IMAGERY TRAINING AND ROWING PERFORMANCE

by

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ABSTRACT

The purpose of this study was to investigate the effect of imagery training in conjunction with peak power ergometer training, on the transfer of the peak power training to an on–the–water sprint. A secondary purpose was to investigate the effect of imagery training alone on an on–the–water sprint. Data were collected on 33 rowers. Subjects were rated on sculling ability by their coaches and then randomly assigned to one of four treatment groups; Group 1 (power and imagery training), Group 2 (power training), Group 3 (imagery training), and Group 4 (no power or imagery training). Subjects performed two 300 meter sprint tests in a single scull and three 90 second power tests on the Concept II rowing ergometer. An ANOVA on the pre sprint and pre ergometer tests reported no significant differences between groups. Percentage difference scores were calculated between the pre and post sprint and ergometer tests. A oneway ANOVA on these scores, using the SPSS–X V3.1 special contrasts program showed no significant difference in percentage improvement sprint scores between each of Groups 1–3 and Group 4. Significant differences in percentage improvement ergometer scores were found between Groups 1 and 4 with $t(29) = 2.62$, $p < .007$; and between Groups 2 and 4 with $t(29) = 2.44$, $p < .010$; and Groups 3 and 4 with $t(29) = 2.00$, $p < .0275$ on the ergometer tests. Athletes reported in individual logs and

interviews that imagery rehearsal had been beneficial for competition preparedness and for facilitation of the technical acquisition of sculling skills.

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DEDICATION

to

Kurt and my 1987–89 Crews

CHAPTER 1

INTRODUCTION

Imagery or visualization rehearsal is a specific component of mental practice that has been used as a technique to enhance sport performance (Vealey, 1986). It has been described in simple terms as the process of creating mental images, although Suinn (1976) considered the processes much more. He felt it was better described as a multisensory experience. Although the literature on the benefits of mental practice and imagery rehearsal is equivocal, a greater proportion of the studies indicate that mental practice is associated with improved performance.

As mentioned above the research on the benefits of mental imagery remains in question. There have been studies which have shown that imagery training does facilitate motor skills (Goss, Hall, and Buckholz, 1983; Ryan and Simons, 1982; Weinberg, 1982; Corbin, 1972). Other studies produced findings which have shown that imagery rehearsal has no significant effect on motor performance (McIntyre, 1987; Eby, 1986; Mumford and Hall, 1985; Epstein, 1980).

Despite these contradictory results, coaches and athletes are becoming increasingly convinced that peak performance is a function of psychological training as well as physiological fitness. For example, testimonies from our Canadian Olympians have identified mental training and mental coaching as critical prerequisites for competitive success (Partington, 1988). It has also been known for some time that the Eastern European countries have used this technique in their training. The ability of athletes to create mental images of themselves performing at optimal levels, is the single most–used tool in the Soviet mental training arsenal

(Domey, 1987, 1988). Domey adds that the great American rifle shooters also have used this technique in their training and that it improved their actual technical performance.

Upon examination of the studies in the field it is evident that many external variables interfere with the consistent measurement of imagery effect on performance. Among the concerns which have been identified are the variables of task characteristics, skill level, length of practice, imagery style, imagery ability, theoretical framework and experimental design (Wollman, 1986). All of these on their own or in conjunction with each other, may have contributed to the inconsistent results.

Wollman (1986) recommended that there should be more thorough monitoring of the internal experience through both checking the quantity and quality of the internal imagery and the cognition and effect of the subjects. This suggests that there may be a need for more precise imagery instruction and direct communication regarding what is being experienced and accomplished in the imagery sessions.

Imagery in conjunction with physical practice has been purported to be a beneficial method of training (Corbin, 1967, 1972; Chevalier, 1985; Domey, 1987, 1988). It appears that this combination recreates a specific training environment and may affect transfer to physical performance at a sport task. Cormier and Hagman (1987) reported contradictory findings in the area of transfer, while Kohl and Roenker (1980) reported positive bilateral transfer occurring as a result of mental practice.

The amount of transfer may depend on the similarity between the two tasks (Schmidt and Young, 1987). These findings are not too different from those established by Ellis (1965). Ellis made several suggestions for affecting positive

transfer. Those to consider when aiming for specificity of training were over–all task similarity, stimulus similarity, joint stimulus–response variation, amount of practice on original task and task characteristics. It is hypothesized that specificity of training, through the incorporation of a specifically designed imagery training program combined with prescribed physiological training may facilitate the transfer of training to performance.

To examine this question, it was determined that a field study employing a sport skill which uses off–site training extensively would be valuable. Rowing is an ideal sport because of the restrictions of climate and site isolation. The sport uses off–site programs which are designed to address preparation of conditioning, technique and strategy. It was felt that the incorporation of imagery training as a psychological tool might contribute to the power and skill development and perhaps to the transfer of such training to the actual performance of the athletes.

CHAPTER 2

REVIEW OF LITERATURE

This chapter will review the research in the area of mental practice and imagery. It will include studies which consider the theory of the effectiveness of the imagery process and studies which delineate factors associated with the application of imagery rehearsal. Also included in this chapter is a review of the concept of transfer and theories associated with this learning variable. A summary will be presented which will suggest a relationship between imagery rehearsal and transfer.

2.1 IMAGERY

2.1.1 Definitions

The mental practice and imagery literature has included several terms which have been used synonymously with "imagery". In the 1920's and 1930's with the interest in psychological testing and factor analytic study of cognitive abilities, visual imagery was linked with visualization and spatial manipulation which in earlier studies was referred to as mental practice and visuo–motor behavior. Beginning in approximately 1950, imagery became regarded as a behavioral phenomenon and was often referred to as mental practice. Recently, the term visualization has become popular and is frequently used in lieu of imagery. For the purpose of this study, all these terms refer to the same process.

Richardson (1969) defined mental imagery as referring to all those

quasi–sensory or quasi–perceptual experiences of which we are consciously aware. Denis (1985) has further defined imagery as a psychological activity which evokes the physical characteristics of an absent object that is either permanently or temporarily absent from our perceptual field. Suinn (1983) defined imagery rehearsal more practically as the technique of applying imagery to the repetition of an activity, usually with the intent of improving the skill with which it is performed. For the purpose of this study the definition offered by Denis (1985) appears to be the most appropriate.

2.1.2 Imagery Characteristics

Types of Imaging. Richardson (1983) identified four types of imagery. The first of these, after imagery was defined as prolonged and/or intense simulation in a least four sensory modalities. An example of this is when one continues to have a visual sensation after a camera flash has gone off. Second, eidetic imagery used to be refereed to as a photographic memory and has been defined by psychologist Akhler Ahsen (1977, 1979) as a "normal subjective visual image which is experienced with pronounced vividness". Eidetic images are presented in a specific modality such as vision, audition and touch, and so on... (Haber, 1979, p. 619). Third, memory (thought) imagery has been identified by Richardson (1983) as the common and relatively familiar imagery of everyday life. Richardson (1969) reported that it may accompany the recall of events from the past, ongoing thought processes of the present or the anticipatory actions and events of the future. Finally, imagination imagery has been distinguished from thought imagery by using qualifiers such as novel, substance and color. The content of these more intense image experiences may be unexpected and apparently unconnected with any

identifiable memories from one's personal past (Richardson, 1983). In this study, the focus is on thought imagery in that the images are recreations of actual performance.

Nature of Imaging. Imagery has been generally regarded as visual in nature. However, imaging has also been characterized as being multimodal. Images that focus on the feeling of the experience have been called kinesthetic images (Hall, 1985).

Kinesthesis has been defined as the process of being aware of bodily tension or movement on the basis of what one is doing, or in terms of muscular tension and movement in relation to some contemplated mode of behavior. Sensations are received through any or all of the mechanical senses (Phillips, 1941). Kinesthetic imagery is a combination of internal imagery and actual sensations accompanying the imaging.

Function of Imagery. In the imagery literature, there are several schools of thought as to the function of imaging. Some researchers, notably Pylyshyn (1979, 1981a, 1984) believe that the experience of having a mental image is not an important part of the nature and function of cognition and it is only epiphenomenal. Another group feels that imagery is a process associated with information processing and cognition (Kosslyn, 1973) and the third group believes that it is involved in spatial representation and has some relationship to other cognitive activities such as verbal learning (Hollenberg, 1970), memory (Richardson, 1976), and problem solving (Shaver, Pierson, and Lang, 1974).

Research by Finke (1979b, 1981) which was followed up by Johnson (1982) showed that the imagery of an experience was functionally equivalent to the actual

experience. Finke (1979b) reported four experiments that demonstrated that mental images of error were found equivalent to physical errors of movement in creating changes in visuo–motor coordination. Johnson (1982) showed that the classic range effect (*i.e.* the biasing of a movement with regard to length by a secondary interpolated movement) could be produced when the interpolated movement was imaged as opposed to actual performance. This study strongly supports Finke's findings.

In the psychomotor literature, Kohl and Roenker (1983) produced bilateral transfer through imagery rehearsal. This evidence indicates that imagery is functional in cognition and can affect physical performance. This statement is also supported by Farah (1988) in her review of the research in the area of neurological psychology.

2.1.3 Theory of Imagery

Four prevalent theories exist that attempt to explain how imaging affects performance. They are the Gross Framework Theory (Lawther, 1968), the Psychoneuromuscular Theory (Carpenter, 1894), the Attention–Arousal Set Explanation of Motivational Theory (Schmidt, 1982), and the Symbolic Perceptual Theory (supported by Jacobson, 1931; Suinn, 1976; Bird, 1984; Harris and Robinson, 1986). A clear explanation of these theories is presented by McIntyre (1987). Very little support has been granted in the research for the first three of the previous mentioned theories. The most accepted theory is the Symbolic Perceptual Theory which suggests that movement information is represented at a high level of cognitive entities, which can be manipulated by purely psychological processes and do not necessarily involve concomitant motor acts (Minas, 1980). Given the

evidence reported by Johnson (1982), Finke (1979b, 1981), and Kohl and Roenker (1980, 1983), support for the Symbolic Perceptual Theory has been given.

A study by Johnson (1982) supports this theory, where a visual interference occurred as a result of imagery and affected performance. Finke (1979) reported four experiments which showed that mental images are functionally equivalent to physical errors of movement in producing changes in visual–motor coordination, at both central and peripheral levels of the visual–motor system. Denis (1985) claims that the effectiveness of mental practice involving imagery can be accounted for in terms of cognitive processing and he further states that this theory relies in part on the specific effectiveness of imagery and is dependent upon the degree of cognitive demands of the task. He then states that mental practice would mainly provide learners with better perceptual organization through insight, so that skill facilitation would essentially be due to centrally located phenomenon. This supports the notion of the Symbolic Perceptual Theory of mental practice which hypothesizes that images of movements involve mainly visual imagery.

Several studies (Paivio, 1966; Shwartz, 1976) have considered the interactions between information processing and imagery generation. Paivio (1966) claimed that the latency of visual images varied as a function of the imagery value of stimulus words, thus, the faster the generation of the visual image. He further suggested that the complexity of the processes involved in imagery generation does not affect the persistence of images. Shwartz conceptually demonstrated that it is possible to image human movement situations that are impossible to actually reproduce. He maintained that this is evidence that the brain experiences the image and not the neural pattern itself.

Paivio (1985) suggested a comprehensive theoretical framework for examining

imagery effects. He postulated that imagery mediated behavior through either cognitive or motivational mechanisms, which affect specific or general response systems. The framework (see Figure 1) is a 2×2 classification which indicates that imagery plays both a motivational and cognitive role in mediating behavior, each operating at either a general or specific level. The general level refers to the degree of physiological arousal and affect or emotion that might accompany it. The specific aspect is goal–oriented activity. On the cognition side, imagery can potentially affect general behavior strategies or specific responses involved in motor skills.

2.2 STUDIES ON THE MENTAL IMAGERY EFFECT

The concept of imagery has a long history, however, the connection of imaging with action seems to have begun with Washburn in 1916. She contended that movements of slight magnitude occurred when one simply imagined oneself performing an activity. Subsequently, this result was supported by Jacobson (1932). These early findings indicated to researchers that the psychological component was one to be investigated and better understood in an effort to improve performance.

