IMAGERY, PROGRESSIVE MUSCLE RELAXATION AND RESTRICTED ENVIRONMENTAL STIMULATION: ENHANCING MENTAL TRAINING AND ROWING ERGOMETER PERFORMANCE THROUGH FLOTATION REST

by

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Abstract

Examining flotation Restricted Environment Stimulation Technique (REST) as a performance enhancement tool in sport has produced positive results. However, earlier studies using flotation REST combined the technique with guided imagery, confounding the effect that REST-only might have on sport performance. Although more recent studies have examined the effects of flotation REST-only on athletic performance, they have only considered fine motor activities. The current study tested the effects of REST, without guided imagery, on rowing ergometer performance, a gross motor, endurance activity. Further more, the study attempted to ascertain why rowers might benefit from including a period of flotation in their training regime, and whether the flotation REST environment was better for mental training than a Progressive Muscle Relaxation (PMR) condition. Subjects (n=24) were male novice and varsity university rowers. Subjects were matched based on previous ergometer scores, imagery use, and imagery ability, and randomly assigned to either a flotation REST condition or a PMR condition. Both groups were exposed to six administrations of one condition over a 7-week period, during which time they completed three 2000-meter ergometer tests, were part of their required training schedule. Results showed a significant improvement in ergometer scores for the REST group, with no significant improvement for the PMR group. The imagery data suggest several alternative explanations for the effect of environment on mental training, while the physical training data suggest a possible link between flotation REST and recovery from physical fatigue.

TABLE OF CONTENTS

List of Tables

List of Figures

Imagery, Progressive Muscle Relaxation and Restricted Environmental Stimulation: Enhancing Mental Training and Rowing Ergometer Performance through Flotation REST

Introduction

Physical practice is, without a doubt, the fundamental process for learning and becoming proficient at an athletic skill; however, it has been suggested that once a skill is mastered, psychology, involving mental practice, is the "key to athletic excellence" (Rushall, 1989, p.165). In fact, in a study of 235 Canadian Olympic athletes, Orlick and Partington (1988) state that "of the three major readiness factors rated by the athletes - mental, physical, technical - mental readiness provided the only statistically significant link with final Olympic ranking" (p.129). Mental preparation of different sorts varying from imagery practice, mental simulation, relaxation/arousal regulation and focussing to goal setting techniques has been demonstrated to improve performance in a number of sports (Feltz & Landers, 1983; Greenspan & Feltz, 1989; Onestak, 1989; Vealey, 1994; Gould & Udry, 1994), and reports from some of the most elite contenders in sports corroborate the argument for the use of mental skills in preparing for competition (Ungerleider & Golding, 1991; Gould, Tammen, Murphy & May, 1991; Rushall, 1989; Heishman & Bunker, 1989; McCaffrey & Orlick, 1989; Orlick & Partington, 1988; Orlick & Partington, 1987). While sport psychology consultants and researchers alike have utilized, examined and tested the effects of multi-component strategies (Feltz & Landers, 1983; Greenspan & Feltz, 1989; Vealey, 1994; Savoy, 1993; Davis, 1992; Gordon, 1990; Fenker & Lambiotte, 1987; Boutcher & Rotella, 1987), numerous authors have expressed the need to conduct research that examines intervention components independently in order to establish those that are the most effective (Greenspan & Feltz, 1989; Vealey, 1994; Shambrook & Bull, 1996).

An intervention that has received some attention in the athletic performance enhancement literature and that warrants further research is a technique called Restricted Environmental

Stimulation Technique (REST) (Suedfeld, 1980). REST (Suedfeld, 1980) is a term that describes a procedure during which participants experience a reduced stimulus environment void of most sensory and perceptual inputs. Although there are two different versions of REST, chamber and flotation tank, REST research in sport has focussed on flotation REST. In flotation REST, subjects lie supine in a light-proof, sound-attenuated tank containing a solution of Epsom salts and skin-temperature water (Suedfeld, Collier, & Hartnett, 1993). The usual length of time for flotation sessions is a one-hour period. One of the difficulties in training an athlete in mental skills lies in discovering an enjoyable, but effective mental training technique that potentially appeals to a multitude of athletes (Bull, 1991); REST appears to have this potential in that it is an affordable, accessible and pleasant intervention (Suedfeld et al., 1993).

In sport psychology, REST has provided an interesting perspective on performance enhancement, both as an instrument for inducing profound states of relaxation and as a mediator in mental skills training. Barabasz and Barabasz (1996), state that "it is noteworthy that there is consistent agreement about the facilitation of both imagery and the reduction of arousal" (p.3). In relation to general relaxation, REST has been shown to decrease arousal and stress and increase alert relaxation, illustrated by psychophysiological and biochemical indices such as decreased heart rate, blood pressure, muscle tension (Francis & Stanley, 1985; Jacobs, Heilbronner, & Stanley, 1985; O'Leary & Heilbronner, 1985; Turner, Fine, McGrady, & Higgins, 1987), plasma cortisol, ACTH, plasma B-endorphin (Turner, Bayless, & Fine, 1989; Turner & Fine, 1983) and increased EEG theta wave activity (Barabasz, 1990; Fine, Mills, & Turner, 1993). Furthermore, anecdotal self-reports, observer reports and verbal indices of mood and cognitive processes indicate that flotation REST is associated with lowered stress, anxiety, fatigue and depression combined with higher appraisals of calmness, alertness, and vigour (Suedfeld et al., 1993, p.152). In relation to imagery and mental training, REST has been associated with increases in such imaginal activity as imaginative involvement, absorption (how absorbed one is in one's own thoughts), vivid fantasizing, imagery, concentrated thought and creative thinking over that experienced in the normal environment (Barabasz, 1982, 1984; Barabasz, Barabasz, & Mullin, 1983; Barabasz & Barabasz, 1996; Barabasz et al., 1993; Budzynski, 1976; Lilly, 1977, Suedfeld, 1979, 1980; Suedfeld, Metcalfe & Bluck, 1987).

Some of the first documented evidence for the use of flotation REST to improve athletic performance comes from anecdotal reports and case studies with athletes (Hutchison, 1984; Stanley, Mahoney, & Reppert, 1985). Stanley et al. (1985) looked at the effects of a pilot training program with flotation REST on eight NCAA football players, and all eight of the athletes reported that the experience had improved their performance. Subsequently, the need for scientific research produced a number of studies involving flotation REST and sport. Lee and Hewitt (1987) found that novice and intermediate female gymnasts exposed to 40 minutes of flotation REST with a visualization script, once a week for six weeks, performed significantly better and reported significantly reduced negative physical symptoms compared to visualization-only and no-treatment control groups. In examining the effects of flotation REST and imagery on basketball free-throw shooting performance of volunteers who only played basketball occasionally or not at all, Suedfeld and Bruno (1990) found that a REST plus guided imagery treatment group significantly improved from pre-test to post-test of 20 consecutive free throws compared to the other groups of relaxation/imagery and imagery only, who showed no significant improvement. Wagaman, Barabasz & Barabasz (1990, 1991) also examined the effects of flotation REST and guided imagery on basketball performance, testing 22 male expert collegiate basketball players. They found that subjects exposed to REST plus guided imagery for six sessions over five weeks performed significantly better than the imagery-only subjects, as measured by standardized game performance statistics. In a study on tennis performance, McAleney, Barabasz, & Barabasz (1990) found that subjects exposed to flotation REST plus guided imagery scored significantly more first service points than a relaxation/imagery group.

While the aforementioned studies involving REST tested the effects of a combined treatment of flotation REST and guided imagery, several more recent studies (Suedfeld et al., 1993; Barabasz, Barabasz, & Bauman, 1993) found that REST alone can be a powerful tool for improving sport performance. Suedfeld et al. (1993) compared the effects on dart throwing skill of flotation REST, guided imagery training, and a combination of both, with those of a control condition. There was a significant main effect for REST, with the REST-only and REST plus guided imagery groups improving 11.5% and 13.3%, respectively. Furthermore, REST showed a significant main effect regardless of baseline skill level. No significant difference was found between baseline and post-session results for the guided imagery-only and control treatments. Barabasz et al. (1993) reported a significant difference in marksmanship scores for a collegiate rifle marksmanship training class following a period of dry-flotation REST, compared with those of a control group from the same class who experienced hypnotically induced relaxation. Within-group analysis showed a significant increase from pre- to post-test for the REST group, but no significant difference for the control. Post-experimental inquiry revealed no differences in expectation from either group, with most of the control group indicating that they felt improved confidence, thus suggesting that flotation REST had an effect beyond a mere placebo.

The results of these studies suggest that REST, independent of any other implemented techniques, can be an effective mediator in athletic training for maximum performance. Nonetheless, these two most recent studies illustrate the potential of REST-only for sports involving fine motor performance, while no study to date has demonstrated the effect of REST-only on gross motor skills or sports that emphasize speed, power and/or endurance (Suedfeld et al., 1993). In fact, Suedfeld et al. (1993) suggest that "skills most likely to benefit from flotation are those that require relatively low arousal and a full measure of control over a complex coordinated movement" (p.153). The current study looks at the effects of REST-only on rowing ergometer performance, predominantly a gross motor activity that requires all of the above elements, endurance, power, and speed. In an examination of case studies, Barabasz (1992) reported that a rower of Olympic potential substantially improved rowing performance after four sessions of flotation REST and guided imagery. This study is interested in isolating the effect of flotation REST on rowing ergometry and establishing possible explanations for why it may act as a performance enhancement tool in rowing and possibly other sports.

While the REST and performance studies conducted thus far have helped to establish flotation REST's utility as a performance enhancement tool, conclusive explanations for its effectiveness are still lacking. Based on subjective reports, associated with psychophysiological studies showing increased alert relaxation as a consequence of flotation REST, Suedfeld et al. (1993) advance two possible, not totally independent, explanations of the effects of REST on athletes:

> 1. Many floaters, including experienced practitioners of meditation or systematic relaxation techniques, report having reached previously unattained levels of relaxation while in the tank. In follow-up interviews, some also indicate that they have been more capable of again reaching such levels when they try to do so after the first tank experience. Floating may enable athletes to avoid levels of tension and arousal that might impair their performance in competition.
>
> 2. Many REST participants describe an improved ability to focus their concentration on topics that concerned them prior to entering the tank (usually personal problems or goal-directed plans). This effect may contribute to improved athletic performance, particularly in sports that require a tight attentional focus on a particular percept or motor behaviour (p.152).

