THE EFFECTS OF COGNITIVE STRATEGIES ON SWIMMING PERFORMANCE

A Thesis Presented to the
Faculty of University Schools
Lakehead University

In partial fulfillment of
the requirements for the
Degree Master of Science in
the Theory of Coaching

By


Denis Ford

ACKNOWLEDGEMENTS

The author wishes to acknowledge a deep debt of gratitude to Dr. Brent S. Rushall for his support, professionalism and guidance throughout the design, execution and completion of this thesis. Thanks also go to the swimmers who participated in this study.

ABSTRACT

The purpose of this thesis was to examine the effects of various cognitive strategies on the performance of a 400 metre swimming task. The experiment consisted of three replications of a single subject design. The independent variables were the three forms of cognitive strategies presented to each subject. The major dependent variable was the length of time it took each subject to perform a 400 metre swim. One treatment per session was presented. The order of the treatment conditions was randomly selected from a 3 x 3 Latin square. Where performance was indicated as being superior for one particular condition, then that condition was applied more frequently.

The results indicated that two out of the three subjects (subjects 1 and 2) performed better using a task specific strategy. No differences in effect of the treatment conditions were indicated for the other subject (subject 3). Posttest and postexperiment questionnaires indicated that: (a) subjects 1 and 2 experienced more discomfort using the task specific strategy; (b) that pain was not a major limiting factor in performance; (c) all subjects could concentrate on the assigned strategy; (d) a learning effect occurred for subject 1 using the task specific strategy and for subject 3 using the task specific and voluntary distraction conditions; (e) pretest expectations to do well or poorly might have affected performance for subjects 1 and 3; and (f) all subjects preferred the task specific strategy, and considered it to be the best and most effective condition for improving performance.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued) Page

LIST OF FIGURES

Chapter I

INTRODUCTION

Statement of Purpose

The purpose of this thesis was to examine the effects of various cognitive strategies on the performance of male swimmers in a maximum effort swimming task.

Significance of the Study

There is an ever growing body of opinion amongst coaches, sports psychologists and exercise physiologists that psychological and not physiological factors are the major limiting factors in improving sports performance (Kane, 1979; Morgan & Pollock, 1977; Rushall, 1979; Taylor, 1979). Why on numerous occasions do athletes in the peak of physical condition fail to meet expectations? Obviously psychological considerations must play a commanding role. Whilst recognizing that there are many different factors involved in psychological preparation for competition, this study was solely concerned with cognitive strategies which were used during the event itself to try and alter pain coping capacities. This concentration evaluated one major psychological determinant of performance.

Many athletic events, including the 400 metre swim, incur varying amounts of pain owing to the onset of lactic acidosis and the discomfort of muscular fatigue. In many events these physiological parameters are unavoidable. They can be delayed by improved physical training but they are still unavoidable. The athlete therefore has to face and endure pain which is obviously a limiting factor in performance.

It has been shown that cognitive strategies are successful in altering pain coping capacties (Barber & Hahn, 1962; Beers & Karoly, 1979;

Blitz & Dinnerstein, 1971; Peterson, 1978). However, most of the research in this field has been conducted in the laboratory using methods of pain stimuli such as cold pressors and radiant heat. There have been few attempts to study the effects of pain reducing strategies in the actual sporting environment. Crossman (1977) attempted to assess the effectiveness of cognitive strategies on the maximum endurance of inter-collegiate wrestlers whilst treadmill running. All subjects preferred strategy conditions to unaided conditions. Selkirk (1980) tested endurance runners performing in a maximum endurance run on a treadmill. Running performance of endurance runners was increased when a planned strategy was used. Two areas of criticism of Selkirk's design were: (a) the athletes only had one attempt at each of the strategies and as such were incapable of becoming skilled in their use, and (b) the athlete performed on the treadmill as opposed to the actual athletic track.

This experiment attempted to answer these criticisms by (a) allowing the subjects many attempts at performing the strategies, (b) allowing the subjects time to prepare and rehearse the strategies, and (c) testing the effectiveness of these strategies in the actual sporting environment.