2.2.1 Mental Practice Effect

More studies began to appear that claimed positive results for mental practice. Among these early works which showed that mental practice improved performance were those of Perry (1939) and Woodrow (1946). Other researchers found more support for the combination of physical practice and mental practice (Clarke, 1960;

IMAGERY FUNCTION

	Motivation	Cognition
General	Arousal and affect	Strategies
Specific	Goal–oriented responses	Skills

(Paivio, 1985).

Figure 1. Paivio's Analytical Framework for Imagery Effects

Egstrom, 1964).

These findings were repeated in later studies. Surburg (1968) and Rawlings, Rawlings and Yilk (1972) reported that mental practice had a facilitary effect on physical skills. In other studies, Lewin (1982) reported automobile drivers who used mental imagery practice to bring improvement in driving skills while McFadden (1982) found that mental rehearsal was very effective in improving goal–tending performance in hockey. Supporting an interactive position, Weinberg (1982) reported that some combinations of mental practice and physical practice were superior to just physical practice which in turn was superior to mental practice.

Apart from this supportive research, other studies have reported negative results. Corbin (1976b) found that mental practice had little or no effect on performance while Shick (1970) and Singer and Wilker (1970) also found that mental practice had little or no effect on performance.

Wollman, Hill, and Lipsitz (1985) conducted two experiments which investigated the effects of imagery on sport performance. The first, using cross country runners, found that the imagery group did not improve significantly over the non–imagery group. The second experiment also reported that imagery effects on performance using bowling as the performance task produced no significant difference between the imagery group and the control group. Indeed, the imagery group was almost significantly worse.

There have been three previous studies carried out at the University of Victoria, none of which have clearly supported the benefits of imagery training. Eby (1986) found no significant effect of imagery training on the performance of selected field hockey players while McIntyre (1987) found that mental imagery training did not facilitate learning in either elite or non–elite basketball players, but

gave assistance to performance in non–elite basketball players. A recent study by McKenzie (1989) concluded that imagery training in rugby tackling led to a more confident approach to the task, although no significant difference in performance was found between imaging and non–imaging conditions.

What is most obvious about mental practice research is the large variability in effect size. Wollman (1986) suggested that this may be a direct result of the variety of methods used in research and lack of consideration for other factors such as imaging style, physical ability, imagery ability, task type and certain performer characteristics such as age and gender, and the actual imagery practice conditions.

2.2.2 Factors Affecting Imagery

Imagery Style. There appears to be support for the notion that imaginal style is dynamic and multimodal (Sheehan, 1979; Short, 1953). Several studies (Hale, 1986; Mahoney and Avener, 1977) suggested that a neurological distinction exists between imagery styles. The two styles discussed are internal and external.

Internal imagery is when one can visualize oneself performing an action looking from the inside out. This has also been referred to as first person imagery. Internal is thought to be more closely associated with kinesthetic imaging where the subject experiences the feeling of the action. External imagery is visualization from the outside looking on. The action is observed by the image. This has also been referred to as third person imagery. This style of imaging is predominantly visual where the subject watches the performance. Researchers have investigated the effects of different imagery styles; internal (kinesthetic) and external (like watching oneself on a video) imagery. The literature on imagery modality has suggested that an internal and a kinesthetic imagery process would be most beneficial. In contrast

to the other studies, Pennebaker and Lightner (1980) conducted experiments which examined the competition of external and internal information during a treadmill exercise. There were three focal groups: (1) own breathing, (2) taped street sounds, and (3) nothing at all. Results indicated that subjects hearing the street sounds reported less fatigue and fewer related symptoms than the subjects hearing an amplification of their own breathing. This appears to have great implications for the focus of the desired image and its effectiveness in mental strategy practice.

However, Mumford and Hall (1985) found that performance by figure skaters revealed no significant differences between the three proposed types of imagery training used in their study. These were external, internal, and kinesthetic styles of imagery. They reported that the senior skaters showed greater performance improvement and appeared to be superior kinesthetic imagers than the novice skaters.

In a descriptive analysis of Olympic gymnastic finalists in 1976, it was reported that they imaged as if they were inside their bodies experiencing those sensations which might be expected in actual competition (Mahoney and Avener, 1977, p. 137) instead of viewing themselves from the outside as "home movies" (Suinn, 1983).

Epstein (1980) found with dart throwers that there was no significant difference in performance of subjects under internal and external imagery instructions. Epstein (1980) indicated that internal imagery tends to be positively related to performance, whereas, external imagery is related negatively to performance. Mahoney and Avener (1977) concluded that internal imagery has been associated with better performance while Hale (1982) found more increased levels of muscle activity during internal imagery than external imagery. A study by Rotella, Candneder, Ojala, and Billing (1980) found no clear delineation between internal

and external imaging.

Evidence suggests that in the synthesis of a kinesthetic image one feels what it is like to perform the movement, what the image is and where it is. Most agree that they can go through a movement mentally and experience what is involved in the performance (Jones, 1965). Studies indicate a tendency for the more skilled performers of specific manual tasks to test higher on traditional kinesthetic tests than do less skilled individuals. Corbin (1972) reported that if kinesthetic feedback was important to the effectiveness of mental practice, then internal imagery would produce higher levels of performance than external imagery because it is accompanied by higher levels of muscular activity.

Skill Level Ability. The level of learning or experience of the performer appears to be another concern. Results (Corbin, 1972; Richardson, 1967) indicated equivocal findings regarding the influence of experience on a task. A minimal amount of experience in executing a task appeared to enhance the effectiveness of the imagery (Corbin, 1972; Feltz and Landers, 1983; Phipps and Morehouse, 1969). The importance of physical skill level on imagery effectiveness has been studied by several researchers (Feltz and Landers, 1983; Mumford and Hall, 1985; Clarke, 1960). Several theorists (Adams, 1971; Fitts and Posner, 1967; Marteniuk, 1976; Schmidt, 1982) indicated that mental practice should have its greatest effectiveness during the cognitive phase of skill learning.

Of specific research studies, there have been inconsistent results. Mental imagery training did not facilitate learning in either elite or non–elite basketball players but it was suggested that it may act as a benefit to performance in non–elite basketball players (McIntyre, 1987). Rotella, Candneder, Ojala, and Billing (1980) reported that more skilled skiers focused on the difficult parts of the race course and

planned strategies in a positive manner to prepare for competition. Zecker (1982) suggested that if mental practice is introduced late into the learning procedure, it should not have much impact since the internal representation is formal and more resistant to forgetting. Schmidt (1982) suggested that because imagery in general deals with the cognitive aspects of a skill, and because beginners tend to focus on this aspect of the skill (as opposed to beginners who tend to focus on cues external to the actual skill) that beginners will benefit more from imagery in the facilitation of learning. Contrasting to the studies above, Yamamoto and Inomata (1982) reported that accuracy of the imagined skill increased as a function of physical training.

Imagery Ability. Another aspect considered in studies has been the belief that the general ability of individuals to image differs. Denis (1982) stated that individual differences in imagery may be reflected in short term retention of movement information. Housner and Hoffman (1981) studied individuals classified as high and low ability imagers. No significant interaction was found between ability level and three retention periods. Paivio (1971) reported that high imagery ability was thought to reflect an innate or conceptual habit to think in pictures instead of in words. Hall (1980) claimed that high imagery values should be associated with better performance.

Although imagery ability seems to be an important factor to control, measuring imagery ability appears to be fairly difficult. Studies that attempt to measure imagery ability by combining scores on a spatial task with self–report imagery compound the conceptual and operational confusion (Richardson, 1983). In almost all studies that have included spatial ability measures and vividness of imagery measures, the correlations have been small and scant. Factor analysis shows that

visual and other imagery tests load on a factor orthogonally similar to the one on which tests of spatial ability are loaded (DiVesta *et al.*, 1971; Richardson, 1977). The standard imagery test questionnaires, the Gordon Test of Visual Imagery Control, and the Betts QMI Vividness of Imagery Scale have not seemed suitable for accurate description of imagery ability. A further test termed the Movement Imagery Questionnaire was developed by Hall and Pongrac (1985). It also has not proved to be entirely satisfactory and it appears that more research in and creation of a measurement is required.

Task Characteristics. Little work has been completed related to the characteristics of the task. Poulton (1957) believed the type of task performed whether open or closed appears to influence the amount of impact mental rehearsal has on actual performance.

Wrisberg and Ragsdale (1979) found that mental rehearsal was as effective on a task having high cognitive demands. This is reported by Feltz and Landers (1983) who as a result of their meta–analysis found that mental practice seemed to be most effective with primarily symbolic cognitive tasks.

Performer Characteristics. Aside from imaging ability, other factors associated with the performer appear to affect the effectiveness of imagery. Among the other variables, age and gender have been investigated in relation to imagery ability. Among such studies Rapp and Schoder (1973) investigated at what age mental practice begins to be effective for skill learning. They found that preschool children (5–6 years of age) performed significantly better at rope skipping after mental practice.

With gender, Denis (1985) found that men developed better spatial

visualization than women, particularly during and after adolescence. In contrast Sherman (1980) found that spatial visualization scores were significantly more discriminating within groups of women than within groups of men.

Corbin (1967) suggested that mental practice need not be merely based on experience but also on physical practice. He argued physical practice after mental practice might act as a catalyst to bring out the full effects of this mental practice. Others felt that mental practice should have more impact during the early stages of practice when cognitive or verbal activity is prevalent (Adams, 1961). In a similar way Schmidt (1975) postulated that after a response becomes automated, mental practice seems to have less impact on subsequent practice.

Imagery Practice Characteristics. Several reviews (Denis, 1985; Feltz and Landers, 1983; Weinberg, 1982; Corbin, 1972; Shick, 1970; Oxendine, 1969; and Twining, 1949) have reported that length of mental practice affects performance. The general conclusion drawn from these studies was that there appears to be an optimal length of practice; perhaps no less than one minute and no more than 3–5 minutes. The literature in this area is also equivocal.

Very little research has investigated the most effective parameters for application of imaging as a practice variable. Attention needs to be paid to length, duration, frequency of session and type of imaging used.

2.3 SUMMARY OF IMAGERY RESEARCH

Imagery appears to be a valuable practice variable, however, the research is still equivocal and perhaps this is due to a lack of control. Wollman (1986) directed attention to these concerns and identified factors that mediate or modify imagery's

elusive success and offered three methodological strategies. First, a need for greater variety of control group across imagery studies. Second, imagery research would benefit by complementing traditional group design research with single–subject methodology and lastly, thorough monitoring of the experience of the subjects, whether by single–subject or group designs. He stated that this includes checking both the quantity and the quality of the imagery and the cognition and affect of subjects.

2.4 TRANSFER AND IMAGERY

In the literature, imaging has been suggested as a way to facilitate learning and performance. In essence, imaging has been described as a way to enhance the transfer of skill from practice to performance. Therefore this section will review the concept of transfer and summarize the literature which indicates a link between imagery and the concept of transfer.

2.4.1 Definitions of Transfer

Transfer of learning has been defined by Ellis (1965, p. 3) as experience or performance on one task that influences performance on some subsequent task. In a similar way Logan (1985, p. 369) defined transfer of learning as the influence of having previously practiced a skill or skills on the learning of a new skill. Transfer of training has been identified by Royer (1979) as a more restricted concept than the transfer of learning. He stated that transfer of training refers to the generalization of programmed responses established through conditioning and those where transfer may be mediated solely by cognitive factors. He claimed that while the concept of

learning includes transfer of training examples, it also covers instances where transfer occurs without training or where there is not behavioral evidence of transfer.

2.4.2 Types of Transfer

Kerr (1982, p. 95) defined three kinds of transfer: bilateral transfer, intertask transfer, and intratask transfer. Bilateral transfer is sometimes referred to as cross education. It is the transfer of skill between limbs. For example, practicing a pursuit rotor task with the right limb will have a positive influence on performance of the same task done with the left limb, even when the skill has never been previously practiced with that limb. This phenomenon had been explained from both a physiological and a psychological point of view. It appears that most of the transfer can be explained in terms of the overall cognitive organization of the task.