Using the first of these explanations, one could hypothesize that flotation REST teaches athletes sensitivity to lower levels of arousal. Once an athlete knows what lowered arousal really feels like, it may be possible, through recreating the REST experience in one's memory, to return to that state of lowered arousal at a later point during competition. This may or may not be a difficult thing for an athlete to achieve; however, sensitizing an athlete to lower levels of arousal than previously experienced, even outside the competition environment, may be an important first step in mental training for optimal performance. The second of these explanations suggests that the flotation tank environment is conducive to sport related thoughts, focus and possibly imagery use. If athletes are able to improve their focus and such abilities as imagery using flotation REST, it is also possible that they may improve their competition performance by having dealt with a sport-related problem, developed a competitive strategy or engaged in skill, confidence enhancing or goal setting imagery during the flotation session.

Although the above two hypothetical explanations are presented separately, the author of the current paper hypothesizes that the explanation for the effects of flotation REST derives from a combination of these two accounts. In other words, flotation REST works to enhance athletic performance because it provides a profoundly relaxing experience in an environment conducive to greater amounts and better quality of sport-related imagery, planning and strategic thought processes than possible in other environments. Such an experience can be recalled explicitly, or even implicitly, at a later point in time to conjure up feelings of relaxation and/or memories of positive sport imagery that can lead to improved performance. Essentially, what is key to flotation REST is that one can experience getting into a "zone" where optimal sport imagery is practiced; with an alert mind and a relaxed body, and no distractions from external stimuli, positive images can be easily created. The potential for such an experience to improve rowing ergometry is quite high due to the nature of the sport. Rowing 2000 meters on a rowing ergometer under competition parameters is not only physically, but also mentally challenging. To be successful in both competitive rowing and rowing ergometry alike one must be very motivated and very prepared. In preparing for competition, such things as goal setting, strategic planning, and practicing attentional focus are important to maximizing performance; and, any opportunity to engage in quality imagery related to these preparation factors could help one's ergometer performance. For rowing ergometry, it may be that rowers return to a positive mind-set practiced in the tank environment, recalling their sport-related imagery to enhance performance. Generally, the author hypothesizes that the relaxing, distraction-free REST environment will invoke a greater amount and higher quality of sport-related imagery use among rowers than the relaxation/control environment.

Many authors in the sport and imagery literature advocate the belief that a state of alert relaxation, free from distractions, is conducive to imagery production and beneficial to the creation of vivid and controllable images (Bernstein & Borovec, 1973; Gauron, 1984, Hellstead, 1987; Korn, 1994; Orlick, 1990; Sheikh, Sheikh & Moleski, 1994; Smith, 1987; Suinn, 1980; Syler & Connolly, 1984; Weinberg & Gould, 1995; Weinberg, Seaborne & Jackson, 1981). It also makes sense intuitively that any mental function, including imagery, problem-solving, planning, or focussing, might be carried out more easily if there were no distractions present from either external stimuli (ambient visual, auditory, tactile) or internal stimuli (physiological arousal/anxiety). In such an environment, all cognitive resources could be directed toward a particular mental task, such as imagery, instead of being utilized to attend to information from one's surroundings or to the physiological cues that accompany states of high arousal or anxiety. Korn (1994) states that learning how to render your mind completely receptive by quieting "external distractions and internal chatter" through relaxation is necessary in order to use imagery to its greatest potential (p.202). Furthermore, one of the most popular mental preparation techniques utilized in the sport psychology field, Visuo-Motor Behavioural Rehearsal (VMBR) (Suinn, 1990), includes relaxation training as a necessary precursor to guided imagery use. Nonetheless, although such techniques as VMBR include relaxation before a guided imagery script, relaxation carried out in a distraction-free environment might prompt athletes to engage in positive sport related imagery even without an imagery script. In fact, it seems reasonable to hypothesize that a stimulus reduced environment, such as flotation REST, may invoke more imagery than normal stimulus environments because all of one's cognitive resources can be directed toward the imagery instead of being distracted by the environment. Two studies examining the use of imagery by athletes in rowing (Barr & Hall, 1992) and other selected sports (Hall, Rodgers & Barr, 1990) found that one of the most frequent uses of imagery by rowers and other elite athletes occurs in bed before falling asleep, suggesting that either athletes might find the relaxing, stimulus reduced environment of one's bedroom a particularly good place to do imagery, or, lying in bed before sleeping is simply a time when and a place where imagery occurs spontaneously. Moreover, a large majority of the athletes, including most of the rowers, reported the highest frequency of imagery use prior to their all-time best performance, suggesting a positive association between unguided imagery use and maximal performance. In essence, relaxing in the right environment seems to be associated with imagery production, even without any script, which in turn is associated with improved sport performance.

From the above findings, it could be argued that the relaxing flotation REST environment may help athletes who experience it regularly to improve their sport performance by prompting them to engage in a great amount of sport related imagery. It is possible that, like one's sleeping environment as presented in the Barr & Hall (1992) and Hall et al. (1990) studies, REST may be associated with increased imaginal activity. In fact, anecdotal reports and studies involving reduced stimulus environments have shown that REST increases such imaginal activity as imaginative involvement, absorption, vivid fantasizing and imagery, concentrated thought and creative thinking over that experienced in the normal environment (Barabasz, 1982, 1984; Barabasz et al., 1983; Barabasz & Barabasz, 1996; Barabasz et al., 1993; Budzynski, 1976; Lilly, 1977; Suedfeld, 1979, 1980; Suedfeld et al., 1987). Since athletes are often preoccupied with their sport, such imaginal activity experienced during REST is likely to include sport related thoughts and imagery. Suedfeld (1981) states that in response to reduced external stimulation "the individual may become aware of thoughts, emotions and physical processes that are normally unconscious or intensify the level of fantasizing, intense dreaming, concentrated thought, and emotional experience above that characterizing processing in the normal environment" (p.78). It is possible that athletes experiencing REST may become aware of unconscious processes and/or intensify thoughts related to their sport, thus allowing them to change or redirect detrimental thought patterns and enhance positive ones. Yet, even though it seems that REST may be conducive to imagery production and concentrated thought, there is some evidence that REST does not necessarily interact with guided imagery (Suedfeld, et al., 1993); and, elite athletes may even perceive guided imagery during REST to be interfering with the positive REST experience (McAleney, et al., 1990). In fact, the introduction of an imagery script into the REST environment actually adds an element of external auditory stimulation, thus interfering with the whole purpose of reducing stimulation. As previously mentioned, the earlier studies with REST and sport always combined the REST sessions with guided imagery practice involving an imagery script and did not include a REST-only comparison group, thus rendering the individual contribution of the different elements (REST and guided imagery) uncertain. Nonetheless, the two most recent studies found REST effects both with and without guided imagery. However, it could be suggested that the lack of difference between REST-only and REST plus imagery groups in the Suedfeld et al. (1993) study resulted because subjects in the REST-only condition engaged in their own imagery practice even without an imagery script. Nonetheless, the association between REST, imagery use and athletic performance enhancement warrants further exploration.

In categorizing rowing ergometry as a gross motor activity, it must be noted that rowing not only requires the elements of speed, power and endurance, but also intense mental tenacity, concentration and cognitive expenditure. The incredible endurance pain and muscle fatigue of rowing makes it a tough mental challenge that requires planning, strategy, and rigorous mental preparation in order to be successful. Thus, given the opportunity to engage in rowing related imagery and self-directed mental preparation, many rowers could enhance their performance. As reported by Barr and Hall (1992), most rowers already do this to aid their performance; however, introducing a group of rowers to a regular schedule of flotation REST, without an in-float guided imagery script, could prompt them to engage in a greater amount of beneficial mental preparation than a Progressive Muscle Relaxation (PMR) control group not exposed to REST.

It has been suggested that skill measurement precision may be a factor in testing the effects of REST (Suedfeld et al., 1993), and, while previous studies involving gymnastics, basketball, tennis and ski racing (excluding dart throwing and rifle marksmanship) have utilized more crude measures of skill, the Concept II Rowing Ergometer to be used in this study offers very precise measures of performance, including time to the nearest hundredth of a second, stroke rate per minute, projected 500 meter split times (the time it would take to reach 500m at the current output), and several other measures. The author hypothesizes that compared with the PMR control group, subjects exposed to flotation REST will show significantly greater enhancement of scores from pre- to post- 2000meter test on a rowing ergometer. Furthermore, the subjects experiencing REST are expected to report having had a significantly greater increase from baseline on measures of sport-related imagery production during and following their REST sessions than the control group. In fact, it is expected that those athletes who report more rowing-related imagery during the experimental sessions will improve their performance the most.

Method

Subjects

Subjects (n=26) from the UBC men's rowing program were approached to voluntarily participate in a mental training study. After the first meeting and gathering of some of the baseline measures, two rowers dropped out of the study because they found that they did not have the time to participate. Of the twenty-four participants that remained, the ages ranged from 18-33 years with an average age of 22.54 years. In terms of rowing experience, 12 rowers had only been rowing for four months prior to the beginning of the experimental sessions, 11 rowers had 18 months experience, and 1 rower had 2.5 years of experience. The final sample (12 control and 12 experimental) was represented by 15 men from the novice crew, 4 from the lightweight varsity crew and 5 from the heavyweight varsity crew. The lightweight category is limited to rowers under 160 pounds with an average crew weight of 155 pounds. Any rower can row in the heavyweight category. It should be noted that there was not a lot of experience at any level; however, it is not uncommon for elite rowers to have begun their rowing careers in university and not at a younger age.

Instrument

The Sport Competition Anxiety Test (SCAT; Martens et al., 1990) was used to gather baseline and post experimental data on individual differences in trait anxiety and arousal, and how levels of anxiety/arousal were affected by the experimental and control conditions (levels of trait anxiety should not be affected by the experiment; therefore, stable pre- to post-test SCAT scores would indicate that it was a valuable measure to use as a pre-experimental matching factor).

The Sport Imagery Questionnaire (SIQ; Hall, Mack, & Paivio, 1996), and the Movement Imagery Questionnaire (MIQ-R; Hall & Martin, in press) were used to gather baseline measures of imagery use and content and visual and kinesthetic imagery ability. Imagery content and use were also assessed again in the post-experimental period to determine the effect of the environment on amount and quality of imagery practiced. Imagery ability has been suggested as a mediating variable that must be considered in studies investigating the effects of imagery-based strategies (Murphy, 1994), and, furthermore, imagery ability has been shown to interact with learning during flotation REST (Taylor, 1985). Imagery use has also been associated with all-time best performances by rowers and athletes in other sports (Barr & Hall, 1992; Hall, Rodgers & Barr, 1990). Furthermore, imagery content and ability have been shown to be related to self-confidence, with highly self-confident athletes using more mastery and arousal imagery and demonstrating superior visual and kinesthetic ability than low self-confident athletes (Moritz, Hall, Martin, & Vadocz, 1996).