Significant results from this study would have direct implications for improving athletic performance. Pain is a major limiting factor in athletic performance. The successful implementation of pain coping strategies would provide invaluable assistance to athletes throughout a great variety of sports.

This thesis extended the work of previous researchers by using an improved research design. The demonstration of an effective psychological strategy that improves performance would make a significant contribution to coaching science.

Delimitations

This thesis was delimited to the study of the performance of club swimmers on the specific task of 400 metre swimming. Three male swimmers were used. Their ages ranged from 14 to 16 years. The swimmers were all of the elite level for their respective age groups.

The independent variable was three forms of cognitive strategies used by the swimmers. The three strategies were as follows: (a) unaided, (b) task specific, and (c) voluntary distraction. These strategies were selected because they (a) have been used in similar experiments by Crossman (1977), and Selkirk (1980); (b) have been successfully used in pain reducing experiments; (c) are simple to understand and employ; and (d) have been used in sporting situations.

The dependent variable was the length of time it took each subject to perform a 400 metre maximum effort swim.

Limitations

This study was limited to the performance of three male club swimmers. The following assumptions were made: (a) that the subjects were able to understand and employ the learned strategies; (b) that the strategies were performed as instructed; (c) that the pain control strategies were applicable for controlling extreme fatigue; (d) that any performance improvements were due to treatments and not to subject expectancies; (e) that a 400 metre swim was an appropriate distance for employing a cognitive strategy; and (f) that the subjects performed at maximum effort for each 400 metre swim. For differences to be deemed significant, obvious visual patterns of change had to be displayed in the data. The requirement that the subjects performed at maximum effort was employed to maintain the assessment of practicality in the findings.

Definitions

Cognitive Strategy refers to a consistent perceptual methodology or mental plan employed by an athlete during an endurance activity in order to alter or transform the experience of pain from extreme physical fatigue (Selkirk, 1980).

Unaided Strategy refers to the uninstructed individual plan, or lack of it, employed by the athlete as a thought control procedure during an athletic feat (Selkirk, 1980).

Task Specific Strategy refers to the instructed plan which involves total concentration on technique associated with the activity as a thought control procedure during an athletic feat (Selkirk, 1980).

Voluntary Distraction Strategy refers to the implementation of one of numerous uninstructed self-chosen plans such as counting backwards, goal setting, or singing as a thought control procedure during an athletic feat (Selkirk, 1980).

Maximum Effort is the highest degree of effort that can be given during the 400 metre swim.

Performance Time refers to the number of seconds that a subject swims under a specific condition in an attempt to perform at maximum effort over a distance of 400 metres.

Club Swimmers refers to the three, male subjects aged 14, 15 and 16 years. The swimmers compete provincially and nationally.

Chapter II

REVIEW OF LITERATURE

Although cognitive strategies have been extensively used in pain reducing experiments their application has been somewhat neglected within the sporting arena. In the laboratory, cognitive strategies have been successfully employed in altering the pain threshold and pain tolerance levels of a wide variety of individuals (Beers & Karoly, 1979; Blitz & Dinnerstein, 1971; Spanos, Horton & Chaves, 1975). Few attempts have been made to alter the pain coping capacities of athletes in relation to the pain caused by the lactic acid and muscular fatigue which accompanies a maximum effort performance. Crossman (1977) and Selkirk (1980) compared the effects of different cognitive strategies in alleviating the pain experienced in a maximum endurance task. The fact that there has been limited research into increasing pain coping capacities during athletic performance, necessitates a concentration in this review on the control of experimentally induced pain, and the pain associated with medical problems. It would be debatable that the pain associated with muscular fatigue and lactic acidosis is a similar experience to the pain associated with laboratory experiments or clinical ailments. However, Cautela (1977) did establish certain criteria for clinical pain which are satisfied by the pain experienced in sporting events.