Intertask transfer is the influence of a previously learned task on the learning of a second task. Although evidence for positive transfer is mixed, there appears little evidence of negative transfer between skills. An example of intertask transfer in rowing is learning and performing the phases of the stroke cycle on a rowing tank or ergometer and then performing them in a shell.

Intratask transfer occurs between different versions of the same skill or the same skill performed under different conditions. Rowing the race distance in practice at a low rate and high intensity, and then racing at a high rate and high intensity is an example of intertask transfer.

Transfer has been generally divided into two types. Freeze (1984) defined positive transfer as occurring when previous learning facilitates new learning and negative transfer occurring when previous learning hinders new learning. Negative

transfer effects are rare in motor learning (Annett & Sparrow, 1985; Schmidt, 1987) and this refers to the actual movement control parameters involved in motor performance. It has been argued that negative transfer effects are cognitive rather than motor (Magill, 1989, p. 379).

2.4.3 Nature of Transfer

Debate still exists as to the question of what is transferred positively or negatively when a previous experience has an effect on a subsequent experience.

Theories of Transfer. There are a number of theories for transfer. The Identical Elements Theory (Thorndike, 1901) has evolved within the behavioral tradition and emphasizes the environmental perspective. The critical element of the transfer process appears to be the features shared between the original learning event and the performance to which the learning is to be transferred. Thorndike and Woodsworth (1901) suggested that the transfer of learning from one task to another would vary directly with the proportion of shared stimulus elements.

The Cognitive Construct Theory, originating with Judd's (1908) Generalized Elements Theory as explained by Freeze (1984) emphasizes the internal mental processes that are presumed to mediate learning. The critical element of the transfer process is thought to be the activation of previously learned cognitive construct structure, associated with the original learning of a new event.

The third theory is the Transfer–Appropriate Processing Hypothesis which emphasizes the processes through which original learning is represented in memory and later retrieved at the event to which learning was transferred (Morris, Bransford, Franks, 1977). This theory evolved from the information theories of

human learning and movement.

So from one perspective, transfer is thought to occur due to the specificity of environmental conditions and task components. Therefore, the more similar the practice conditions are, with regard to these two elements, the greater the possibility of transfer from practice to actual performance.

The second perspective focuses on the similarity of cognitive processes utilized in the practice situation and in performance. Magill (1989, p. 383) claims that the processing view may be an extension of the components view and may come into play when skill components and context similarities are minimal, while processing activities are highly similar. He supports Schmidt and Young (1987) by stating that more work needs to be done in this area in order to answer the question of why transfer occurs.

Both of these theories refer to the necessity of specificity of practice but the difference lies in the nature of the specificity, whether it is conditions and task components or whether it is the underlying cognitive processes.

2.4.4 The Relationship between Imagery and Transfer

Imagery is regarded as a practice variable and as such should facilitate and improve performance. As previously stated the image of an experience has been suggested to be equal to the actual experience (Finke, 1979b; Johnson, 1982). In this way, imaging may contribute to the specificity of the training situation given that specificity is the key to the transfer of training (Schmidt, 1988). A study that indicates this phenomenon, but in regard to bilateral transfer, is the work by Kohl and Roenker (1980, 1983). This relationship between imaging and transfer has been alluded to in the literature (Corbin, 1967, 1972; Chevalier, 1985; Domey, 1987,

1988) but has not been empirically tested. Therefore, the primary purpose of this study is to investigate the effect of imaging used in conjunction with the actual practice of rowing on an ergometer on the subsequent performance of rowing in a competition situation on the water. A secondary purpose is to investigate the effect of using imagery training alone on performance. It is with the methodological concerns raised by Wollman (1986) in mind that the following hypotheses were tested:

2.5 HYPOTHESES

- Subjects trained to image a 300 meter water sprint and who use prescribed imagery training during peak power ergometer training (Group 1) will show greater improvement in acceleration on a 300 meter water sprint than the subjects who are not trained in imagery, but who have participated in peak power ergometer training (Group 2).

- Subjects who engage in peak power ergometer training will show greater improvement in acceleration demonstrated on a 300 meter sprint (Group 2) than subjects who receive imagery training but no peak power training (Group 3) and those subjects who receive neither imagery training nor peak power training (Group 4).

- Subjects who are trained in imagery but do not participate in peak power ergometer training and who practice imagery, with the 300 meter sprint as the focus will show greater improvement in acceleration demonstrated on the

300 meter sprint (Group 3), than those subjects who do not receive any imagery or peak power training (Group 4).

- Subjects who participate in peak power ergometer training (Groups 1 and 2) will show greater improvement in peak power on the rowing ergometer than the subjects who do not participate in peak power ergometer training (Groups 3 and 4).

CHAPTER 3

RESEARCH METHODS

This chapter will report the research methodology and procedures employed in the study. The selection of subjects, variables, limitations, definitions, instrumentation, procedures, collection of data, and data analysis are included.

3.1 SUBJECTS

Of the original 41 subjects who volunteered for the study, eight did not complete all the tests and their data were not included. In the final sample there were 16 females and 17 males, with a mean age of 20, from the University of Victoria Varsity and Junior Varsity rowing crews (see Appendix A for timeline). All of the prospective subjects were informed of the general intent of the study at the initial meetings in September. Subjects met individually with the researcher to sign consent forms (see Appendix B) and parental consent was also obtained for those who were under 19 years of age prior to data collection (see Appendix C).

The height and weight of each subject was recorded and whether he/she rowed lightweight or heavyweight was noted (see Appendix T).

3.2 VARIABLES

3.2.1 Independent Variables

The independent variable in this study was the various levels of treatment. The four levels were imagery training, peak power ergometer training, a combination of imagery training and peak power ergometer training, and control.

Imagery Training. A six week training program (see Appendix G) consisting of 17 sessions, focusing on relaxation (see Appendix H), rowing technique (see Appendix I), power (see Appendix J), and pre–competition preparedness for a 300 meter sprint.

Peak Power Ergometer Training. A six week interval training program with 17 sessions consisting of interval training based on progression of frequency, duration, and intensity (see Appendix F).

Imagery and Peak Power Ergometer Training. A combination of the six week interval power training and the six week imagery training programs carried out while training on the ergometer.

Control. Subjects continued to follow their regular training.

3.2.2 Dependent Variables

The dependent variables in this study were a 300 meter sprint test in a single scull and a 90 second peak power ergometer test.

300 Meter Sprint. An all–out water sprint in a single scull. Splits every 100 meters were recorded in addition to final times.

90 Second Ergometer Test. A 90 second all–out power test on the Concept II rowing ergometer. The wattage output every 15 seconds in addition to the total average work output for the test were recorded.

3.3 LIMITATIONS

The following limitations occurred in this study:

1. The study was limited by the head coaches' accuracy in ranking and rating subjects on their ability to scull in a single over 300 meters.

2. The study was restricted to members of the University of Victoria rowing program, 18 years of age and older who were capable of rowing in a single, thus limiting the generalizability of the study.

3.4 OPERATIONAL DEFINITION OF TERMS

Imagery. "A psychological activity which evokes the physical characteristics of an absent object (either permanently or temporarily absent from our perceptual field)", "Images can also be involved in the course of psychological activities oriented towards some kind of production of an externalized response" (Denis, 1985, p. 45).

Peak Power. Power is defined as the rate at which mechanical work (w) is performed; thus $P = w/t$. The standard international unit for power is the watt (W).

Watt. Joules per second.

3.5 INSTRUMENTATION

Stop Watch. Two stop watches were used to record 100 meter splits and final times (see Appendix K for record sheet).

Rate Watch. Rate of striking was measured by a rate watch.

Wind Meter. Readings were taken during each sprint to ensure that no major differences in wind conditions occurred within each testing period and between testing periods.

Ergometer. A Concept II rowing ergometer was used for testing. Wattage output at every 15 second mark, in addition to the total average wattage output were recorded. The same ergometer was used in all three tests (see Appendix L for record sheet).

Boats. Four wooden single boats and sets of sculls were used for the sprint tests.

Logs. Groups 1, 2, and 3 were requested to keep logs and to turn them in upon completion of the study (see Appendix M for log sheets).

3.6 PROCEDURES

The volunteer subjects were recruited during the beginning of the rowing season, September, 1988. Men and women were approached separately at their respective initial meetings. All data were collected between September and November of that year.

At the initial meetings, subjects were informed of the general intent of the study and the tentative schedule involved in participating. Sign up sheets for Ergometer Test #1 and Sprint Test #1 were then posted (see Appendix O).

Coaches were asked to rank subjects in the study and to describe their sculling ability over a 300 meter sprint in a single scull. Coaches placed subjects in one of the following categories: excellent, good, average, below average, or inexperienced (see Appendix D for rating sheet). Rated subjects were then randomly assigned to one of four treatment groups based on their sculling ability (see Table 1).

Table 1

Groups

Group	Treatment*	n
1	power and imagery training	7
2	power training	8
3	imagery training	10
4	no power or imagery training	8

*All groups continued regular training which included rowing, ergometer workouts, running and weight sessions (see Appendix E for sample week).

The researcher met with each subject individually and consent forms were signed. Parental consent forms were completed where necessary. Individuals who did not respond initially were contacted a second time by a telephone call.

Once Ergometer Test #1 and Sprint Test #1 were completed, subjects met in their groups with the researcher. Individual schedules were distributed and the intent of the study was discussed. A statement of the role of the individual in the study was signed by each subject (see Appendix P). The need for confidentiality on the part of the subjects regarding their roles in the study was stressed.

3.7 COLLECTION OF DATA

Sprint Test. All groups performed a 300 meter sprint. Protocol for this test required two heavy weight single sculls, with a standard rig of 159 cm spread for men. Two medium weight singles with a standard rig of 159 cm spread were used for the women. All sculling blades were 298 cm with inboards at 88 cm. The pitch on the oarlock was 5 degrees in the middle of the stroke. The lateral pitch was set at 1 degree.

Race Protocol. The 300 meter course was marked with one lane of buoys placed every twenty meters. During each sprint a wind meter reading was taken over one minute to ensure the same conditions for all subjects.

The course for the post test was set out in a second lake due to continuous windy weather (see Appendix Q).

Ergometer Tests. The 90 second power test was performed by all subjects. Subjects were asked to arrive 30 minutes before testing time in order to warm up on a designated warmup ergometer outside the testing room. The testing was done over the period of one day in a testing laboratory. Total average wattage and wattage output at 15 second intervals were recorded. Subjects were shown their results and then instructed to cool down.

Imagery Training. Groups 1 and 3 met separately over a six week period for 17 imagery sessions of 15–25 minutes duration each (see Appendix G for program and Appendix S for practice instructions). The sessions had a power and technique focus leading to the 300 meter sprint. Group 1 had access to tapes (see Appendix R) which reinforced what to image while performing the interval power training.

Ergometer Training Program. Groups 1 and 2 were instructed to perform 17 interval training sessions on the ergometer (see Appendix F for program). Group 1 did this in conjunction with the imagery Training Program.

Logs. Subjects in Groups 1, 2, and 3 were requested to keep daily logs regarding the treatments in this study (see Appendix M).

3.8 DATA ANALYSIS

The following statistical techniques were used to analyze the data. A one way analysis of variance (ANOVA) on both the sprint and ergometer pretest and posttest measures was used to establish whether there were any significant difference between groups (see Appendix U for raw data). Percentage difference scores were calculated between pre and post tests for both sprint and ergometer

tests. A subsequent one way ANOVA, using the SPSS–X V3.1 special contrasts program was used to test the directional *a priori* hypotheses outlined in Chapter 2.

Post hoc analysis was done on the imagery log questionnaires for descriptive purposes.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter will report and discuss the results of data analyses for each of the directional hypotheses stated in Chapter 2. Results from the oneway ANOVA, using the SPSS–X V3.1 special contrasts program indicated a significant difference on ergometer percentage improvement scores between each of the three treatment groups and the control group but not on the sprint scores. This will be addressed in terms of the implications for transfer of training. The issue of imagery rehearsal for athletes in terms of "feeling" prepared for performance and the facilitation of technical acquisition will also be discussed.