A brief, background questionnaire was administered during the first meeting with the rowing crew. The background questionnaire (BQ) asked for background information such as age, years of rowing experience, current level of rowing, current rowing goals, and past experience with mental training, and included questions regarding each athlete's expectancy of the experimental effects.

The first experimental questionnaire (Q1), administered at the beginning of each experimental session asked subjects to report their previous week's physical training schedule. The author thought that it would be good to have a rough idea of the amount of physical training (PT) completed by each individual in order to account for training as a possible confound. Since there is a likelihood that participants might have been influenced by demand characteristics to report more PT than actually carried out, the training logs were compared to the coaches' schedules and participants were specially instructed to be completely honest; they were told that it did not matter to the experimenter whether they had trained hard or not; the truth was what was most important. There was still a good chance that reports were not totally precise, but the author thought that it was important to attempt to collect the information.

The second experimental questionnaire (Q2), also administered at the beginning of each session, starting with session 2, asked subjects to report on the amount of imagery, if any, and amount of relaxation training, if any, that they had engaged in outside of the lab during the previous week. As people will choose to do their own mental training regardless of participating in a study, it was considered important to collect information on outside mental training to account for its potential effect on the dependent measure.

The third experimental questionnaire (Q3), administered directly after each session, asked subjects to respond to questions regarding their "relaxation/imagery" experience during that session. Specifically, they were asked for a general description of each session, including anything particularly memorable, as well as for a detailed description of their thoughts and any associated emotion, sensation or other feeling. The questionnaire asked if they engaged in any rowing-related imagery, what the rowing imagery was about, and whether the imagery included visual, kinesthetic (they were given definitions of the differences between visual and kinesthetic), first or third person, or more than one of these. It also asked for a report on estimated length of time that they spent doing rowing imagery. The second half of the questionnaire included a question asking participants to rate the level of relaxation experienced during the session on a scale of 1-10 with 1 anchored by the statement, *very tense; I could feel that my muscles were tight; I could not imagine feeling less relaxed*; and, 10 anchored by the statement, *very relaxed; my muscles were loose; I felt more relaxed than from any previous experience in my life.* Three more questions regarding relaxation and arousal during the session were asked, with answers presented on 5-point scales. Participants were asked if they realized an increased sensation to the feeling of relaxation compared to previous experience and if they felt that they had control over their arousal level (HR, muscle tension, nervousness, etc.), with 1 being *not at all* and 5 being *completely.* Finally, participants were asked to compare the experience of relaxation to their usual methods that they use to relax, with 1 being *much more relaxing* and 5 being a *lot less relaxing.*

A post-ergometer questionnaire (PEQ) was administered following each erg test, asking subjects to rate the contribution that participating in the study made to their performance. The questionnaire also asked participants to describe why the lab sessions did or did not have an effect on their performance. After the final erg test, several more questions were added to the PEQ that included asking the rowers what they thought were the most important contributors to their performance, followed by a question asking them to break down the contribution of mental preparation and physical preparation into proportions. One last question was asked regarding their health since the beginning of the study and whether they had been sick and for how long.

The final follow-up questionnaire (Q4) was administered to subjects after their last erg test and after they had tried out the alternate experimental condition. The same questions as Q3, regarding each participant's experience of the condition, were asked as well as several questions asking subjects to make comparisons between the two environments. Specifically, they were asked which environment they thought was better for relaxation and which one was better for imagery practice. They were also asked for their general impressions of the study and how they thought that participation in it had impacted upon both their ergometer and on-water performance. Furthermore, subjects were asked if participation in the study prompted them to engage in more imagery-use outside the lab than they would have otherwise engaged in had they not participated in the study. If they did report practicing imagery/relaxation techniques outside of the lab, they were asked to report on how often and in what combinations they practiced relaxation and imagery. There was also a question that asked how much the relaxation/imagery sessions may have helped different aspects of their rowing performance, including training performance, ergometer performance, regatta/race performance, enjoyment of rowing and recovery from fatigue. These items were rated on a 7-point scale ranging from 1- *strong negative effect* to 7 - *strong positive effect.* Finally, there was a questionnaire, the Imagery Content Questionnaire (ICQ), regarding the specific content of their imagery and the frequency of that content for imagery done in and outside of the lab. Barr and Hall (1992) found a relationship between imagery use and rowing performance for competitive rowers, with the highest frequency of imagery use being associated with all-time best performances. Thus, the ICQ served the purpose of obtaining a measure of imagery frequency for different types of rowing imagery that then could be compared with changes in ergometer score. Unfortunately, there was no measure of imagery quality; however, with information on imagery content, it may have been possible to ascertain which types of imagery were making a greater contribution to performance enhancement, if any. The ICQ included ratings of the following items for on-water and ergometer imagery, with separate scales for in-lab imagery and outside-of-lab imagery: I imaged technique on the ergometer/water; I imaged being motivated while rowing on the ergometer/water; I imaged pushing myself past the pain while on the ergometer/water; I imaged pulling a certain 500m split time while on the ergometer; I imaged focussing and refocussing while rowing on the water; I imaged achieving a certain score while on the ergometer; I imaged winning while rowing on the water; I imaged cue words to keep me going while rowing on the ergometer/water; I imagined my short term goals for rowing on the ergometer/water; I imagined my long term goals for rowing on the ergometer/water. Content frequency was rated on a 7-point scale, from 1 - *almost never* to 7 - *almost always*.

Apparatus

Flotation REST Tank: An egg-shaped tank, light-proof and sound attenuated, containing a solution of Epsom salts and skin-temperature water, approximately 30 cm deep. The solution has a density of approximately 1.30 g/cm^3, making it possible to float on one's back with face and chest out of the water.

Chamber/Progressive Relaxation Control: Subjects lay on a comfortable bed inside a REST chamber and listened to a tape taking them through progressive muscle relaxation (PMR) training. The chamber is a small lightproof room with sound absorbing walls that is used to create a stimulus-reduced environment like the tank. However, for the control group, the lights were turned on and the PMR tape was playing, producing total body relaxation that might compare to the tank, yet without the total stimulus reduction, due to visual and auditory stimulation. While one might question why the lights were not turned off in the control condition in order to reduce the difference between the two conditions as much as possible, the original idea of the study was to compare a stimulus-reduced environment to a normal stimulus environment for utility in enhancing imagery and subsequent rowing ergometer performance. The control group was given the PMR training in order to keep them motivated to participate in the study. Motivation to participate and controlling for the placebo effect have been suggested to be crucial elements of performance enhancement studies (Gould & Udry, 1994; Vealey, 1994); Vealey (1994) suggests that in order to "further control for placebo effects, control groups should engage in some type of activity (motivational control)" (p. 499). PMR training was chosen as a technique for use with the control group for several reasons: flotation REST is a total body relaxation technique that has a positive effect on sport performance; similarly, PMR is also a total body relaxation technique that may have a positive effect on performance (Onestak, 1989). Since the hypothesis is that REST will have an effect beyond mere relaxation, it is important to compare it to a relaxation control group. Furthermore, relaxation training is a likely control condition in terms of motivation as it has been shown to be one of the most popular psychological techniques introduced in mental training programs (Bull, 1991), and its appeal has been suggested to be due to the fact that it uses an active rather than passive approach to relaxation (Gould & Udry, 1994).

Concept II Rowing Ergometer: A rowing machine that closely simulates the rowing motion and the force needed to move a rowing shell on the water. The Concept II is used by most countries in the world, who have competitive rowing programs, for rowing ergometer competitions; world record scores obtained on the Concept II at sanctioned ergometer events are official. Furthermore, the Concept II is recognized as the standard in dry-land rowing training by most university and club rowing programs in North America and most likely the world. The ergometer's computer measures time to the nearest second, distance in meters, projected 500meter splits (the time it would take to reach 500 meters at the current stroke output) and stroke rate. Furthermore, the times achieved for 2000m by a single rower on an ergometer are comparable to the pace achieved when rowing in an eight man rowing shell on the water for 2000m.

Procedure

The procedure was designed to assess the effects of flotation REST on subjects' rowing ergometer performance over 2000m compared with the effects of a PMR control condition. Subjects were introduced to the experimenter by the rowing coach and asked to volunteer for the study, at which time volunteers were asked to fill out baseline measures of imagery-use and ability, and trait anxiety. The baseline measures were collected in the third month of the season, approximately 5-6 weeks prior to the first experimental session. At the midpoint of the season, volunteers were asked to participate in the experimental "relaxation/imagery" sessions. Subjects were matched based on past ergometer scores obtained from the coach, level of rowing (novice, varsity, light and heavyweight) and baseline measures of imagery use and ability and levels of trait anxiety, and then randomly assigned to either the flotation REST treatment condition or the progressive muscle relaxation (PMR) control condition. None of the novice sample had experience with REST or PMR; similarly, none of the varsity sample had experience with PMR. However, all of the varsity rowers had participated in a pilot study the previous year that involved sessions in flotation REST. Therefore, it could be suggested that the varsity sample was initially biased to expect more from the flotation REST condition because of positive results from the previous year favoring REST over a control condition. Nonetheless, the subjects from the previous year neither were informed of the results, as the final analyses were completed after the end of university classes, nor did they inquire about them at any time after completion of the study. Furthermore, the current study was designed to provoke equal expectations from subjects across conditions by employing an active comparison group as opposed the passive control condition used in the pilot study. Initial and post-experimental reports by all subjects in both groups indicated they were equally enthusiastic about PMR and REST. Subjects were invited to the lab and given a full introduction to both "experimental" conditions and a brief history of the effects of REST environments and PMR in the athletic field. All subjects were told the following regarding sport psychology interventions and the current study:

> It has been reported throughout the literature in sport psychology that relaxation/ arousal control plus some form of mental training, such as imagery practice, can have a positive effect on sport performance. However, it is not clear from which types of relaxation/imagery technique rowers will benefit the most. This study is looking at the effects on your rowing performance of a brief period of concentrated relaxation/arousal control combined with self-directed imagery worked regularly into your schedule.