Pain threshold and pain tolerance have been the most frequently used experimental yardsticks whereby an individual's pain coping abilities can be measured. The relationship between pain threshold and pain tolerance is unclear. Clarke and Bindra (1956) found a high correlation between the two concluding that, "attitudinal variables are responsible for a large

part of the individual differences in both pain threshold and pain tolerance levels, and that these attitudinal factors are primarily affective (anxiety, timidity) rather than cognitive in nature" (p. 75). Gelfand (1964) reported a low correlation, and concluded that pain tolerance had a larger number of psychological components than pain threshold. This research supported the work of Hall and Stride (1954) who reported that "major variations in pain tolerance can be attributed to central attitude or pain conceptualization and not to differences in peripheral sensitivity" (p. 59). Athletes and non-athletes have been compared in experimental tests, and whilst pain threshold levels were of a similar magnitude, athletes displayed a marked capacity to tolerate pain (Nowlin, 1974; Ryan & Kovacic, 1966; Walker, 1971). However, experimentation has not shown that the greater pain coping capabilities of athletes are a direct result of cognitive strategy implementation. Moore (1976) reported that non-elite marathoners used cognitive strategies to dissociate their thoughts from the feelings of pain. In direct contrast, none of the elite marathoners interviewed by Moore followed this procedure, but instead associated with the pain, and concentrated on task specific thoughts. Concentrating on the feedback from the pain, to control and determine task specific actions and thoughts, could in itself be classified as a cognitive strategy. Whatever the case, it is becoming increasingly apparent that success in a wide variety of sports is as equally, if not more, dependent on psychological than physiological factors (Kane, 1979; Taylor, 1979).

The effects of pain have been altered by a variety of cognitive strategies. Blitz and Dinnerstein (1971) found that cold pain was reduced to an equal degree either by suggestion to imagine only the cold aspect

of the water, or interpret the water as pleasant. Beers and Karoly (1974) compared the effectiveness of four cognitive pain-attenuation strategies. These were: (a) task-irrelevant condition where the subject counted backwards in threes; (b) incompatible-imagery condition, which involved imagining a pleasant, warm scene; (c) compatible imagery condition, that is, imagining a pleasant but cold-related scene; and (d) rational-thinking condition, which had the subjects making positive self-statements designed to emphasize the positive, and minimize the unpleasant aspects of the noxious stimulation. All the strategies had the desired effect of increasing pain tolerance. Rational thinking and compatible imagery were generally the most effective. Spanos, Horton and Chaves (1975) reported that the employment of the relevant strategy (imagining a situation inconsistent with pain) was more effective in raising pain thresholds than an irrelevant strategy (imagining a situation unrelated to pain). However, those results were only applicable to those subjects who had shown high pre-test pain thresholds. It would seem that those with low pain thresholds did not have sufficient time to employ the strategies. Jaremko (1978) used a cold water treatment with 70 subjects and found that the reversal strategy (imagining a hot day and concentrating on the cool, refreshing aspects of the water), and the rationalization strategy (rationalizing the pain in terms of receiving course credit for participation in the experiment) were the most effective for increasing pain tolerance. Jaremko also reported that those subjects who became highly involved in their strategies tolerated pain for longer periods. Multiple strategies were used by Scott and Barber (1977) when they subjected 80 subjects to cold and pressure pain. Four treatments aimed at reducing pain were administered. They were: (a) the collective use

of five cognitive strategies; (b) the same instructions to use five strategies, but given in a brief form (45 secs.); (c) instructions to use one specific cognitive strategy; and (d) control. Both of the instructions to use five cognitive strategies raised average pain tolerance about 100% above the control level. The employment of the multiple strategies was also significantly greater than the single strategy, which in turn, was better than no strategy at all.

Cognitive strategies have been frequently used in the control of clinical ailments as an alternative to pain medication. Levendusky and Pankratz (1975) in dealing with patients suffering chronic abdominal pain, managed to execute a successful drug withdrawal procedure by teaching self-control of pain through relaxation, covert imagery, and cognitive relabelling. Ribstein-Blinchik (1978) used three different types of cognitive strategies to reduce persistent pain. They were: (a) reinterpreting the painful stimuli; (b) diverting attention from the painful stimuli; and (c) concentrating on the sensation itself. Peterson (1978) successfully used a combination of relaxation, distractive imagery, and comforting self-talk to minimize pain and anxiety in hospitalized children.