4.1 MEANS AND STANDARD DEVIATIONS

Means and standard deviations of both sprint tests are given in Table 2 and the means and standard deviations for the three ergometer tests are reported in Table 3.

4.2 ANALYSIS OF VARIANCE

Examination of the results of an initial ANOVA on both the sprint and ergometer pretests indicated no significant differences between the four groups which verified that the groups were equally divided. The results were as follows (see Tables 4 and 5): Sprint Test 1 reported $F(3,29) = .74$, $p < .54$; Ergometer Test 1 reported $F(3,29) = .62$, $p < .61$.

Table 2

Performance Times in Seconds of Sprint Tests for Each Group

		Tests			
		1		2	
Group	N	Mean	SD	Mean	SD
Imagery & Power	7	87.6	22.1	76.3	11.1
Power	8	97.3	32.8	85.7	21.6
Imagery	10	81.6	10.4	73.9	8.7
Control	8	90.9	22.4	80.1	9.7
ALL	33	89.4	21.9	79.0	12.8

Table 3

Means and Standard Deviations of Ergometer Tests for Each Group

		Tests					
		1		2		3	
Group	N	Mean	SD	Mean	SD	Mean	SD
1	7	389.5	116.1	416.6	124.7	420.0	125.4
2	8	444.7	108.1	469.4	102.9	476.6	111.7
3	10	396.9	74.7	402.4	71.7	421.1	86.0
4	8	437.8	106.8	425.6	96.7	441.8	113.7
ALL	33	417.2	101.4	427.3	99.0	439.9	109.2

Table 4

ANOVA of Differences between Groups on Sprint Test 1

Source	SS	df	MS	F	p
Between	1139.48	3	379.83	.74	.54
Within	14931.93	29	514.89		
Total	16071.41	32			

Table 5

ANOVA of Differences between Groups on Ergometer Test 1

Source	SS	df	MS	F	p
Between	18923.02	3	6307.67	.62	.61
Within	292718.82	29	10093.75		
Total	311641.84	32			

Percentage improvement scores were calculated (see Appendix V) between the pre and post water tests and the pre and post ergometer tests. A oneway ANOVA on each set of percentage improvement scores using the special contrasts program was used to test each of the four directional hypotheses. As a result it was found that there was no significant difference in relative improvement on the sprint test $F(3,29) = .09$, $p < .96$ (see Table 6) between groups. Obtained values for t were as follows; $t(29) = -.349$, $p < .365$ between Groups 1 and 4, $t(29) = -.12$, $p < .452$ between Groups 2 and 4, $t(29) = +.145$, $p < .442$ between Groups 3 and 4. There was significant relative improvement for each of the three treatment groups over the control group on the ergometer test $F(3,29) = 2.91$, $p = .05$ (see Table 7). The standard error and pooled variance estimated for t are shown in Table 8.

4.3 HYPOTHESES

***Hypothesis* 1.** Subjects trained to image a 300 meter water sprint and who use prescribed imagery during peak power ergometer training (Group 1) will show greater improvement in acceleration on a 300 meter water sprint than subjects who are not trained in imagery but who have participated in peak power ergometer training (Group 2).

There was no support indicated for this hypothesis. The obtained value of $t(29) = -0.23$, $p < .409$ revealed a nonsignificant result.

***Hypothesis* 2.** Subjects who engage in peak power ergometer training will show greater improvement in acceleration demonstrated on a 300 meter sprint (Group 2) than subjects who receive imagery training but no peak power training (Group 3)

Table 6

Oneway ANOVA of Differences Between Percentage Improvement on Sprint Scores for all Groups

Source	SS	df	MS	F	p
Between	17.05	3	5.68	.09	.96
Within	1826.31	29	62.98		
Total	1843.36	32			

Table 7

Oneway ANOVA of Differences Between Percentage Improvement on Ergometer Scores For All Groups

Source	SS	df	MS	F	p
Between	268.88	3	89.63	2.91	.05
Within	893.47	29	30.81		
Total	1162.35	32			

Table 8

Obtained t for Ergometer Percentage Improvement Scores Between Groups

	Groups	Standard Error	t	df	p
Contrast	1 → 4	2.87	2.617	29	.007
Contrast	2 → 4	2.78	2.436	29	.010
Contrast	3 → 4	2.63	2.002	29	.027
Contrast	1 → 2	2.87	0.264	29	.397
Contrast	2 → 3	2.63	0.566	29	.288
Contrast	1 → 3	2.74	0.821	29	.209

and those subjects who receive neither imagery training nor peak power training (Group 4).

The reported $t(29) = -0.272$, $p < .393$ for the contrast between Groups 2 and 3 percentage improvement scores on the water sprints revealed nonsignificant findings as did $t(29) = -0.120$, $p < .452$ for Groups 2 and 4, thus this directional hypothesis was not supported.

***Hypothesis* 3.** Subjects who are trained in imagery but do not participate in peak power ergometer training and who practice imagery, with the 300 meter sprint as the focus will show greater improvement in acceleration demonstrated on the 300 meter sprint (Group 3), than those subjects who do not receive any imagery or peak power training (Group 4).

The reported $t(29) = +.145$, $p < .442$ for contrast between Groups 3 and 4 on the water sprint proved nonsignificant, therefore, this hypothesis was not supported.

***Hypothesis* 4.** Subjects who participate in peak power ergometer training (Groups 1 and 2) will show greater improvement in peak power on the ergometer than the subjects who do not participate in peak power ergometer training (Groups 3 and 4).

An obtained $t(29) = +0.821$, $p < .209$ indicated no significant difference in percentage improvement scores on the ergometer test between groups 1 and 3 and between Groups 2 and 3 with $t(29) = +0.566$, $p < .288$. However, $t(29) = +2.617$, $p < .007$, for contrast between Groups 1 and 4 was significant as was the contrast between Groups 2 and 4 with an obtained $t(29) = +2.436$, $p < .010$.

These results (see Figure 2 for illustration of mean percentage ergometer difference score) suggest that the Imagery and Power Training Group (1) and Power

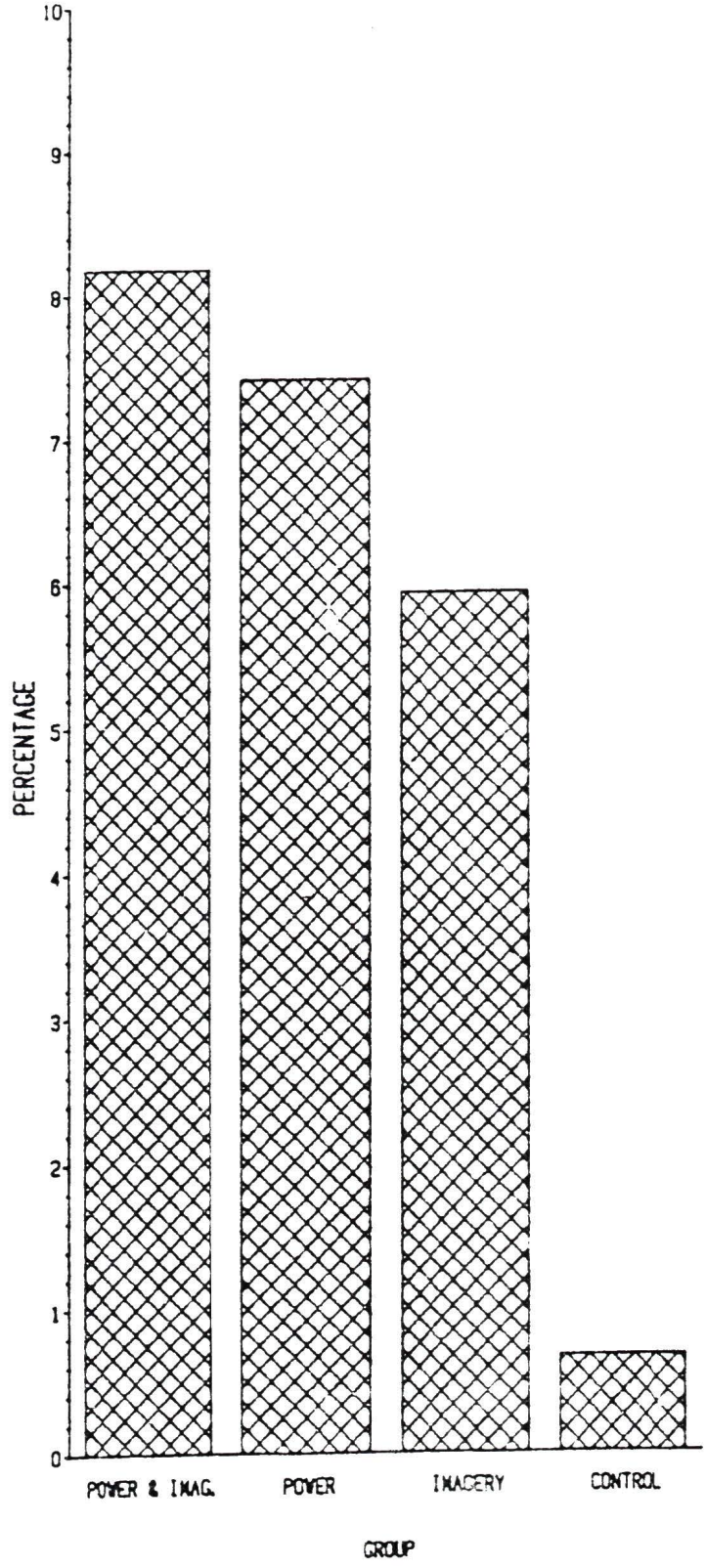

Figure 2. Mean Percentage Ergometer Difference Score For All Groups

Training Group (2) made significant percentage improvement over the Control Group (4) on the post ergometer test. Whereas, the Imagery and Power Training Group (1) and the Power Training Group (2) did not make a significant improvement over the Imagery Group (3).

This introduces an interesting phenomenon whereby it appears that the ergometer training and/or imagery training was beneficial in affecting some positive transfer on the final ergometer test and affecting no positive transfer to performance of the water sprint. A more detailed discussion of these findings follows the results of the imagery log questionnaires.

4.4 *POST HOC* ANALYSIS

A *post hoc* analysis of the contrast between mean percentage ergometer improvement scores of the Imagery Group (3) and the Control Group (4) revealed $t(29) = +2.002$, $p < .027$ which was significant. This suggests that the imagery treatment may have contributed to improvement on the ergometer test. In order to monitor more closely the imagery experience an imagery questionnaire log was designed to give a general indication of how imagery rehearsal and power training were developed during the study for Groups 1 and 3. Subjects were asked to respond on a 9–point Likert type scale; 1 representing least skill and 9 representing most skill. Questions were designed in order to determine ability to recall, imagery skill, external/internal imagery, sensory input and situation/location and time of imaging.

Means and standard deviations of the Imagery Log Questionnaires completed by Group 1 (Power Training and Imagery) showed that subjects scored a mean of 5.8 on ability to *remember* what was done in the previous imagery session, 5.9 on ability to *image* what had been introduced in the last imagery session, 4.5 on ability to actually *see* themselves doing the action, 2.8 on how *real* the imaging *felt*, 3.5 on *feeling* like being on the *water*, 4.0 for *ease* of imaging while on the *ergometer*, and 4.8 for *spontaneous imaging* at other than prescribed times (see Table 9 for means, standard deviations, and range).

Group 3 (Imagery Training) gave the following mean responses to their Imagery Log Questionnaire. For ability to *recall* what was done in the last session 7.5, 7.1 ability to *image* what was done in the last imagery session, 6.5 for ability to *see* themselves doing the action, 5.8 for *feeling* like being on the *water*, 6.6 for *ease* of imaging prior to falling asleep, and 4.7 for *ease* of early morning imaging (see Table 10 for means, standard deviations, minimums and maximums).