It must be noted that while subjects were told that this study was concerned with imagery use and relaxation/arousal control, there actually was no guided imagery script. Nonetheless, both groups were told about the involvement of imagery in the study for several reasons: first, to increase interest and motivation to stay in the study (competitive rowers really want to feel as though they are doing something useful if they are sacrificing time in their busy schedules to participate); and, second, to ensure that both groups had equal expectations about imagery and relaxing environments before they began the experiment. Subjects were informed that they had been randomly assigned to one of the two "relaxation environments" for statistical reasons, and that the researcher was interested in looking at the effects of different relaxation techniques/environments on their rowing. In order to create equal expectations and to control for the placebo effect, all subjects were told that although relaxation/arousal control has been shown to have positive effects on athletic performance, the type of relaxation/arousal control training that is optimal for a given sport is not clear and thus we were testing differing relaxation/arousal control techniques/environments to find one that might be suited best for rowing. Furthermore, to add a sense of fairness and to satisfy participants' curiosity about the two different conditions, participants were informed that they would have the chance to try out the alternate condition at the end of the study. In fact, after the final dependent measure was collected, all rowers were asked to spend one session in the alternate environment and asked to compare the two for utility in practicing imagery and relaxation. Although it was noted that one session of REST or PMR may not have been adequate for the rowers to make an in-depth comparison of the two environments, the author, having experienced both conditions and feeling a difference after the initial experience of each, felt that the one time experience was enough for subjects to form an impression and offer valuable subjective feedback.

Following the introduction, participants were asked to fill out a consent form and the weekly PT training log (Q1). To ensure that all of the participants had equal expectations about what to do with their time in the environment, both groups were given the suggestion before entering the environment for the first time to practice rowing-related imagery. A standardized outline of the type of imagery they might practice as well as a definition of what the experimenter meant by imagery were provided to ensure that all participants had an equal understanding of imagery, at least at a basic level. The following definition of imagery was provided and discussed with each rower:

> Imagery is the imaginal rehearsal of an action, event, sensation or emotion in the absence of the action, event, sensation or emotion. It is not just a visual picture in the mind; it also includes what is called kinesthetic imagery, which is imagined sensation (or imagining what the body feels like). When doing imagery as it relates to sport, it does not just include visualizing the technical aspects of the movement (although this is part of it); imagery can include mental simulations of a strategy (i.e. how you approach a 2000m ergometer test), mental simulations of winning an event, medal or championship; imagery can also include mental simulations of your mental state during a performance, practice, or training routine (i.e. you may imagine yourself pushing yourself past the pain of a rowing race); imagery also includes how you might feel; you can use it to mentally simulate the positive emotions of success; it can be used to simulate calming yourself before training or competition; it can be used to boost your self-confidence by recalling a past positive

event or imagining yourself doing well in the future. Finally, it also can be used for skill practice and anything else that comes to mind in relation to the sport of rowing.

It is important to note that subjects were given no imagery script or guidance during their session. The sole purpose of the suggestion/discussion on imagery was to ensure that what we were really comparing in these two conditions was how the environment impacted upon imagery practiced. If some of the rowers did not even think to engage in imagery then we may not have been measuring the extent to which these environments are conducive to imagery use, but rather the extent to which rowers in general happen to use rowing imagery, regardless of condition. Following the imagery suggestion, participants entered the assigned condition for either a 50min period in the chamber or a 45min period in the flotation tank (the difference in time was to account for the fact that the chamber group listened to a PMR tape for the first ten minutes, while it usually takes about five minutes to get accustomed to the flotation tank; thus, both groups had approximately 40 uninterrupted minutes during which to practice imagery). The subjects in the PMR-control condition had a light turned on and the PMR training tape playing through a speaker on the wall near the bed on which they lay. The subjects in the REST condition lay, supine, in the flotation tank with no light or sound stimulation. Both groups were monitored through a one-way intercom system for the duration of their sessions. For the first session of the experiment, both groups only spent 25 minutes in the environment; this first session was considered important to give participants an introduction to the protocol and ensure that each one was comfortable with the environment that they would be going into once a week for the following 6 weeks. In fact, one subject had to switch environments after the introduction because of a prior inner ear injury that did not allow him to tolerate the flotation (he felt "sea-sick"). He switched places with a same-level subject, randomly chosen from the PMR-control group. The switch did not significantly affect the baseline equality between the REST and PMR groups. The subsequent 6 sessions, including the post-experimental condition-switch, were all of full length . Before each session, subjects filled out the Q1 and Q2, physical and mental training logs. Following each session, each participant filled out the Q3 regarding his thoughts, imagery and state of relaxation during the session.

With regard to the dependent measures, it was speculated, given that a 2000m ergometer test is a particularly gruelling event that is feared by many rowers, testing in this study had to be part of the coaches' regular training program in order to ensure maximum motivation from the rowers. Therefore, all ergometer scores were either part of regular team testing, which makes up a large portion of team selection criteria, or from official ergometer competitions set up by provincial and national rowing programs. The ergometer scores were obtained from three different 2000m ergometer competition tests completed during the course of the study. The first test, called "Beat the Beast", was taken after week 2 of the study, the second test, "Monster Erg", was taken after week 3, and the final test, "Power Erg", was taken after week 6. "Beat the Beast" was a regional competition, "Monster Erg" was a national competition, and "Power Erg" was a intra-university competition. Results from the ergometer testing were used to generate difference scores for rowers in each condition. These difference scores were then used for the statistical analyses. Unfortunately, not all rowers were present at every ergometer test, due to illness or other reasons. Tests that were missed were made up during the week following the official test. Nonetheless, for the difference score of most interest, from the erg test after the third week of the experiment to the final post-experimental erg test after week 6, all but three rowers participated at the scheduled time. The three who missed made up the test during the following week. Following the post-intervention ergometer test, all rowers were asked to spend one session in the alternate environment and asked to compare the two for utility in practicing imagery and relaxation. Finally, all rowers were administered the SIQ, and SCAT again. Upon completion of the questionnaires, the rowers were debriefed, and informed that they would get a chance to hear about the results after the data analyses had been completed.

Results

Pre-experimental expectancy question, possible confounds, and post-experimental beliefs about effects of the study:

A one-way ANOVA (group X expectancy question) revealed no significant difference between REST ($\underline{X}(12) = 4.58$, $\underline{SD} = .67$) and PMR ($\underline{X}(12) = 4.75$, $\underline{SD} = .75$) for expectancy of experimental effects, $\underline{F}(1, 22) = .33$, $p>.50$; most rowers in both groups reported an expectancy of slight to moderate positive performance effects as a result of participation in the study. A series of one-way ANOVAs revealed no significant differences between REST and PMR for any of the following factors: imagery ability, SIQ (or any subscale), prior rowing ergometer performance, prior use of relaxation techniques, prior use of mental training, rowing goals, rowing experience and age, suggesting that the matching technique was successful in creating two homogenous groups.

Ergometer Score Performance:

Between and within group comparisons were made for changes in ergometer score for each of the following three erg-test combinations: Beast to Monster Erg, Beast to Power Erg, and Monster to Power Erg. A 2x2 (group x erg-test) repeated measures ANOVA was performed for each erg-test comparison. For all levels, novice and varsity combined, there was a significant interaction effect between erg score improvement and group for the Beast to Power Erg comparison, with the other two group x erg-test interactions approaching significance at the .10 alpha level (See Figure 1 and Table 1). Within-group comparisons with paired samples T-tests revealed significant improvement on all three erg-test comparisons for the REST group, with no significant improvement for the PMR group on any erg-test comparison (See Table 1).

Average Improvement in Ergometer Score:

Flotation REST vs. PMR

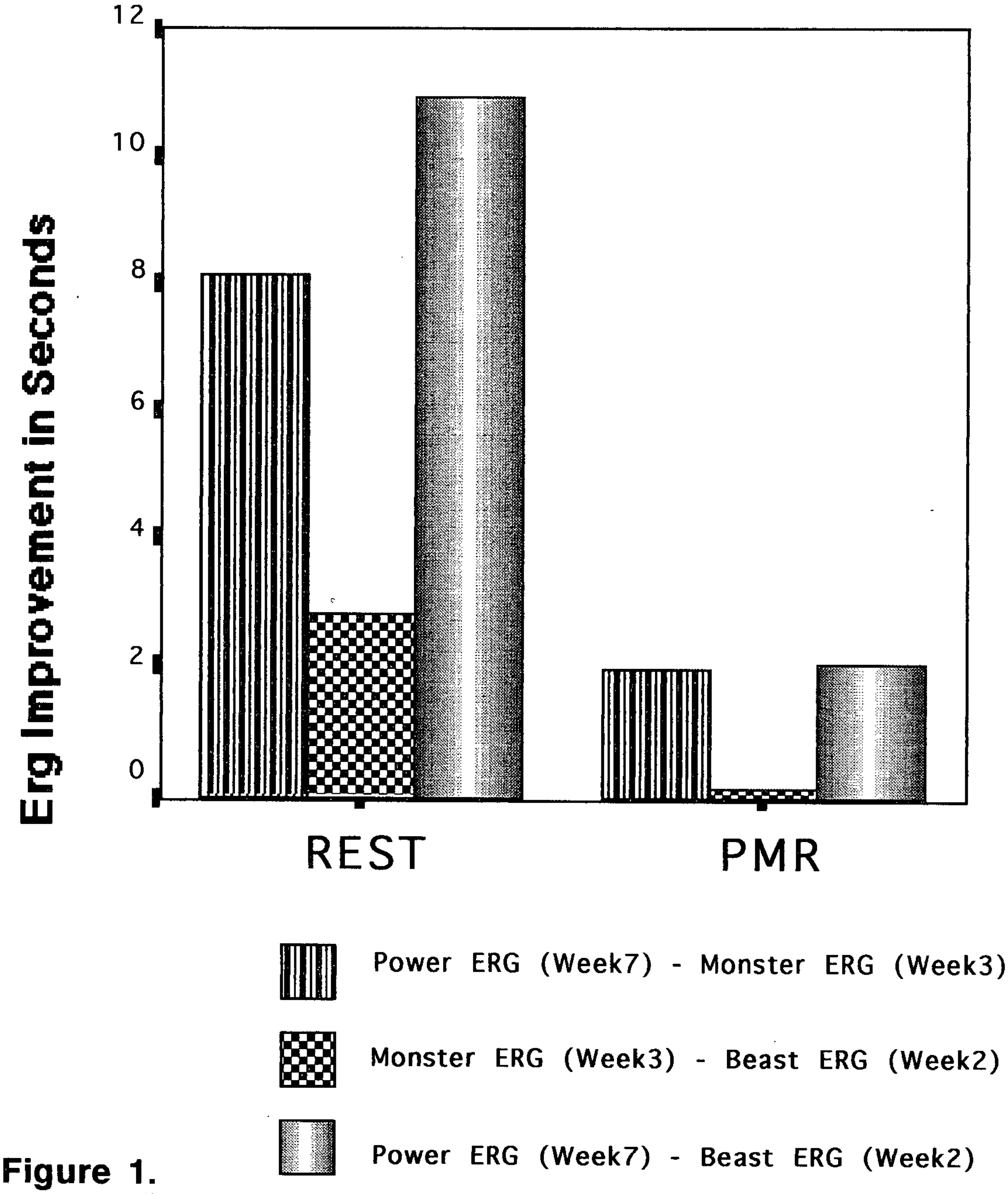

Figure 1.

