TUE	27 "	
THURS	29 "	
SAT	1 OCTOBER	GAME VIEWING 2.
SUN	2 "	
SAT	8 "	
SUN	9 "	

HAWAII TOURNAMENT / WENMAN CUP (GAME VIEWING)

TUE	18 OCTOBER	TRAINING SESSION 2.
THURS	20 "	
TUE	25 "	
THURS	27 "	
SAT	29 OCTOBER	GAME VIEWING 3.
SUN	30 "	
SAT	5 NOVEMBER	
SUN	6 "	
SAT	12 "	
SUN	13 "	
TUE	15 NOVEMBER	TRAINING SESSION 3.
THURS	17 "	
TUE	22 "	
THURS	24 "	
SAT	26 NOVEMBER	GAME VIEWING 4.
SUN	27 "	
SAT	3 DECEMBER	
SUN	4 "	

APPENDIX I

Criteria for Determining Successful and Attempted Tackles

CRITERIA FOR DETERMINING SUCCESSFUL AND ATTEMPTED TACKLES.

1. The definition of a successful tackle:

> A tackle occurs when a player carrying the ball in the field of play is held by one or more opponents so that while he is so held he is brought to the ground or the ball comes into contact with the ground. If the ball carrier is on one knee, or both knees, or is sitting on the ground, or is on top of another player who is on the ground, the ball carrier is deemed to have been brought to the ground (International Rugby Football Board, 1988-89).

2. An attempted tackle shall occur when the defensive player is perceived by the observer to have made contact with the ball carrier with more than one hand in an attempt to bring him to the ground. The tackler must be in a position to control the ball carrier in the tackle.

3. If the tackler is committed to the tackle and completes the tackle, then this shall be deemed to be a successful tackle. If the prospective tackler pulls out of the tackle because he sees that the ball has gone, or the whistle goes, or the ball carrier has gone out of bounds, then this shall not be included in the analysis (i.e. neither an attempted tackle nor a successful tackle).

4. If the defensive player is attempting to either hold the ball carrier up, or trying to wrestle the ball away from him (e.g. in maul situations), then this shall not be included in the analysis.

5. More than one player may tackle the ball carrier and be awarded one tackle each. If two players tackle the ball carrier, the tackle shall be awarded to both players, unless it is clear that only one player was largely responsible for the tackle. If this is not clear, then the tackle shall be awarded to both players. If the initiator of the tackle (i.e. the person who

makes contact with the ball carrier first) needs assistance to complete the tackle, then this shall be regarded as an attempted tackle. If, however, the actions of the initial tackler have caused the ball carrier to begin to go to the ground, yet before he hits the ground another defensive player makes contact with the ball carrier and assists in bringing him down, the the tackle shall be awarded to the initial tackler. This is because he was more active in the tackle, and would have completed the tackle on his own had the second defensive player not arrived. In this situation, the second defensive player will not be awarded either an attempted or a successful tackle.

6. It must be the actions of the defensive player(s) that mainly contributes to the ball carrier being tackled, if the attempt is to be considered successful. No supporting players (of the ball carrier) must have contributed to the ball carrier being tackled. If this is not clear, then the situation will not be included in the analysis.

7. If two or more players tackle the ball carrier, and only one player is able to be identified, then the analysis shall be performed using the identifiable player. The unidentified players will not be included in the analysis.

8. All tackles that are not determined "late tackles" by the referee shall be included in the analysis.

APPENDIX J

Game Analysis Sheet

GAME ANALYSIS SHEET

DATE OF GAME: _____ OBSERVER: _____

GAME: _____ vs _____

VENUE: _____

PLAYERS	ATTEMPTED TACKLES	HT	SUCCESSFUL TACKLES	HT
1 PROP				
2 HOOKER				
3 PROP				
4 LOCK				
5 LOCK				
6 FLANKER				
7 FLANKER				
8 No. 8				
9 SCRUMHALF				
10 FLYHALF				
11 WING				
12 INSIDE CENTRE				
13 OUTSIDE CENTRE				
14 WING				
15 FULLBACK				

	ATTEMPTED		SUCCESSFUL		% SUCCESS	
	HT	FT	HT	FT	HT	FT
TIGHT FIVE						
BACK ROW AND HALFBACKS						
MIDFIELD AND OUTSIDE BACKS						
TOTALS						

VITA

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Author: [redacted]

(Signature)

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(Name in block letters)

April 14th 1989

(Date)

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