The information from the questionnaires indicates that Group 3 (Imagery Training) reported higher means on most questions. It should be noted here that some subjects in Group 1 experienced difficulty in calling up the feeling of being powerful required to maintain a high wattage output reading on the ergometer while imaging being powerful on the water. The two requirements for power were different enough to make the task of rowing the ergometer for power (and at the same time imaging being in a single scull, rowing powerful strokes), confusing and consequently difficult. One subject reported:

> "I have a lot of difficulty with trying to feel like I am on the water. The way I row the erg is a lot different than the way I row my single. To me the two are completely different entities."

Table 9

Means, Standard Deviations, Minimums and Maximums of Imagery Logs for Group 1

Degree 1 – 9				
Question	Mean	SD	Min	Max
1. Recall	5.8	1.7	3.9	7.8
2. Image	5.2	1.5	3.7	7.7
3. See	4.5	2.1	2.6	7.8
4. Feel	4.9	2.1	2.1	7.5
5. Real	2.8	2.3	1.0	6.7
6. Water	3.5	2.4	1.2	7.5
7. Ergo	4.0	2.2	2.0	7.6
8. Other	4.8	2.1	2.7	7.9

N = 5

Table 10

Means, Standard Deviations, Minimums and Maximums

of Imagery Logs for Group 3

Degree 1 – 9				
Question	Mean	SD	Min	Max
1. Recall	7.5	.7	6.5	8.3
2. Image	7.1	.9	6.1	8.1
3. See	6.8	1.2	5.3	8.2
4. Feel	6.5	1.2	5.1	8.1
5. Real	5.8	1.1	5.1	7.9
6. Water	6.5	1.3	5.1	8.4
7. Night	6.6	2.3	2.8	8.9
8. Morning	4.7	2.1	2.6	7.2

N = 5

Whereas, another subject stated:

> "I felt that using imagery while on the ergometer transferred to the water I could find the feeling of certain skills on the ergometer, *i.e.* locking the hips when on the water. I remembered the feeling practiced on the ergometer."

These comments suggest that the physical intensity required to perform interval pieces may have detracted from the ability of the subject to image, whereas the prescribed imaging may have interfered with the quality of the power effort.

The negative results on the percentage difference Sprint scores indicate that the imagery training and/or power training did not contribute to an improvement in acceleration between the two tests. This may be partially due to the length of the water test. Also, it could be an indication that the imagery and power training treatments may require some fine tuning for the repetition of this experiment.

However, positive statements indicated anecdotally that there was a certain degree of transfer from the prescribed imagery rehearsal and power training to the final sprint and ergometer test. Reports from subjects using imagery (Groups 1 and 3) support the notion of feeling prepared for and confident about the performance of the required tests. They felt that the situation was familiar and not threatening because the race and precompetition plans had prepared them for the task and one subject reported:

> "Imaging the race plan was amazing, except that I found myself so small. It was like watching a very tiny rower give it all down the course. I was right inside the boat the entire time; it was the most exhilarating sensation afterwards."

Another subject reported:

> "Imaging the full race and preparation is now a lot easier (than it used to be). It is now easier to keep up with my strokes in the race. They are all at race pace and I can do all 48 strokes without losing my concentration."

Novice scullers found the technique imaging and race rehearsal beneficial in preparing for the final sprint. One subject reported:

> "Being an inexperienced sculler, I found the imagery rehearsal of the rowing stroke made me feel like I had rowed the final 300 meter sprint better. I felt that I had a better understanding of the sequence of the rowing stroke."

Another rower stated:

> "When on the erg I find I can concentrate more on specific parts of the stroke discussed the day before, but I find it difficult to actually see or feel myself on the water."

Some subjects claimed that it was easier to image on the ergometer when their eyes were closed. There appeared to be evidence of external and internal imaging occurring. One report was:

> "Throughout the whole thing (study) I never really saw myself in the boat on the water. What I saw, I saw as though I were looking out of my eyes. I could see my feet, and the footstretchers, and my legs and I could see the decking of the boat, but I never really saw the water that I was supposed to be rowing on. In the beginning I was only able to image separate parts of the stroke...but they were not flowing together, but now at the end I can image 48 strokes, one after another with no real breaks in the rowing pattern."

Subjects using ergometer training only (Group 2) reported feeling more powerful in approaching weight training but subjects using imagery while training on the ergometer (Group 1) reported, as did Group 2, that the interval training was rigorous and time consuming.

Some of the *a priori* results of this study were significant and the anecdotal information was largely positive and encouraging for making a case to include imagery and/or ergometer training as a portion of competition preparation programs for athletes. This is supportive of the McKenzie (1989) position that the imagery may aid feelings of self–confidence rather than performance itself.

4.5 CONCLUSION

The results of the physical practice group and physical practice plus imagery training group indicated that the prescribed peak power training on its own and in conjunction with the imagery training did not contribute significantly to improvements in the 300 meter sprint test. However, the percentage difference scores indicate that there may have been transfer from the treatments given in all three treatment groups to the final ergometer test but not on the final water test.

This suggests that perhaps some transfer occurred as a result of the specific treatments given during the study and therefore the areas of specificity of training and transfer need to be examined more carefully.

The nonsignificant results on the sprint tests of Groups 1 and 2 may be due to the rigorous baseline training schedule subjects continued to follow for their rowing program in addition to the physical requirements of this study. Also, the nonsignificant results on the sprint may perhaps be explained by the short distance which did not allow for large differences in performance scores.

Reports and logs from subjects who participated in the imagery training program either on its own or in conjunction with physical practice indicated a strong perception of feeling "better prepared" for the final sprint in two senses.

Subjects felt that the race strategy and actual stroke for stroke rehearsal in the imagery sessions helped them prepare technically and psychologically for the event. Any uncertainty in approaching the final sprint appeared to be removed.

Secondly, a number of less experienced scullers reported that imagery rehearsal for technique acquisition was beneficial. It was also stated that when certain athletes were required to change sides in sweep rowing, imagery was used to aid in the transition.

Finally, the percentage improvement difference scores seem to confirm the literature in the sense that it appears that imagery and/or ergometer training may have transferred to the ergometer and not to the water as indicated by the posttests, therefore leaving the transfer question unanswered.

The results, however, tend to support Weinberg's (1982) position that combinations of mental practice and physical practices are superior to just physical practice, which in turn is superior to mental practice. Perhaps, in accordance with Denis' (1985) definition of imagery, the imagery treatments created psychological activity which evoked the physical characteristics of rowing. Also, the results tend to support the literature (Farah, 1988) in that imagery appears to be functional in cognition and can affect performance.

4.6 RECOMMENDATIONS

Suggestions for future studies are: (*i*) that the performance measure be over a longer distance (1500 meters); (*ii*) that the groups be divided in terms of sculling ability (novice and skilled); (*iii*) that the treatment period be reduced to 3–4 weeks and that (*iv*) the field testing be conducted during warmer months when the water

is less frigid (in the event of capsizing) and the weather is more stable and (*v*) that more attention be given to the investigation of specificity of training and transfer and what is transferred from the ergometer to the water, if anything, and (*vi*) in a general sense, there appears to be a need to examine the question of whether imagery contributes significantly to the self–confidence of the athlete and improves the probability of approaching sport tasks rather than performance of the skill itself.

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APPENDIX A

TIMELINE

Day	Date	Event	
1	12	Women's meeting	
2	13	Men's meeting	
3	14	Coaches' rankings	
4	15	Athletes randomly assigned to groups	
5	16	Individual meetings and signing of consent forms	
6	17		
7	18	300 Meter Water Pretest	
8	19		
9	20	90 second Power Ergometer Pretest	
10	21		
11	22	Group meetings and definition of role in study	
12	23		
13	24		
14	25		
15	26	Imagery Session #1	
16	27	Imagery Session #2	
17	28	Imagery Session #3	Ergometer Session #1
18	29	Imagery Session #4	
19	30		Ergometer Session #2
20	1		
21	2		
22	3	Imagery Session #5	Ergometer Session #3

23	4	Imagery Session #6	
24	5	Imagery Session #7	Ergometer Session #4
25	6	Imagery Session #'s 8 & 9	
26	7		Ergometer Session #5
27	8		
28	9		
29	10		Ergometer Session #6
30	11	Mid–study 90 second Power Ergometer Test	
31	12	Imagery Session #10	Ergometer Session #7
32	13	Imagery Sessions #'s 11 & 12	
33	14		Ergometer Session #8
34	15		
35	16		
36	17	Imagery Session #13	Ergometer Session #9
37	18	Imagery Session #'s 14 & 15	
38	19	Imagery Session #16	Ergometer Session #10
39	20	Imagery Session #17	
40	21		Ergometer Session #11
41	22		
42	23		
43	24	Imagery Practice	Ergometer Session #12
44	25	Imagery Practice	
45	26	Imagery Practice	Ergometer Session #13
46	27	Imagery Practice	
47	28		Ergometer Session #14

48	29		
49	30		
50	31	Imagery Practice	Ergometer Session #15
51	1	Imagery Practice	
52	2	Imagery Practice	Ergometer Session #16
53	3	Imagery Practice	
54	4	Imagery Practice	Ergometer Session #17
55	5		
56	6		
57	7		
58	8	Post 90 second Power Test	
59	9	Post 300 meter Sprint Test	
60	10	Log Collection	

APPENDIX B

INFORMED CONSENT

INFORMED CONSENT

I, _____, having been informed of the activities proposed in the research project by the researcher, do voluntarily agree to participate in the training study. I regularly engage in exercise and activities similar to and of a like intensity to those described to me in the research project as part of my normal activities. I am also unaware of any physical or medical reason which would make me at risk for engaging in such activities.

I also understand that I am free to withdraw from the study at any time, without affecting my status within the rowing program.

Name: _____
PLEASE PRINT

Signature: _____

Date: _____

APPENDIX C

PARENTAL CONSENT

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

SCHOOL OF PHYSICAL EDUCATION

PARENTAL CONSENT FORM

I do/do not agree to allow _____

to participate in the project proposed by Patricia Steinbrink from the University of Victoria.

Name of parent/guardian: _____
(PLEASE PRINT)

Signature of parent/guardian: _____

Date: _____

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

SCHOOL OF PHYSICAL EDUCATION

16th September, 1988

To: The Parent/Guardian of: _____

Dear Parent/Guardian:

I am a graduate student working in the area of Sport Psychology and I am presently investigating the effects of imagery and power training in rowing. As a means of investigation I propose to administer two 300m sprint tests on the water in a single and three 90 second ergometer tests.

_____ has agreed to participate in this study (see enclosed Consent Form). It would be appreciated if you would give your consent by signing the enclosed form and returning it to me in the envelope provided.

Thank you for your cooperation. Should you require any further information please do not hesitate to contact me.

Yours sincerely,

_____

Patricia Steinbrink,
Researcher

_____

Dr. B.L. Howe,
Supervisor

APPENDIX D

RATING

Coaches' Ratings

Check the category the following athletes fall under in their ability to scull, in relation to the others on the list, in a single, during an all out sprint.

Subject *n*	Excellent 8	Good 6	Average 8	Below Average 6	Inexperienced 5
1					★
2				★	
3				★	
4					★
5					★
6			★		
7			★		
8	★				
9		★			
10					★
11				★	
12		★			
13	★				
14			★		
15		★			
16			★		
17				★	
18				★	
19	★				
20					★
21			★		
22			★		
23				★	
24		★			
25			★		
26		★			
27	★				
28	★				
29	★				
30	★				
31	★				
32		★			
33			★		

APPENDIX E

SAMPLE WEEKS

UVIC VARSITY WOMEN TRAINING PLAN

Week of: September 26 – October 2

Day		Training Focus	Workout Details
Monday	AM	Erg anaerobic threshold	10 minute warmup HR 160–165
			3×8 min. @ 28–29/2 min. @ 26
		5 min. cooldown	
	PM	Pat's erg where designated	
		Weights	Intro lower core and upper core routines
Tuesday	AM	Workparty	Finish Ellis/set up Best Ever boats boats, move 8+s around
		Erg technique	Work on easy swing/relaxed motions
	PM	Erg VO_2Max	Carding athletes on Gjessing; others on Concept II.
		Lower core work	5 minute warmup. 6×3 min. on/off. SR @ 29–31 HR 180–190
Wednesday	AM	Off	
	PM	Pat's erg	
		Weights	As Monday
Thursday	AM	Erg aerobic	Steady state @ 150–165 HR; 24–26 SR
		Technique	
			Same focus Tuesday
	PM	Erg time trial	4K piece. Record.
		Lower core work	
Friday	AM	Work party	Final prep for rowing
		Erg AT	6×3 min. @ 28–29/3 min. @ 26 HR 160–165
	PM	Pat's erg	
		Weights as Monday	
		Rick in weightroom	

Day		Training Focus	Workout Details
Saturday	AM	Row anaerobic	Around the Lake piece and threshold
		Lower core work	Technique drills
	PM	Off	
Sunday	OFF	Safety Clinic; coxswains please attend.	