TABLE 1.

Means for Ergometer Score Improvements (in seconds) across Conditions for all Levels: Flotation REST, and Progressive Muscle Relaxation (PMR)

Erg Difference	Condition		Erg Difference X Group Interaction Effects		
	PMR	REST	df	F	p
Novice & Varsity*	(excluding Lightweights)				
	(n=10)	(n=10)			
Erg Difference1 Beast - Monster					
M (*SD*)	-0.08 (4.38)	2.37** (1.74)	1, 18	2.70	.118
Erg Difference2 Beast - Power					
M (*SD*)	2.72 (5.92)	9.10** (7.19)	1, 18	4.69	<.05
All Rowers					
	(n=12)	(n=12)			
Erg Difference3 Monster - Power					
M (*SD*)	2.51 (5.67)	6.55** (6.74)	1, 22	2.52	.126

Note. * The four lightweight varsity rowers did not compete in the Beat the Beast ergometer competition. Means denoted by ** differ significantly from zero, p<.005.

For several reasons, analyses were also run for the novice and varsity men separately. To begin with, the varsity group had all participated in a flotation REST pilot study the previous year (Richardson, 1997); more varsity rowers than novices missed the scheduled test dates and had to make them up on alternate days; and, the novices were a larger, more homogenous group than the varsities. For the novice men-only, there were significant interaction effects between erg score improvement and group for the Beast to Power Erg and Monster to Power Erg comparisons (See Table 2). Within-group analyses with paired samples T-tests revealed significant improvement on all three erg-test comparisons for the REST group, with no significant improvement for the PMR group on any erg-test comparison (See Table 2).

TABLE 2.

Means for Ergometer Score Improvements (in seconds)
Across Conditions - Novice Men Only:
Flotation REST, and Progressive Muscle Relaxation (PMR)

	Condition		Erg Difference X Group Interaction Effects		
Erg Difference	PMR (n=8)	REST (n=7)	df	F	p
Erg Difference1 Beast - Monster					
M (*SD*)	0.06 (4.89)	2.79** (1.79)	1, 13	1.93	.188
Erg Difference2 Beast - Power					
M (*SD*)	2.04 (6.21)	10.89** (5.89)	1, 13	7.95	<.02
Erg Difference3 Monster - Power					
M (*SD*)	1.97 (6.41)	8.10** (4.71)	1, 13	4.33	<.06

Note. Means denoted by ** differ significantly from zero, $p<.005$.

For the varsity men-only, there were no significant interaction effects between any of the erg score improvements and group, nor were there any significant results for any of the within-group comparisons (See Table 3).

TABLE 3.

Means for Ergometer Score Improvements (in seconds)
Across Conditions - Varsity Men Only:
Flotation REST, and Progressive Muscle Relaxation (PMR)

	Condition		Erg Difference X Group Interaction Effects		
Erg Difference	PMR	REST	df	F	p
Heavyweights Only*					
	(n=2)	(n=3)			
Erg Difference1 Beast - Monster					
M (*SD*)	-0.65 (2.19)	1.40 (1.41)	1, 3	1.72	n.s.
Erg Difference2 Beast - Power					
M (*SD*)	5.45 (5.16)	4.93 (9.55)	1, 3	0.00	n.s.
Light & Heavyweights					
	(n=4)	(n=5)			
Erg Difference3 Monster - Power					
M (*SD*)	3.57 (4.45)	4.38 (9.04)	1, 7	0.03	n.s.

Note. * The four lightweight varsity rowers did not compete in the Beat the Beast ergometer competition.

Imagery measures and Erg score improvement:

To assess the relationship of imagery-use, imagery content, imagery duration and changes in all of these to erg score improvement, correlation matrices were generated for all of the imagery measures and their association to erg score improvement for each group. The matrices were examined for any significant correlations and also for consistent patterns among the groups, REST and PMR. As the imagery construct is complex and difficult to measure, looking for patterns in the data was important. Where relevant, between-group analyses using ANOVA were also conducted to check for absolute differences in imagery among REST and PMR groups.

SIQ Results

Between and within group comparisons were made for changes in SIQ and all five subscales from pre- to post-experiment. A 2x2 (group x SIQ score) repeated measures ANOVA was performed for each of the pre-post SIQ total and subscale scores. For all levels, novice and varsity combined as well as for novice and varsity separate, there were no significant interaction effects between pre-post SIQ scores and group; varsity and novice rowers changed their scores on the SIQ about the same amount and in the same direction. Main effects were revealed for the Cognitive General and Motivational General-Arousal subscales for all rowers. All rowers significantly increased their scores on Cognitive General from pre- ($\underline{X}$ = 4.35, $\underline{SD}$ = 1.37) to post-experiment ($\underline{X}$ = 4.94, $\underline{SD}$ = 1.17), $F(1,21) = 8.27$, $p<.01$, and on Motivational General-Arousal from pre- ($\underline{X}$ = 4.33, $\underline{SD}$ = 1.33) to post-experiment ($\underline{X}$ = 4.82, $\underline{SD}$ = .94), $F(1,21) = 4.47$, $p<.05$. Correlational analyses revealed no significant associations or consistent group patterns between any SIQ score changes and erg score improvement. The change in the Cognitive General subscale shared a slight correlation with erg score improvement for the Monster to Power Erg difference, $r(23) = .29$, which approached significance at the .10 alpha level.

Weekly In-session Imagery Report

Correlational analyses conducted for the association between changes in self-reported duration of weekly in-session imagery and erg score improvement revealed no significant relationships for the REST or PMR groups, nor any consistent group patterns. Analyses by level, separately, yielded the same non-significant results. Tests of group differences in weekly amounts of self-reported in-session imagery were not deemed relevant because there is evidence for a loss of sense of time during flotation REST (Richardson, 1998) which could have distorted reports of imagery duration for the REST group.

Weekly Outside-Lab Imagery Report

ANOVAs revealed no significant group differences for amount or for changes in amount of imagery done outside of the lab for all rowers. Analyses by level, separately, yielded the same non-significant results. Correlational analyses revealed a pattern of significant positive correlations between change in outside-lab imagery and erg score improvement for the PMR group, with non-significant negative correlations obtained for the REST group (see table 4).

TABLE 4.

Correlations between Change in Outside-Lab Imagery and Ergometer Score Improvements across Conditions for All Levels: Flotation REST, and Progressive Muscle Relaxation (PMR)

Change in Weekly Outside-Imagery Minutes	Erg-Test Difference: Beast-Monster	Beast-Power	Monster-Power
	REST		
Week 3-2	-.02		
Week 6-2	-	-.02	
Week 6-3	-	-	-.17
	PMR		
Week 3-2	.51		
Week 6-2	-	.71*	
Week 6-3	-	-	.75**

Note. *p < .05. **p < .01.

Specific Imagery-Content Questionnaire (ICQ):

ANOVAs revealed no significant group differences on any of the items on the ICQ. Analyses by level, separately, yielded the same non-significant results. A breakdown of the correlational analyses by level revealed different patterns for novice and varsity rowers; thus, the correlation results are presented for each level separately.

Results for the novice men yielded a cross-over interaction between the total ICQ score and erg score improvement for REST vs. PMR, in which ICQ scores were positively correlated with erg score performance (erg difference 2) for the PMR group, $r(8) = .87$, $p<.005$, but were negatively correlated with erg score performance for the REST group, $r(7) = -.20$, $p>.25$ (see Figure 2). Examination of the correlation matrix for individual ICQ items and erg score improvement for the REST group revealed a pattern of low, negative correlations for most of the ICQ items and erg difference scores (see Table 5), with the largest negative correlations represented by erg pain imagery (I imaged pushing past the pain of and ergometer test) and erg difference 2 (Monster to Power Erg), $r(7) = -.86$, $p<.02$, and erg motivation imagery (I imagined being motivated while rowing on the ergometer) and erg difference 2, $r(7) = -.61$, $p<.15$. There was one positive correlation between erg-split imagery (I imaged pulling at a certain split on the ergometer) and erg difference 2, $r(7) = .60$, $p<.16$. There also was a pattern among the magnitudes of the correlations in which twelve out of the sixteen correlations had a larger magnitude if the imagery was practiced in the lab versus outside of the lab.

Relationship between Self-Reported Imagery and Ergometer Score Improvement

Flotation REST vs. PMR

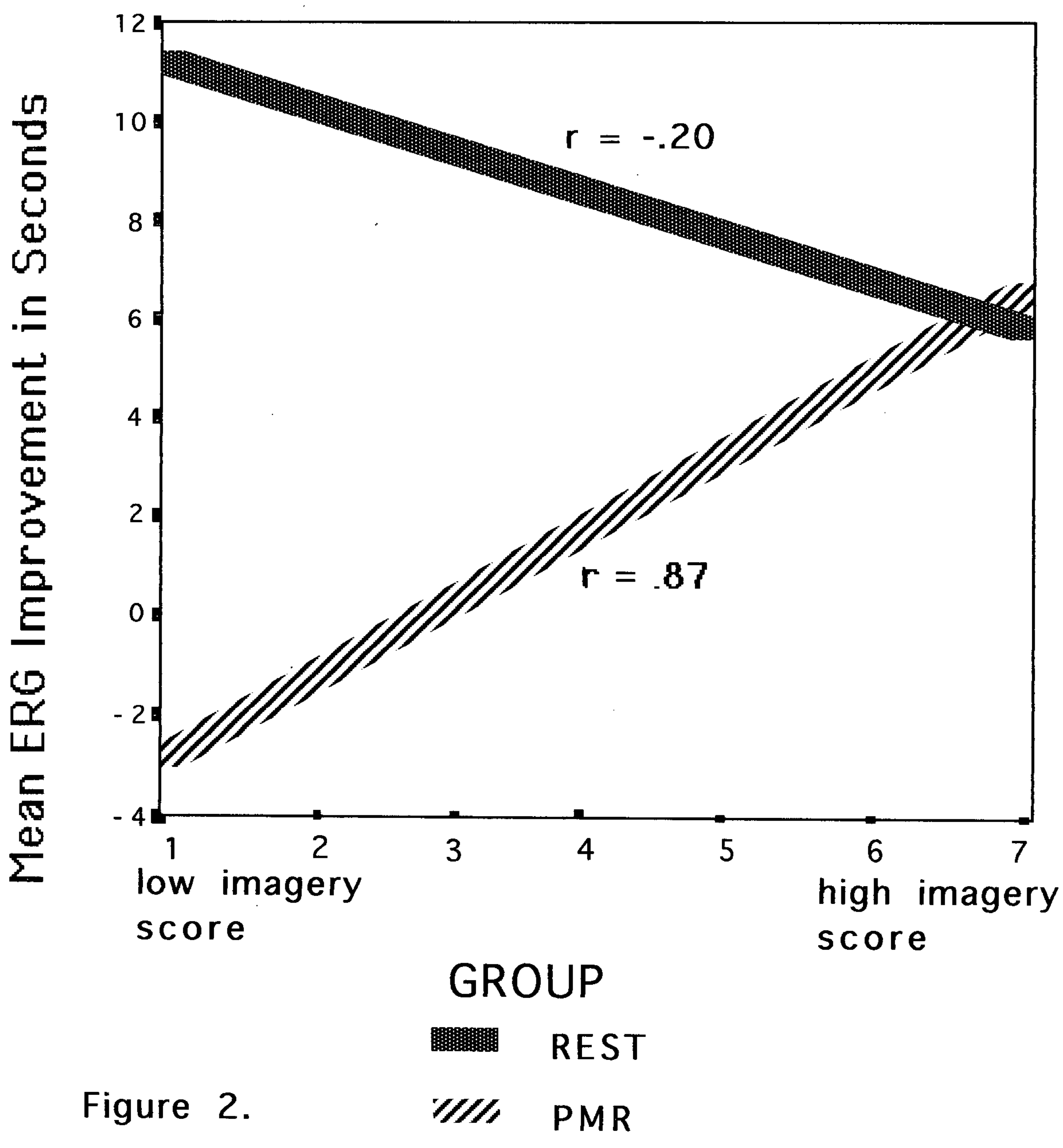

Figure 2.

TABLE 5.

Correlations between ICQ Scores and Ergometer Score Improvements across Conditions for Novice Men: Flotation REST, and Progressive Muscle Relaxation (PMR)

ICQ Test Item	Erg-Test Difference: Beast-Power	Erg-Test Difference: Monster-Power
	REST (n=7)	
Total ICQ Score	-.20	-.20
Imagery Related to Erg Performance		
Erg Cue-word Imagery Lab	-.32	-.31
Erg Cue-word Imagery Outside	.00	.08
Erg LT Goal Imagery Lab	-.34	-.46
Erg LT Goal Imagery Outside	-.12	-.09
Erg Motivation Imagery Lab	-.59	-.61
Erg Motivation Imagery Outside	-.22	-.15
Erg Pain Imagery Lab	-.86**	-.83**
Erg Pain Imagery Outside	-.22	-.15
Erg Score Imagery Lab	-.17	-.25
Erg Score Imagery Outside	-.22	-.15
Erg Split Imagery Lab	.56	.60
Erg Split Imagery Outside	-.17	-.06
Erg ST Goal Imagery Lab	-.17	-.21
Erg ST Goal Imagery Outside	-.13	-.06
Erg Technique Imagery Lab	-.54	-.59
Erg Technique Imagery Outside	-.32	-.22
Imagery Related to On-Water Performance		
Water Cue-word Imagery Lab	-.48	-.57
Water Cue-word Imagery Outside	-.19	-.18
Water LT Goal Imagery Lab	-.13	-.17
Water LT Goal Imagery Outside	.09	.01
Water Motivation Imagery Lab	.10	.15
Water Motivation Imagery Outside	.03	-.13
Water Pain Imagery Lab	.05	-.14
Water Pain Imagery Outside	-.36	-.38
Water Focussing Imagery Lab	.28	.13
Water Focussing Imagery Outside	-.18	-.21
Water Winning Imagery Lab	-.06	-.23
Water Winning Imagery Outside	-.13	-.19
Water ST Goal Imagery Lab	-.39	-.41
Water ST Goal Imagery Outside	-.18	-.12
Water Technique Imagery Lab	.26	.40
Water Technique Imagery Outside	-.02	.11

	PMR (n=8)	
Total ICQ Score	.37	.87***
Imagery Related to Erg Performance		
Erg Cue-word Imagery Lab	-.07	.53
Erg Cue-word Imagery Outside	-.14	.49
Erg LT Goal Imagery Lab	.24	.66*
Erg LT Goal Imagery Outside	-.02	.28
Erg Motivation Imagery Lab	.36	.59
Erg Motivation Imagery Outside	.42	.83**
Erg Pain Imagery Lab	.39	.62
Erg Pain Imagery Outside	.37	.78**
Erg Score Imagery Lab	.32	.72**
Erg Score Imagery Outside	.28	.65*
Erg Split Imagery Lab	.09	.39
Erg Split Imagery Outside	.10	.33
Erg ST Goal Imagery Lab	.04	.73**
Erg ST Goal Imagery Outside	.37	.84***
Erg Technique Imagery Lab	.43	.73**
Erg Technique Imagery Outside	.57	.86***
Imagery Related to On-Water Performance		
Water Cue-word Imagery Lab	-.14	.45
Water Cue-word Imagery Outside	.01	.67*
Water LT Goal Imagery Lab	.02	.14
Water LT Goal Imagery Outside	.51	.64*
Water Motivation Imagery Lab	.11	.38
Water Motivation Imagery Outside	.44	.80**
Water Pain Imagery Lab	.26	.60
Water Pain Imagery Outside	.43	.78**
Water Focussing Imagery Lab	-.20	-.07
Water Focussing Imagery Outside	.24	.57
Water Winning Imagery Lab	.38	.68*
Water Winning Imagery Outside	.44	.73**
Water ST Goal Imagery Lab	.16	.39
Water ST Goal Imagery Outside	.59	.81**
Water Technique Imagery Lab	-.03	-.28
Water Technique Imagery Outside	.58	.71**

Note. *$p < .10$. **$p < .05$.***$p<.01$

Results for the varsity men yielded the same pattern of correlations between the ICQ scores and erg score improvement for both REST and PMR; thus, the groups were combined for the analyses. Total ICQ scores were positively correlated with erg score improvement, $r(9) = .62$, $p<.08$; in the overall correlation matrix, results yielded mostly positive correlations between individual ICQ items and erg difference 2 (see Table 6). The magnitudes of the correlations were greater if the imagery was done inside the lab versus outside of the lab for thirty of the thirty-two correlations.

TABLE 6.

Correlations between ICQ Scores and Ergometer Score for Varsity Men: REST and PMR Combined

	Erg-Test Difference	
ICQ Test Item	Beast-Power	Monster-Power
	Heavyweights (n=5)	Light & Heavy (n=9)
Total ICQ Score	.32	.62*
Imagery Related to Erg Performance		
Erg Cue-word Imagery Lab	.59	.81***
Erg Cue-word Imagery Outside	.51	.75**
Erg LT Goal Imagery Lab	.51	.61*
Erg LT Goal Imagery Outside	.14	.13
Erg Motivation Imagery Lab	.52	.58
Erg Motivation Imagery Outside	.17	.32
Erg Pain Imagery Lab	.62	.80***
Erg Pain Imagery Outside	.18	.32
Erg Score Imagery Lab	.41	.70**
Erg Score Imagery Outside	-.01	.29
Erg Split Imagery Lab	.35	.59*
Erg Split Imagery Outside	.19	.42
Erg ST Goal Imagery Lab	.24	.62*
Erg ST Goal Imagery Outside	.09	.13
Erg Technique Imagery Lab	.71	.74**
Erg Technique Imagery Outside		

Imagery Related to On-Water Performance		
Water Cue-word Imagery Lab	-.35	.51
Water Cue-word Imagery Outside	-.07	.46
Water LT Goal Imagery Lab	-.07	.18
Water LT Goal Imagery Outside	.37	.19
Water Motivation Imagery Lab	.04	.16
Water Motivation Imagery Outside	.62	.22
Water Pain Imagery Lab	.77	.91***
Water Pain Imagery Outside	.52	.50
Water Focussing Imagery Lab	.52	.80***
Water Focussing Imagery Outside	.17	.44
Water Winning Imagery Lab	.21	.42
Water Winning Imagery Outside	.04	.16
Water ST Goal Imagery Lab	-.17	.14
Water ST Goal Imagery Outside	.17	.18
Water Technique Imagery Lab	-.17	.14
Water Technique Imagery Outside	-.06	.03

Note. *p < .10. **p < .05.***p<.01

Physical Training (PT) and Erg Score Improvement:

Changes in average weekly training minutes for rowers in each group were examined for their associations to erg score improvement. Difference scores for weekly training were created by subtracting the average weekly training minutes for the week preceding one erg test from the average weekly training minutes for the week preceding the erg test of comparison. These difference scores were compared with erg difference scores to determine if change in weekly training affected changes in performance. With all rowers together, there were no significant correlations between changes in average weekly training and changes in erg performance. However, with the groups separated, analyses revealed a cross-over interaction between physical training (PT) and erg score improvement (see Figure 3). For the REST group, an increase in PT from earlier erg tests to later erg tests was associated with greater improvement in erg score; while for the PMR group, an increase in PT from earlier to later erg tests was associated with less improvement, or even a decrement, in erg performance (see Table 7), despite no significant between-group differences in weekly training minutes. There were no differences among levels, varsity or novice, for patterns in PT and erg performance.