UVIC MEN TRAINING PLAN

October 17–23

Day	Exercise Prescription	Ergogenesis	HR	SR
Monday	OFF			
Tuesday	(a) technique (b) 20 minutes steady state (c) 6×5 min. @ VT /1 min. off (d) 3 min. tempo in 10 min.	Aert	130–150 130–150	22–24
Wednesday	(a) technique (b) 20 minutes + 20 minutes + 20 minutes	Aert Aert Aert	130–170 130–170 130–170	20–22 22–24 24–26
Thursday	(a) technique (b) 20 min. steady state (c) 4×9 minutes TURBOS @ VT /4–5 minutes off 2 minutes @ 22–24 3 minutes @ 24–26 (4 minutes @ 24–26) (d) 3 minutes tempo in 10 minutes	Aert Aert–Ant	130–150 VT	22–24 26–28
Friday	(a) technique (b) 70 min. steady state include 6×2 minutes power rowing (c) 3 minute tempo in last 10 minutes	Aert	150–160	20–22
Saturday	Alumni Challenge Regatta	Long distance rowing		
Sunday	Off			

APPENDIX F

PEAK POWER ERGOMETER TRAINING PROGRAM

(6 week program; 3 × week)

F.1 Objectives

The objectives of this program are to improve peak power efficiency. The emphasis is on "explosive erg work".

The program is based on the following principles:

progress in frequency

progress in duration

progress in intensity

F.2 Instructions

It is recommended that subjects do ergometer workouts in pairs and record each other's wattage splits.

Subjects are to precede all power workouts and tests with a stretching program and a 20 minute warmup on the rowing ergometer.

Similarly, all power workouts and tests are to be followed by a cooldown consisting of five minutes low rate easy pressure rowing. As in the warmup a prescribed series of stretches should be performed upon completion of the ergometer work.

F.3 Rest

Rest between pieces should be 1 – 1.5 minutes, depending on how long it takes your heart rate to drop down.

F.4 ERGOMETER PEAK POWER Training Program

Week	Monday	Wednesday	Friday
1		(10–12) × 20"	(10–12) × 20"
2	(9) × 30"	(9) × 30"	(9) × 30"
3	(8) × 40"	(8) × 40"	(8) × 40"
4	(7) × 50"	(7) × 50"	(7) × 50"
5	(7) × 60"	(7) × 60"	(7) × 60"
6	(7) × 60"	(7) × 70"	(7) × 70"

Rest: 1–1.5 minutes **Rates:** 38–42

APPENDIX G

IMAGERY TRAINING PROGRAM

G.1 Objectives

The objectives of this program are:

- better awareness of how to relax
- improved preparedness for competitive events
- more practice time through imagery rehearsal
- help performance on the water
- help ergometer performance

Session	Content	Duration
1	General intro to imagery; emphasizing relaxation as ideal condition;	8 minutes
	schedules.	2 minutes
	"Breathing exercise."	
	"Progressive muscle relaxation"	20 minutes
2	Review breathing and PMR checklist	5 minutes
	Imagery/visualization;	15 minutes
	2 non–rowing scenes.	
3	Checklist	5 minutes
	Elk Lake visualization	5 minutes
	Video of "powerful stroke" × 2	5 minutes
	Image doing one powerful stroke	1 minute
4	Checklist	5 minutes
	Video and audio of "release"	5 minutes
	Practice imaging release	1–3 minutes
5	Checklist	5 minutes
	Video and audio of "recovery"	5 minutes
	Image "recovery"	1–3 minutes
6	Checklist	5 minutes
	Video and audio of "entry"	5 minutes
	Image "entry"	1–3 minutes

Session	Content	Duration
7	Checklist	5 minutes
	Video and audio of "drive"	5 minutes
	Image "drive"	1–3 minutes
8	Checklist	2 minutes
	Explain "race plan"; start, mid and end (total strokes = 45–50)	5 minutes
	Audio of "power words"	2 minutes
	Video of "powerful strokes"	2 minutes
	IMAGE 5 "powerful strokes"	1.5–3 minutes
9	Checklist	2 minutes
	Audio of "power words"; imaging powerful strokes	2 minutes
10	Audio of "power words"	2 minutes
	Audio of "coxies start" (with warmup)	30 seconds
	Image the start (16 strokes)	20 seconds
11	Focus	1–2 minutes
	Image presprint, stretching, ergo warmup, paddle to start. Start and mid	20–25 seconds
	Audio of "coxie's start and image	30 seconds
12	Focus	1–2 minutes
	Image start while listening to "coxie's tape".	20 seconds
	Image mid to "coxie's tape"	40 seconds
	Image on own, timed for 40 seconds	
13	Breathing and focus	3 minutes
	Image mid	37 seconds
	Listen and image to "coxie's tape"	37 seconds
	Video of race bringing out "prerace feelings".	3 minutes
14	Focus	1–3 minutes
	Image end	42 seconds
	Listen and image to "coxie's tape"	37 seconds
	Video of "power"	1 minute
	Image being powerful	1 minute

Session	Content	Duration
15	Focus	1–3 minutes
	Video of power	2 minutes
	Image entire "sprint"	1 minute, 30 seconds
	Image warmup and "sprint" and cooldown.	5 minutes
16	Focus	1 minute
	Image stretch	1 minute
	Image ergo warmup	1 minute
	Image paddle to start	2 minutes
	Image "sprint"	1 minute, 20 seconds
	Image cooldown	2 minutes
17	Focus	1 minute
	Rehearse the entire prerace and race procedure on own.	8 minutes

APPENDIX H

RELAXATION VISUALIZATION SCENARIOS

Three different scenes were created that were non–rowing specific. They can be found in *Managing Stress Before It Manages You* (1980).

The rowing specific visualization is given here.

It is 4:30 in the afternoon as you pull into the parking lot at Elk Lake. You get out of your car and walk to the front of the boathouse. You are going to take a single out today. It is drizzling and cool.

The water is calm, the geese are flying overhead and cars are swishing along the Pat Bay Highway.

You go into the single's bay to stretch and relax. There are many other athletes around, but you're not concerned about them.

You check your breathing as you stretch.

Once you've stretched, get your blades and put them on the dock. There is a lot of traffic on the dock. You get someone to help you carry your single. You put your blades in and gently get into the boat, checking your oarlocks and foot stretchers. Relaxed, you push off from the dock. You check the balance of your boat as you row away. The people on the dock seem insignificant. You are relaxed and the water is beautiful and calm. The boat is perfectly set.

APPENDIX I

ROWING TECHNIQUE

There are four major components of the rowing stroke which you are already well aware of:

1. the release
2. the recovery
3. the entry
4. the drive

I.1 Release

The release can be divided into three subcomponents and they are:

1. approaching
2. extracting
3. follow through

I.1.1 Approaching Approaching the release, the right hand is slightly leading the left one. Once clear the overlap the left hand chases to catch the right hand. Shoulders are relaxed but rolling and contributing. Arms should be back and out, shoulder blades slightly pinched. Be patient. The slide sits for a while as you swing back and then forward. Let the boat run.

I.1.2 Extracting At the release press down hands first so that the blades are partially extracted on the square, rolling the fingertips. Keep pressure on the thumbs against the butts of the blades.

I.1.3 Follow Through Hands are continually moving, shoulders and seat remain still while arms move down and away, almost straight.

I.2 Recovery

Hands are continually moving, shoulders and seat remain still while arms move down and away, almost straight. A gentle tug in the shoulders cues the body forward while the knees are held down. The arms moving forward is the transition into the recovery; the body swing forward is the start of the recovery. Knees are held down and once the hands are past the knees most of the body angle has been established prior to moving up the slide. Travel up the slide at a constant speed always trying to minimize body movement.

I.3 Entry

The three subcomponents of the entry are:

1. approach
2. entry
3. lock

I.3.1 Approach The approach involves controlled relaxation, particularily in the arms; this also relates to bladework. The body angle is established and good posture is important; the shins should be approaching the perpendicular, be relaxed and the arms go up into the catch.

I.3.2 Entry The entry is concerned with blade/seat timing. The seat is moving forward, try to achieve backsplash on the blades — be quick and accurate.

The arms should be loose and the action of catching independent from the shoulders and the body. It is done with the arms.

I.3.3 Lock The lock requires quickness of application. The slide reverses direction; the blade enters, the seat moves, and the body is linked up. You feel as if you are suspended between the feet, oarlock, and seat.

You should be able to draw a straight line between your hands. They should be even, the right hand leading in.

I.4 Drive

The knees and hips are engaged with the knees as the major force applicator. The hip is initially engaged, the back, shoulder and arms are engaged but not transmitting. As you move through the stroke cycle the hip becomes the major force applicator. The arm pull begins to blend in; you finish off with the hips and knees first — then the arms follow quickly.

I.5 Summary

There is a cyclical, transitory, blending, an overlap between all phases.

Keep the body linear and horizontal. The centre of gravity is to travel linearly in order to eliminate bounce in the boat and thus to eliminate disturbing the run of the boat.

APPENDIX J

AUDIO POWER SCRIPT

In order to call certain images to mind it has been shown that it can be helpful to cue or call up words that will help you to see and/or feel the desired situation and sensation.

When working on power in your imagery practice (Group 3) or power ergometer piece (Group 1), try using these words to call up a feeling of being powerful (Group 3 at home and Group 1 on the ergometer).

might	explode	dynamic
force	hoist	fast–alert
impel	crumble	jab
smash	drive	rap
snap	carve	smack
rip	quick	flick
blast	explosive	whip
boom	solid	fling
bang	push–pull	pop
thump	sunburst	dash
thrust		

APPENDIX K

SPRINT TEST RECORD SHEET

SCULLING SPRINT TEST #1
September 18, 1988

SUBJECT: _____ RESULT: _____

GROUP: _____

RATING: excellent good average below average inexperienced

TIME OF START: _____

BOAT: _____

STARTER: _____

FINISHER: _____

WIND METER: _____

WATER CONDITIONS: _____

TIME

0M	100M	200M	300M

RATES

SPLITS

COMMENTS:

APPENDIX L

ERGOMETER TEST RECORD SHEET

POWER ERGOMETER TEST #1

September 20, 1988

SUBJECT: _____ RESULT: _____

GROUP: _____

TIME OF TEST: _____

TESTER: _____

	15"	30"	45"	60"	75"	90"
WATTS						
RATE						

AVERAGE WATTAGE OUTPUT: _____

APPENDIX M

SAMPLE LOG SHEETS

M.1 Imagery Logs

M.1.1 Red Imagery Log (Group 1)

Please circle the number that best describes your answer to the question.

1 = NOT AT ALL and 9 = EXTREMELY WELL

1. To what extent were you able to recall what was rehearsed in the last imagery session?

   Degree 1 2 3 4 5 6 7 8 9

2. To what degree were you able to image what was done in the imagery sessions?

   Degree 1 2 3 4 5 6 7 8 9

3. To what degree could you "see" yourself doing the actions?

   Degree 1 2 3 4 5 6 7 8 9

4. To what degree could you "feel" or "sense" the activity imaged?

   Degree 1 2 3 4 5 6 7 8 9

5. To what degree was your imaging so real that you felt that you were on the water?

   Degree 1 2 3 4 5 6 7 8 9

6. To what degree could you "see" yourself on the water?

   Degree 1 2 3 4 5 6 7 8 9

7. To what degree do you find it easy to image while on the ergometer doing interval training?

   Degree 1 2 3 4 5 6 7 8 9

8. To what degree do you find yourself rehearsing other than on the ergometer?

   Degree 1 2 3 4 5 6 7 8 9

M.1.2 Blue Imagery Log (Group 3)

Please circle the number that best describes your answer to the question.