Relationship between Changes in Training Load and Ergometer Score Improvement:

Flotation REST vs. PMR

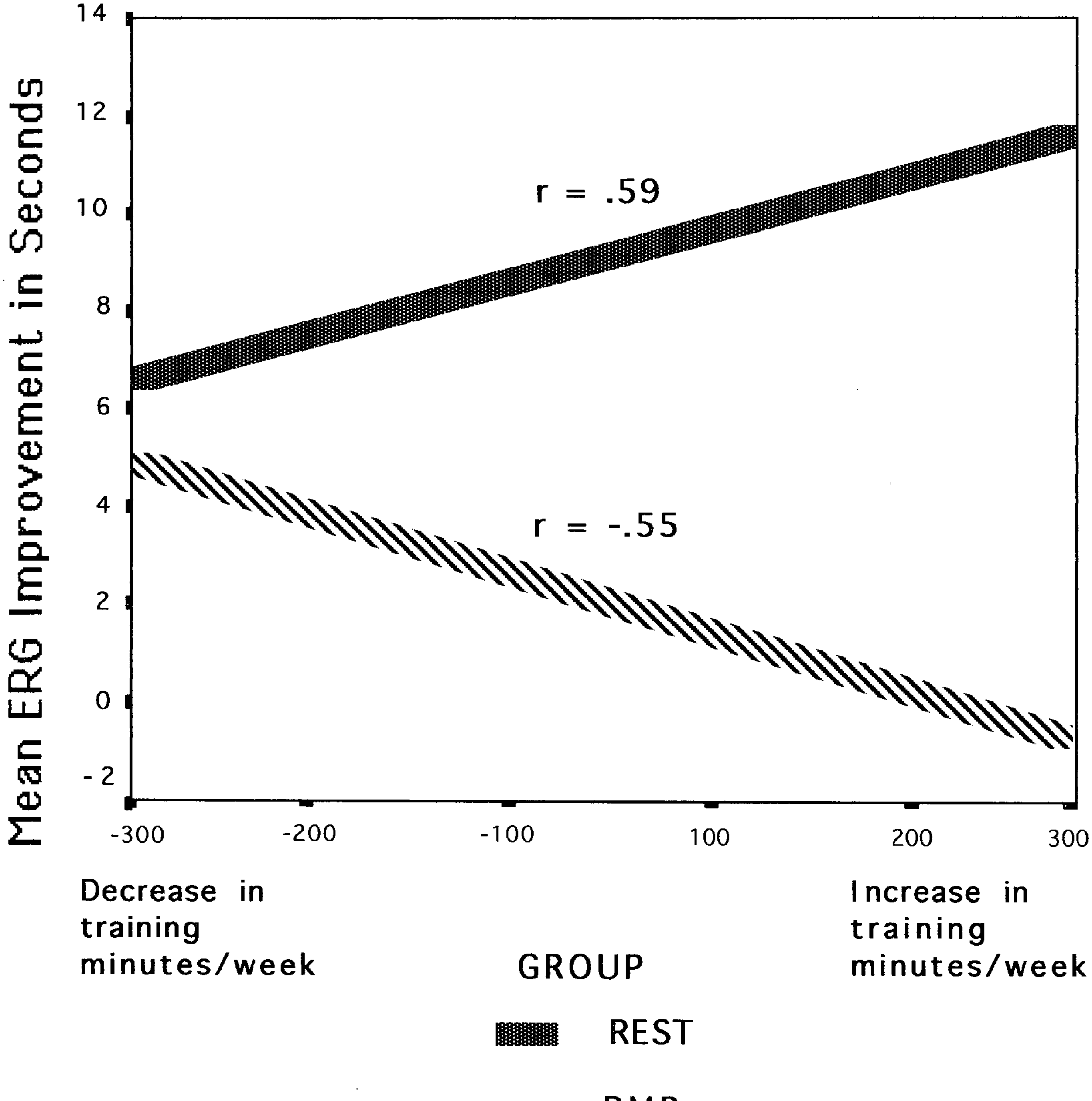

Figure 3.

TABLE 7.

Correlations between Change in Physical Training (PT) and Ergometer Score Improvements across Conditions for All Levels: Flotation REST, and Progressive Muscle Relaxation (PMR)

	Erg-Test Difference		
Change in Weekly Average PT Minutes	Beast-Monster	Beast-Power	Monster-Power
	REST		
Week 3-2	.61*		
Week 6-2	-	.80***	
Week 6-3	-	-	.59**
	PMR		
Week 3-2	-.22		
Week 6-2	-	-.25	
Week 6-3	-	-	-.55*

Note. *p < .10. **p < .05.***p<.01

Ratings of relaxation and erg performance:

Changes in subjective ratings of relaxation for each experimental session were compared with changes in erg performance. Analyses yielded no significant associations between changes in ratings of relaxation and erg score for either REST or PMR groups. Examination of the reports of relaxation done outside of the lab also yielded no significant associations between relaxation and erg performance.

Beliefs about the effects of participation in the study:

Post-experimental inquiry regarding beliefs about the effects of participation in the study on rowing ergometer performance, rated on a scale from 1- "No effect" to 5 – "Most important factor contributing to my erg performance", revealed no significant differences between REST (X = 2.92, SD = .90) and PMR (X = 2.92, SD = 1.31). There were also no group differences in ratings of the effect of participation in the study on recovery from fatigue, training performance and enjoyment of rowing, rated on a scale from 1 – "Strong negative effect" to 7 – "Strong positive effect" (see Table 8).

TABLE 8

Means for Ratings of Study Effects on Different Aspects of Rowing across Conditions: Flotation REST, and Progressive Muscle Relaxation (PMR)

	Condition	
Effects of Study	**PMR**	**REST**
Recovery From Fatigue		
M (*SD*)	5.00 (1.13)	4.63 (0.64)
Enjoyment of Rowing		
M (*SD*)	5.09 (0.94)	4.83 (1.03)
Training Performance		
M (*SD*)	5.64 (1.29)	5.25 (0.97)

When asked to compare the two environments for utility in imagery use, REST was preferred 13:8 by all rowers, with one rower from the REST group rating the two environments equally. Seven out of eleven from the REST group and six out of eleven for the PMR preferred the REST environment for imagery practice. Comparison of the two conditions for relaxation resulted in a 13:9 preference for the PMR condition. Six out of eleven from the REST group and seven out of eleven for the PMR preferred the REST environment for relaxation practice. Chi-square analyses revealed no significant differences among any of the above frequencies. In response to a question about which environment the rowers liked better overall, rowers were split equally. For the REST group, five preferred the REST tank, four preferred the PMR condition and two reported equal liking for the two conditions. For the PMR group, five preferred the REST tank, five preferred the PMR condition and one reported equal liking for the two conditions. One rower from the REST group was undecided and did not answer any of the comparison questions and one rower was not able to make a valid comparison because he could not float due to a previously mentioned inner-ear injury. The most common reason reported for preferring the REST environment was that it was dark and had fewer distractions, while the most common reason reported for preferring the PMR condition was that it was better for relaxation.

Discussion

The results from the interaction effect between ergometer score improvement and experimental condition indicate a reliable improvement in 2000 meter ergometer score for novice male rowers who participated in flotation REST on a weekly basis compared to a matched comparison group who participated in a PMR condition. While not all interaction effects reached significance, within-group analysis demonstrated significant improvement for all rowers in the REST group on each ergometer test, with no significant improvement for the PMR group on any of the tests. The lack of REST effects for the varsity rowers indicates that flotation REST might be most useful for novice athletes; however, there were several key factors that may have confounded the results for the varsity members. Unfortunately, on the last dependent measure, the Power Erg, three of the heavyweight varsity rowers did not show up on the morning scheduled for the test, all of them from the PMR group; consequently, these three rowers took the test later in the week at a time best suited to them. Of the varsity rowers that did show up, three from the REST group were highly fatigued from on-water racing done the day before, while the remaining participants from the PMR group, who had not been involved in the on-water racing, were less fatigued, having had a light row the previous day. In fact, all three of the rowers from the REST group expressed a concern that they were not in a good state to take the test, but they did it anyway as part of the crew commitment. It may be suggested that ceiling effects were being observed with the varsity athletes, thus resulting in the lack of difference between the REST and PMR groups. While this is a possibility, it is unlikely given the relatively low experience level of the varsity sample (1.5 years); rowers with this length of experience would still be expected to improve more; furthermore, the lack of significant within-group improvements is possibly due to the low power (small n) of the test rather than a ceiling effect. Finally, the large variability in ergometer score improvements for the varsity athletes suggests that a performance ceiling had not been reached; if the rowers had reached a ceiling, one might expect to see more consistent performance among the sample. Had there been more consistency with respect to the timing of the final ergometer test and to the state of readiness of the varsity rowers, the results may have supported the hypotheses for all rowers. Indeed, results from a pilot study (Richardson, 1997) indicate that flotation REST is a useful intervention for both novice and varsity rowers.

For the most part, the results from the different measures of imagery taken in the study (SIQ, weekly in-session self-reported imagery, weekly outside-lab self-reported imagery, ICQ) do not clearly answer the questions about the role of environment in imagery practice nor the link between imagery and ergometer performance, but do elucidate some interesting possibilities. Results from the SIQ and weekly in-session imagery questionnaires do not support a synergistic interaction between REST and imagery, consistent with the findings from the Suedfeld et al. (1993) dart-throwing study. The results from the outside-lab imagery and the content imagery questionnaires suggest the following possibilities: there may be group differences in imagery effectiveness, REST effects may be overpowering any imagery effects for the flotation group, imagery done during REST may actually reduce the positive effects of REST, and/or REST may actually enhance imagery, but, if it is the wrong kind of imagery, the effect on performance may be detrimental. Furthermore, the relatively small sample size may have contributed to several of the correlations between imagery and performance falling short of significance. With a larger sample size, a more definitive pattern might have emerged among the correlations.

The lack of difference between REST and PMR groups on the SIQ and weekly in-session imagery reports suggests that either the two experimental conditions did not affect imagery differentially, hence there was no synergism between REST and imagery, or the imagery measures were not sensitive to the effects of condition on imagery-use. As far as the weekly in-session imagery reports were concerned, it appears that amount of time spent doing rowing-related imagery in the lab was not a crucial factor to performance, and REST participants were not prompted by their environment to increase their in-session imagery any more than PMR participants. As for the SIQ, it may be that time of administration was a key element in the lack of significant results. Taking SIQ measures six weeks before the beginning of the intervention and one week after the last dependent measure might not have been precise enough to capture changes in performance associated with changes in imagery-use, nor to illuminate any between group differences in imagery-use. The small positive correlation between the Cognitive-General subscale and ergometer score improvement from Monster Erg to Power Erg suggests that there might be some sort of relationship between changes in the SIQ and performance that could be tapped by a more refined measurement protocol. Nonetheless, it also may be the case that the SIQ is simply not associated with ergometer performance or affected by mental training environment. The increase in SIQ subscales, Cognitive General and Motivational General-Arousal, from pre- to post-experiment for all rowers is consistent with the fact that the rowers were dedicating extra time each week to participate in a "mental training" study, during which they received the suggestion to practice strategy related imagery (Cognitive General subscale) and spent time learning arousal-control techniques (Motivational General-Arousal subscale).

For the weekly reports of outside-lab imagery, the consistent pattern of significant positive correlations between changes in rowing-related imagery-use and improvement in ergometer score for the PMR group, and the small non-significant negative correlations for the REST group, suggest two possible, not mutually exclusive, explanations: the PMR group's outside imagery was more effective than the REST group's, or the effect of the flotation experience was powerful enough that it rendered differences in outside imagery-use for the REST group insignificant. If the baseline measures of imagery-use and ability (SIQ, MIQ-R) are a good indication of individual differences in imagery effectiveness, it may be that the latter explanation bears more weight, as the groups were matched on these variables. Nonetheless, the effectiveness of imagery is, most likely, a very difficult thing to measure and a combination of the two explanations might provide the best fit. Perhaps, the most distinctive picture of what is going on between the groups may be elucidated by the results of the specific imagery content questionnaire (ICQ).

While some of the aforementioned measures of imagery could be criticized for not assessing the specifics of each rower's imagery, the imagery content questionnaire (ICQ) asked for specific detail on ergometer-related and on-water imagery done in- and outside of the lab during the course of the study. Regrettably, the ICQ was only administered at the end of the study; nevertheless, the results obtained suggest some interesting associations among experimental condition, level of rowing and ergometer performance. For the novice men, the consistent pattern of negative correlations between imagery and ergometer performance for the REST group suggests that either time spent doing imagery during REST detracts from the positive effects of REST, or REST enhances imagery, which, if negative, can degrade performance effects. In terms of the first explanation, there is some evidence that athletes may perceive guided imagery to be subtracting from the positive REST experience (McAleney et al., 1990). Thus, imagery interfering with the REST experience could have been the mechanism that resulted in the negative correlations between imagery use and erg performance for the novice men's REST group. However, imagery in the current study was self-directed rather than guided; it may be that an imagery tape played in the REST environment, which adds the element of auditory stimulation, may be the distracting factor, rather than the practice of imagery itself. Furthermore, the positive correlations between ICQ scores and erg performance for the varsity athletes suggest alternate explanations for the interaction between REST and imagery and subsequent effects on performance.

Addressing the issue of REST enhancing imagery, both positive and negative, several studies in the sport literature (Powell, 1981; Woolfolk, Parrish, & Murphy, 1985; Woolfolk, Murphy, Gottesfeld, & Aitken, 1985) have demonstrated that in addition to performance-enhancing effects of positive imagery, negative imagery rehearsal can inhibit performance. To begin with, the moderate to strong negative correlations between ICQ items and erg score improvement for in-lab ergometer pain imagery - "I imaged pushing past the pain of rowing on an ergometer" ($r = -.85$) and ergometer motivation imagery - "I imagined being motivated while rowing on the ergometer" ($r = -.61$), suggest the possibility that many of the novice rowers may have imagined the pain without getting past it or imagined negative outcomes in their motivational imagery to the detriment of their performance (which is possible with novice rowers who do not have as much experience with erg testing, and especially as the erg test is one that provokes fear and anxiety among many rowers). Furthermore, the one moderate positive correlation between in-lab ergometer split imagery - "I imaged pulling a certain 500m split time while on the ergometer" -and ergometer performance for the REST group ($r = .60$), suggests that there is potential for REST to enhance performance if the imagery is positive. Finally, the consistently greater correlation magnitudes between ergometer performance and imagery done during REST compared to that done outside the lab suggest that any imagery effects for the REST group were a result of in-lab imagery practice, once again suggesting an imagery-enhancing effect for REST.

For the varsity men, the positive correlations between imagery-use and erg score performance among both the REST and PMR groups suggests that imagery-use is important to erg performance, but the environment where imagery is practiced, whether in the PMR condition or the REST condition, may not be crucial for experienced rowers. The fact that the correlations for imagery use and erg performance were positive for the varsity men in the REST group suggests that REST may be a good environment for imagery practice for rowers, contrary to the possibility uncovered by the novice men's results that imagery may detract from the REST experience. However, the lack of control over the erg testing for several of the varsity rowers precludes any conclusive discussion about group differences in imagery use and its effects on performance for experienced rowers.

While the relationship among imagery-use, mental training environment, and erg performance is not totally clear, the link among physical training, experimental environment and erg performance is more clearly established from the results. It appears that spending one session a week in a flotation REST tank can help athletes to benefit more from increases in training than one session a week doing PMR. While it was not part of this study to examine any physiological effects that flotation REST might have in terms of recovery from fatigue, I would like to offer some possible explanations for the PT results. To begin with, the physiological relaxation effects reported in the REST literature (Francis & Stanley, 1985; Jacobs, & Stanley, 1985; O'Leary & Heilbronner, 1985; Turner et al., 1987; Turner, et al., 1989; Turner & Fine, 1983; Barabasz, 1990; Fine et al., 1993) may be more profound than those experienced using other relaxation techniques, such as PMR, even though there was no subjective difference on the report of relaxation between REST and PMR groups. Second, there may be some particular physical aspects of the REST tank environment, such as the Epsom salts (magnesium sulfate) that may have some effect on muscle recovery. Indeed, there is evidence in the medical literature for the relaxing effects of magnesium sulfate on arteries and smooth muscle (Kumasaka, Lindeman, Clancy, Lande, Croxton, & Hirshman, 1996; Bloch, Silverman, Mancherje, Grant, Jagminas, & Scharf, 1995; Okayama, Okayama, Aikawa, Sasaki, & Takishima, 1991; Nelson, & Suresh, 1991), which might suggest a link between flotation REST and recovery from muscle fatigue. Third, it is also possible that the stress reduction effects associated with REST (Francis & Stanley, 1985; Jacobs, & Stanley, 1985; O'Leary & Heilbronner, 1985; Turner et al., 1987; Turner, et al., 1989; Turner & Fine, 1983; Barabasz, 1990; Fine et al., 1993) may contribute to a release of built-up training stress that, if relieved on a regular basis, might lead to greater training benefits. While this study neither addressed any of the above mentioned issues, nor provided any evidence to support any of these possible explanations for REST effects, future research that tries to isolate the mechanism of recovery could be very useful to furthering understanding of flotation REST effects.

Perhaps, the question that might arise concerning REST, especially as it appears to enhance performance in a number of different sports by potentially different mechanisms, is whether the effects are beyond those of a placebo. Placebos have been defined in numerous ways in the medical and psychological literature (Harrington, 1997; White, Tursky, & Schwartz, 1985). Shapiro & Shapiro (in Harrington, 1997) define placebos as "any therapy prescribed knowingly or unknowingly by a healer, or used by laymen, for its therapeutic effect on a symptom or disease, but which actually is ineffective or not specifically effective for the symptom or disorder being treated" (p.12). The most common mechanism of placebo effects that has been offered by theorists and researchers of placebos is expectancy (Harrington, 1997; White et al., 1985). Expectancy of experimental effects can be mediated by several factors, including individual differences in subject populations, differences in experimental procedures, and differences in experimenter behaviour toward one group or another.

In terms of flotation REST and sport performance, REST has been shown to be effective for enhancing performance, but the research may be questioned on its lack of identifying the causes of enhanced performance. In the current study, mechanisms of the performance enhancement effects of REST were sought after but not clarified and expectancy effects might be considered to be responsible for the results. However, many REST studies (Richardson, 1997; Barabasz et al., 1993; Barabasz & Barabasz, 1990; Suedfeld et al., 1987; Suedfeld & Baker-Brown, 1986; Barabasz, 1982; Suedfeld, Landon, Epstein, & Pargament, 1971), including the current study, have included expectancy manipulations or measures and have demonstrated REST effects independent of expectancy. In fact, Suedfeld et al. (1987) found REST enhanced creativity significantly more than a control condition despite subject expectancy that was contrary to the hypothesis and outcome, while Barabasz and Barabasz (1990) demonstrated that high expectancy induction did not have any greater impact on REST effects than low expectancy induction. Suedfeld et al. (1971) found that induced subject expectancy affected subjective reports of stress following REST but did not affect objective scores on a cognitive test; similarly, Melchiori and Barabasz (1987) found no consistent relationship between subjective feelings following REST and improvements in objective flight simulator performance, with most subjects in the REST group reporting that they were “bored” during the last third of their flotation session. In the sport research, Barabasz et al. (1993) found no differences in expectations between REST and control groups participating in a rifle marksmanship study, with most of the control group reporting improved confidence. In the current study, I believe that expectancy was well controlled. The groups were matched on several important variables out the outset of the study; the groups differed neither on a pre-experimental expectancy question nor on any post-experimental questions regarding beliefs about experimental effects. Both groups were treated equally by standardized procedural protocol and there were no group differences in preference for one environment versus the other. Furthermore, the fact that the subjective similarities between REST and PMR (that they were equally preferred, were rated similarly for effect on ergometer score and several other measures) were not congruent with the objective differences in the dependent measures of the study (that REST was associated with significantly greater erg score improvement than PMR) suggests that REST participants may not have been aware of the effects of REST on their performance. In essence, REST effects do remain to be explained, but the enhancement effect of flotation REST over that of a comparable expectancy-inducing technique, PMR, suggest that the effects go beyond those of a placebo.

Summary

The results from this study are congruent with the previous research on REST and sport performance, demonstrating that REST can be a powerful tool for enhancing athletic performance. The study also extends the applications of REST to include power/endurance sports. The current results suggest that the most useful application of REST in the sport of rowing might be for novice rowers. However, dismissing the potential for REST effects with experienced rowers might be premature because the current study failed to collect consistent ergometer score performance data for some of the varsity group. Although the study did not clearly identify the mechanisms underlying REST effects on rowing ergometer performance, it did illuminate several possible explanations that could be examined by future research. Indeed, the issue of the specific mechanisms of REST effects must be clarified to avoid the label of REST as a placebo, and to help establish credibility for REST research in sport. I conclude with an optimistic outlook on the possibilities for REST in the sport performance arena.

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