1 = NOT AT ALL and 9 = EXTREMELY WELL

1. To what extent were you able to recall what was rehearsed in the last imagery session?

   Degree 1 2 3 4 5 6 7 8 9

2. To what degree were you able to image what was done in the imagery sessions?

   Degree 1 2 3 4 5 6 7 8 9

3. To what degree could you see yourself "doing" the actions?

   Degree 1 2 3 4 5 6 7 8 9

4. To what degree could you "feel" or "sense" the activity imagined?

   Degree 1 2 3 4 5 6 7 8 9

5. To what degree was you imaging so real that you felt you were on the water?

   Degree 1 2 3 4 5 6 7 8 9

6. To what degree could you "see" yourself on the water?

   Degree 1 2 3 4 5 6 7 8 9

7. To what degree do you find it easy to image while lying in bed at night?

   Degree 1 2 3 4 5 6 7 8 9

8. To what degree do you find it easy to image early in the morning before you get up?

   Degree 1 2 3 4 5 6 7 8 9

M.1.3 Red and Green Ergometer Log (Groups 1 and 2)

POWER ERGOMETER LOG

NAME: _____ DATE: _____

RECORD WATTAGE IN SPACES PROVIDED

INTERVAL

	1	2	3	4	5	6	7	8	9	10	11	12
15"												
30"												
45"												
60"												
75"												
90"												
⌐												

AVERAGE WATTAGE/ INTERVAL

AVERAGE TOTAL WORKOUT _____

APPENDIX N

CALENDAR OF EVENTS

University of Victoria Men's and Women's

Ergometer Tests and Regattas

Month	Date	Event
September	17	Men's ergometer test (Concept II)
September	24	Women's ergometer test (Concept II)
October	12	Women's ergometer test (Gjessing)
October	15	Deep Cove Classic
October	16	UBC Burnaby Lake
October	29	Head of the Gorge
October	30	Elk Lake
November	12	Frostbite (Seattle)
November	13	Head of the Lake (Seattle)

APPENDIX O

SAMPLE SIGNUP SHEET

300 Meter Sprint Test

Signup Sheet for Saturday, November 5

Elk Lake

Be at the boathouse 45 minutes before your time. Times listed below are when you should be on the starting line.

1. Warmup and cooldown must be done on the ergometer.
2. Boats must be brought in immediately.
3. Bring a change of clothes.

Stagger male and female in signing up.

F	8:00
M	8:05
F	8:10
M	8:15
F	8:20
M	8:25
F	8:30
M	8:35
F	8:40
M	8:45
F	8:50
M	8:55
F	9:00
M	9:05

F	9:10
M	9:15
F	9:20
M	9:25
F	9:30
M	9:35
F	9:40
M	9:45
F	9:50
M	9:55
F	10:00
M	10:05
F	10:10
M	10:15
F	10:20
M	10:25
F	10:30
M	10:35
F	10:40
M	10:45
F	10:50
M	10:55
F	11:00

APPENDIX P

ROLE IN STUDY FORMS

RED (Group 1)

As a participant in this study you are vital to the final results of the study. Of course you are free to withdraw at any time. I hope that if something is unclear or not to your liking regarding my program that you will feel free to tell me directly, without involving your coach.

There will be 17 imagery sessions and we hope to accommodate everyone and meet regularly together. The longest session will be 30 minutes. We will try to run a session every day starting on Monday, September 26th. The location as yet to be determined in order to accommodate everyone.

There will be 17 ergometer sessions, the first on September 26th. You will be required to work with a partner.

The ergometer sessions will require that you perform to the best of your ability and it is essential that you image while doing your power ergometer work. You are to practice what was done in the previous imagery session. The two sessions are to complement each other.

The requirements from you as a participant should not place any demands that are unfamiliar to you.

You should be used to the physical demands of the ergometer work. However, the psychological demands may be a little more focused.

You will also required to keep a daily log for your ergometer training and another for your imagery training. These are to be submitted.

TESTS

There will be two 300 meter sprint tests on the water in a single.

There will be three 90–second ergometer tests.

I have listened to the above description of this study and I understand its requirements from me as a participant in this study.

SUBJECT: _____ (please print)

SIGNATURE: _____

GREEN (Group 2)

As a participant in this study you are vital to the final results of the study. Of course you are free to withdraw at any time. I hope that if something is unclear to you or not to your liking regarding my program that you will feel free to tell me directly, without involving your coach.

There will be 17 ergometer sessions. The ergo sessions will require that you perform to the best of your ability.

The requirements from you as a participant should not place upon you any demands that are unfamiliar to you.

The physiological requirements from the ergo work should not be unfamiliar.

You will be expected to work with a partner and to keep a daily log of your ergometer work which is to be submitted.

TESTS

There will be two 300 meter sprint tests on the water in a single.

There will be three 90–second ergometer tests.

I have listened to the above description of this study and I understand its requirements from me as a participant in this study.

SUBJECT: _____ (please print)

SIGNATURE: _____

BLUE (Group 3)

As a participant in this study you are vital to the results of the study. Of course you are free to withdraw at any time. I hope that if something is unclear or not to your liking regarding my program that you will feel free to tell me directly, without involving your coach.

There will be 17 imagery sessions and I hope to accommodate everyone and meet regularly together. The longest session will be 30 minutes. We will try to run a session every weekday starting Monday, September 26th. The location has yet to be determined in order to accommodate everyone.

You will be asked to practice what you have learned in your sessions for 20 minutes every day. In conjunction with the practice sessions, I would like to ask you to keep a daily log and to submit it.

The psychological demands of this program will be perhaps more focused than what you have experienced before, but not too taxing.

TESTS

There will be two 300 meter sprint tests on the water in a single.

There will be three 90–second ergometer tests.

I have listened to the above description of this study and I understand its requirements from me as a participant in this study.

SUBJECT: _____ (please print)

SIGNATURE: _____

YELLOW (Group 4)

As a participant in this study you are vital to the final results of the study. Of course you are free to withdraw at any time. I hope that if something is unclear to you or not to your liking regarding my program, that you will feel free to tell me directly, without involving your coach.

TESTS

There will be two 300 meter sprint tests on the water in a single.

There will be three 90–second ergometer tests.

I have listened to the above description of this study and I understand its requirements from me as a participant in this study.

SUBJECT: _____ (please print)

SIGNATURE: _____

APPENDIX Q

RACE PROTOCOL

Subjects were scheduled to arrive at the boathouse forty minutes before their scheduled sprint time and were instructed to perform a warmup on available rowing ergometers. The dock marshall ensured that subjects were boated at the correct time and were staggered according to gender due to the limited number of single sculls available for testing. This ensured a continuous flow in the procedure.

The weather office was consulted prior to on–the–water testing to determine whether it was safe to carry out the sprints.

Subjects rowed from the dock directly to the start where they were called to the start by a starter in a launch. A recorder was also in the launch. There were flaggers on shore at each 100 meter mark and the finish line. Prior to each sprint the identity of each subject was checked by the wind meter recorder and then subjects were informed of the buoys and asked whether they had a course. The command, "Sit up, are you ready, row" was then given. The starter and recorder both started their watches on the word row, and then proceeded to follow the subject down the course. Splits were recorded every 100 meters as flags were dropped and finish times were recorded as the bow ball of the boat crossed the finish line. The researcher recorded the final times in the launch.

Subjects then rowed immediately to the dock where the next subject stepped into the shell. Subjects were asked to cool down on ergometers and stretch in the boathouse. Upon completion of the last sprint test the course was taken up.

The course for the posttest was set along the beach in Beaver Lake. Four experienced scullers rowed the singles into Beaver to the beach. The dock marshall ensured correct boatings from the beach. Athletes were instructed to warm up on the ergometer at the boathouse and drive to the beach to launch. Subjects were instructed to cool down and stretch at the boathouse. Four experienced scullers

rowed the singles back to the boathouse. Again, the course was taken up immediately after the last sprint. Two safety launches other than the starter's launch were on the course in the event subjects overturned in their singles.

APPENDIX R

IMAGERY POWER ERGOMETER TAPES

These tapes were made available to Group 1, who followed the 6 week ergometer training program and the imagery training program.

Session	Content
1	Elk Lake Scenario, powerful strokes, release
2	Release
3	Recovery
4	Entry
5	Drive
6	Power words
7	Power words, sprint start
8	Power words, sprint start
9	Power words, sprint mid
10	Power words, sprint mid
11	Power words, sprint mid
12	Power words, sprint start and mid
13	Power words, sprint end
14	Power words, sprint end
15	Power words, sprint mid and end
16	Power words, sprint start, mid and end
17	300 meter sprint rehearsal

APPENDIX S

SAMPLE INSTRUCTIONS FOR IMAGERY REHEARSAL ON OWN

Practice for October 23, 25, 26, 27, 31, November 1, 2, 3, and 4; to be done in the morning and evening.

Rehearse your prerace plan by imaging stretching and ergo warmup. Then image your paddle to the start and preparation for the start. Then REALLY RACE the 300 meter sprint. Use your cue words; think, see and feel power (record in your log).

The night before the sprint, use progressive muscle relaxation to help you to fall asleep after you have rehearsed your sprint.

APPENDIX T

GENDER, WEIGHT, HEIGHT, AGE AND ROWING CATEGORY FOR EACH SUBJECT

MEASURES

Subject	Gender M/F	Weight kg	Height cm	Age	Category H/L
43	M	78.6	190.0	19	L
37	F	72.0	175.5	19	H
111	F	71.8	175.0	19	H
45	M	79.0	183.0	19	H
44	F	60.7	179.0	18	H
29	M	78.6	189.0	21	H
15	F	60.0	167.5	19	L
26	F	77.0	180.0	20	H
33	M	71.0	181.0	20	L
32	F	72.5	178.5	19	H
48	F	70.0	175.0	18	H
39	F	75.5	174.0	20	H
38	M	81.8	188.0	19	H
42	F	77.0	180.0	19	H
36	M	80.0	181.0	20	H
22	F	70.4	181.5	19	H
19	M	90.6	191.0	19	H
17	F	86.9	173.5	21	H
310	M	70.5	179.0	18	L
27	M	92.0	188.0	22	H
34	F	71.6	178.0	19	H

28	F	79.5	180.0	19	H
41	M	81.0	185.0	22	H
31	M	74.5	174.0	22	L
210	F	80.2	179.0	23	H
46	F	76.7	176.0	20	H
11	M	73.0	183.0	21	L
35	M	82.5	184.0	19	H
25	M	78.1	185.5	18	H
13	M	86.4	202.5	19	H
12	F	69.6	174.7	22	H
21	M	86.0	184.0	24	H
47	M	86.3	190.5	25	H
Mean	F=16/M–17	77.0	181.4	20.0	H=27/L=6

APPENDIX U

RAW DATA

GROUP	SUBNUM	ERG1	ERG2	ERG3	WATER1	WATER2
1.00	1.00	436.30	420.10	406.30	71.20	68.30
1.00	2.00	367.50	394.60	432.90	73.30	68.00
1.00	3.00	540.80	553.00	555.10	83.50	77.00
1.00	5.00	252.00	272.00	271.90	82.50	75.80
1.00	7.00	338.90	357.90	382.60	131.30	97.00
1.00	9.00	525.50	597.90	605.40	70.00	64.90
1.00	11.00	265.50	285.60	285.90	101.50	83.40
2.00	1.00	559.60	568.40	563.50	74.50	67.10
2.00	2.00	355.60	384.00	372.70	75.00	70.60
2.00	5.00	540.90	576.30	572.30	73.80	65.30
2.00	6.00	387.80	430.80	417.70	95.70	83.00
2.00	7.00	598.10	604.50	641.80	74.20	70.60
2.00	8.00	353.50	385.90	388.70	108.40	98.00
2.00	9.00	445.00	473.10	519.60	107.30	107.60
2.00	10.00	316.80	331.90	336.80	169.40	123.20
3.00	1.00	397.60	390.90	388.90	71.30	66.40
3.00	2.00	310.20	314.60	307.00	82.88	74.00
3.00	3.00	434.80	433.80	455.70	72.22	64.60
3.00	4.00	325.10	321.00	349.50	82.89	77.50
3.00	5.00	482.30	499.30	511.80	70.44	65.90
3.00	6.00	479.60	500.10	517.20	76.03	77.70
3.00	7.00	294.10	323.50	320.70	87.39	77.90
3.00	8.00	475.90	462.30	537.90	99.63	87.10
3.00	9.00	335.40	359.80	361.70	96.92	85.30
3.00	10.00	433.50	418.80	461.00	76.31	62.60
4.00	1.00	551.80	543.20	542.80	77.00	73.30
4.00	2.00	393.30	362.30	378.20	81.90	73.80
4.00	3.00	475.80	471.70	485.80	71.70	69.00
4.00	4.00	307.70	305.90	288.30	81.20	77.80
4.00	5.00	505.10	461.60	526.80	122.30	97.00

GROUP	SUBNUM	ERG1	ERG2	ERG3	WATER1	WATER2
4.00	6.00	342.80	332.50	344.30	79.20	75.40
4.00	7.00	588.60	559.60	607.40	83.30	83.30
4.00	8.00	337.00	368.20	360.70	130.70	91.40

Number of cases read = 33 Number of cases listed = 33

GROUP	SUB NUM	TEST	ERG 15	ERG 30	ERG 45	ERG 60	ERG 75	ERG 90	ERG AVG	WATER 100	WATER 200	WATER 300	WATER FIN
1	1	1	517	449	399	362	375	330	436	23	24	24	71
1	1	2	475	420	406	395	388	383	420	23	21	24	68
1	1	3	456	427	403	369	375	353	406	.	.	.	.
1	2	1	352	365	343	370	354	355	368	23	25	25	73
1	2	2	433	386	384	404	374	401	395	26	23	19	68
1	2	3	451	452	442	454	408	388	433	.	.	.	.
1	3	1	545	550	559	587	519	502	541	28	27	38	83
1	3	2	636	628	579	512	465	466	553	26	23	28	77
1	3	3	550	593	575	522	541	536	555	.	.	.	.
1	5	1	273	263	264	236	244	222	252	27	27	38	82
1	5	2	352	320	269	251	253	233	272	32	18	26	76
1	5	3	310	293	283	262	254	.	272	.	.	.	.
1	7	1	331	329	340	305	341	338	339	46	45	40	131
1	7	2	377	377	354	357	334	321	358	31	31	35	97
1	7	3	399	385	350	334	389	382	383	.	.	.	.
1	9	1	544	540	529	551	506	517	529	24	23	23	70
1	9	2	680	627	623	574	546	478	598	22	21	23	65
1	9	3	695	635	602	577	543	510	605	.	.	.	.
1	11	1	283	293	270	245	249	230	266	34	34	33	101
1	11	2	307	296	285	264	272	278	286	28	29	27	83
1	11	3	314	295	285	267	256	255	286	.	.	.	.
2	1	1	578	552	559	551	522	521	560	26	25	24	74
2	1	2	591	597	587	548	533	585	568	24	19	24	67
2	1	3	629	597	577	554	524	495	564	.	.	.	.
2	2	1	340	360	360	354	352	360	356	26	25	34	75
2	2	2	409	393	395	382	351	331	384	24	21	26	71
2	2	3	426	382	371	344	357	362	373	.	.	.	.
2	5	1	595	563	557	533	535	512	541	25	25	24	74
2	5	2	646	602	571	562	541	488	576	23	19	23	65
2	5	3	627	584	573	570	526	503	572	.	.	.	.
2	6	1	424	431	407	387	352	328	388	34	31	31	96
2	6	2	517	505	440	388	367	321	431	29	25	29	83

GROUP	SUB NUM	TEST	ERG 15	ERG 30	ERG 45	ERG 60	ERG 75	ERG 90	ERG AVG	WATER 100	WATER 200	WATER 300	WATER FIN
2	6	3	476	443	411	388	348	306	418	.	.	.	.
2	7	1	643	641	651	594	520	492	598	26	24	24	74
2	7	2	662	638	615	597	552	506	605	24	23	24	71
2	7	3	625	648	633	668	668	602	642	.	.	.	.
2	8	1	391	369	356	333	350	312	354	.	.	33	108
2	8	2	461	426	388	362	321	260	386	37	29	32	98
2	8	3	462	432	378	358	330	326	389	.	.	.	.
2	9	1	520	528	460	390	294	270	445	38	37	33	107
2	9	2	568	543	488	442	360	350	473	40	34	34	108
2	9	3	633	560	526	523	411	374	520	.	.	.	.
2	10	1	389	343	330	320	282	249	317	58	52	57	169
2	10	2	435	406	333	291	240	254	332	44	40	39	123
2	10	3	409	351	357	301	249	290	337	.	.	.	.
3	1	1	414	391	404	401	392	343	398	24	25	23	71
3	1	2	421	384	381	373	381	.	391	24	20	22	66
3	1	3	399	385	386	386	367	378	389	.	.	.	.
3	2	1	346	298	326	314	279	291	310	27	28	28	83
3	2	2	389	349	345	326	338	250	315	24	23	27	74
3	2	3	361	323	299	302	277	280	307	.	.	.	.
3	3	1	439	451	437	422	414	412	435	24	24	24	72
3	3	2	458	460	440	385	415	374	434	22	21	21	65
3	3	3	482	455	454	442	454	435	456	.	.	.	.
3	4	1	376	346	306	309	307	265	325	27	27	29	83
3	4	2	342	351	321	314	320	349	321	27	24	27	78
3	4	3	377	359	367	348	362	324	350	.	.	.	.
3	5	1	525	515	482	432	452	423	482	23	23	24	70
3	5	2	566	542	488	480	475	429	499	22	20	24	66
3	5	3	568	557	516	515	480	436	512	.	.	.	.
3	6	1	519	506	484	504	426	449	480	26	26	24	76
3	6	2	543	513	481	498	484	495	500	26	24	23	73
3	6	3	569	518	575	530	499	451	517	.	.	.	.
3	7	1	303	315	294	295	282	272	294	29	29	29	87

GROUP	SUB NUM	TEST	ERG 15	ERG 30	ERG 45	ERG 60	ERG 75	ERG 90	ERG AVG	WATER 100	WATER 200	WATER 300	WATER FIN
3	7	2	370	350	331	299	294	309	324	26	25	27	78
3	7	3	351	337	332	307	299	311	321	.	.	.	.
3	8	1	435	457	498	514	496	465	476	35	33	32	100
3	8	2	448	490	499	472	445	402	462	32	26	30	87
3	8	3	613	621	547	505	460	403	538	.	.	.	.
3	9	1	365	362	357	319	300	294	335	33	32	31	97
3	9	2	383	371	352	336	348	334	360	29	27	29	85
3	9	3	376	340	363	354	356	366	362	.	.	.	.
3	10	1	539	471	418	408	355	279	434	24	25	28	76
3	10	2	470	463	428	397	397	.	419	20	20	23	63
3	10	3	566	482	483	454	437	382	461	.	.	.	.
4	1	1	600	592	554	547	506	459	552	26	26	25	77
4	1	2	519	583	545	502	488	481	543	26	22	25	73
4	1	3	557	571	.	540	494	540	543	.	.	.	.
4	2	1	323	417	409	363	350	313	393	28	28	26	82
4	2	2	391	353	361	364	362	347	362	26	22	26	74
4	2	3	430	392	390	361	338	331	378	.	.	.	.
4	3	1	542	510	403	460	444	382	486	24	24	24	72
4	3	2	545	530	501	461	386	366	471	19	25	25	69
4	3	3	505	508	506	465	439	440	486	.	.	.	.
4	4	1	332	337	297	286	293	263	308	27	27	28	81
4	4	2	360	330	312	291	286	256	306	29	22	27	78
4	4	3	330	307	294	280	265	256	288	.	.	.	.
4	5	1	531	515	517	502	445	427	505	42	41	39	122
4	5	2	491	472	487	442	419	407	462	34	31	32	97
4	5	3	618	580	543	505	449	431	527	.	.	.	.
4	6	1	319	343	354	313	310	284	343	25	27	27	79
4	6	2	359	331	331	324	314	305	333	26	23	26	75
4	6	3	384	360	342	333	351	310	345	.	.	.	.
4	7	1	689	592	586	530	547	485	589	32	26	26	83
4	7	2	660	640	610	594	582	.	560	31	27	25	83
4	7	3	696	634	630	587	570	538	607	.	.	.	.

GROUP	SUB NUM	TEST	ERG 15	ERG 30	ERG 45	ERG 60	ERG 75	ERG 90	ERG AVG	WATER 100	WATER 200	WATER 300	WATER FIN
4	8	1	379	362	348	326	311	290	337	44	44	43	131
4	8	2	395	405	386	331	342	314	368	31	30	30	91
4	8	3	391	354	336	380	318	356	361	.	.	.	.

Number of cases read = 99

Number of cases listed = 99

APPENDIX V

PERCENTAGE IMPROVEMENT SCORES

Group	ERG3	ERG1	DIFFERG	WATER2	WATER1	DIFFWAT
1.00	406.30	436.30	−6.88	68.30	71.20	−4.07
1.00	432.90	367.50	17.80	68.00	73.30	−7.23
1.00	555.10	540.80	2.64	77.00	83.50	−7.78
1.00	271.90	252.00	7.90	75.80	82.50	−8.12
1.00	382.60	338.90	12.89	97.00	131.30	−26.12
1.00	605.40	525.50	15.20	64.90	70.00	−7.29
1.00	285.90	265.50	7.68	83.40	101.50	−17.83
2.00	563.50	559.60	.70	67.10	74.50	−9.93
2.00	372.70	355.60	4.81	70.60	75.00	−5.87
2.00	572.30	540.90	5.81	65.30	73.80	−11.52
2.00	417.70	387.80	7.71	83.00	95.70	−13.27
2.00	641.80	598.10	7.31	70.60	74.20	−4.85
2.00	388.70	353.50	9.96	98.00	108.40	−9.59
2.00	519.60	445.00	16.76	107.60	107.30	.28
2.00	336.80	316.80	6.31	123.20	169.40	−27.27
3.00	388.90	397.60	−2.19	66.40	71.30	−6.87
3.00	307.00	310.20	−1.03	74.00	82.88	−10.71
3.00	455.70	434.80	4.81	64.60	72.22	−10.55
3.00	349.50	325.10	7.51	77.50	82.89	−6.50
3.00	511.80	482.30	6.12	65.90	70.44	−6.45
3.00	517.20	479.60	7.84	77.70	76.03	2.20
3.00	320.70	294.10	9.04	77.90	87.39	−10.86
3.00	537.90	475.90	13.03	87.10	99.63	−12.58
3.00	361.70	335.40	7.84	85.30	96.92	−11.99
3.00	461.00	433.50	6.34	62.60	76.31	−17.97
4.00	542.80	551.80	−1.63	73.30	77.00	−4.81
4.00	378.20	393.30	−3.84	73.80	81.90	−9.89
4.00	485.80	475.80	2.10	69.00	71.70	−3.77
4.00	288.30	307.70	−6.30	77.80	81.20	−4.19
4.00	526.80	505.10	4.30	97.00	122.30	−20.69
4.00	344.30	342.80	.44	75.40	79.20	−4.80
4.00	607.40	588.60	3.19	83.30	83.30	.00
4.00	360.70	337.00	7.03	91.40	130.70	−30.07

N = 33

VITA

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Educational Institutions Attended, with Dates of Entering and Leaving:

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Author: [redacted]

(Signature)

PATRICIA MARGUERITE STEINBRINK KELLY

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