Experiments have clearly shown a high correlation between the ability to cope with pain, and an individual's current state of anxiety. Bronzo and Powers (1967) reported that pain threshold was lowered by an anxiety producing situation as measured by an increase in pulse and blood pressure. Hasset (1978) reported that dental patients who were highly anxious displayed lower pain tolerance levels. Feelings of anxiety and the resultant perceptions of pain have been reduced by allowing subjects some measure of self-control over the pain producing stimulation. In experiments using electric shock as a noxious stimulation, subjects who perceived they had

no control over the shock rated less shock as more painful than subjects who perceived they had some control over avoidance of the shock (Ball & Vogler, 1971; Bowers, 1968; Staub, Turksy & Scharwtz, 1971). Staub and Kellett (1972) demonstrated that subjects who received information about the characteristics and effects of the aversive stimuli, displayed increased pain tolerance levels.

The correlation between anxiety and pain tolerance levels were supported by Barber (1959) who hypothesized that pain results when the individual concentrates on and reacts to noxious stimulation with anxiety, or worry and concern. Sternbach (1968) in supporting the role of hypnosis as a pain reducer stated that, "in hypnotic analgesia it is the absence of anxiety about stimulation which is the single necessary and sufficient condition for perceiving the stimulus as a non-painful sensation" (p. 141). However, Barber and Hahn (1962) found that although hypnotically suggested analgesia was an effective pain reducer, it was no more effective than waking imagined analagesia. Greene (1971) investigated the effectiveness of hypnotically suggested analgesia and pleasant imagery conditions in modifying the tolerance of an increasingly intense electrical stimulus. The hypnotically suggested analgesia condition proved most effective in modifying pain tolerance, and the subjects reported that they experienced diluting rather than additive effects in the analagesia plus pleasant imagery condition. Spanos, Radtke-Bodorik, Ferguson, and Jones (1979) assigned subjects to one of four groups according to their hypnotic susceptibility. The groups were: (a) hypnosis and analgesic suggestion; (b) hypnosis alone; (c) suggestion alone; and (d) no hypnosis - no suggestion. Hypnotic and non-hypnotic subjects reported no difference in their report of pain reduction.

Johnson (1974) used relaxation suggestions and found them effective as a pain reducer. Davidson and McDougall (1969) reported relaxation and cognitive rehearsal to be effective in increasing subjects' pain tolerance with the relaxation technique proving to be the most effective. Bobey and Davidson (1970) investigated methods of reducing pain from the noxious stimulation of heat and pressure. They reported that pain tolerance levels were increased after the subjects listened to a 12-15 minute relaxation tape. Cautela (1977) successfully combined relaxation techniques and incompatible imagery to reduce the experience of pain. Whenever the subject felt pain he was told to yell, "Stop, Relax," and then imagine a reinforcing scene. Feurerstein (1978) also successfully used relaxation strategies on 43 subjects who suffered frequent muscle contraction headaches.

The contribution the expectancy factor made in pain reduction was investigated by Chaves and Barber (1974). It was reported that pain reduction occurred for those subjects who were assigned to the expectancy group. However, the groups employing cognitive strategies showed greater reductions. These findings were supported by Beers (1976) who reported that the expectancy factor did not make a significant contribution to pain reduction.

The effectiveness of cognitive strategies in altering pain coping capacities appears to be independent of the type of noxious stimulation which is presented. Scott and Barber (1977) reported no significant difference in effects of the application of cold or pressure pain. Clarke and Bindra (1956) used three stimulators to deliver noxious intensities of electric current, pressure, and radiant heat. They found no significant difference in the type and source of stimulation on pain threshold or pain tolerance levels.

The relationship between personality and pain sensitivity is unclear. Brown, Fader, and Barber (1973) found a consistency of pain responsivity among four personality measures--anxiety, neuroticism, extroversion, and sensation seeking. The conclusion was drawn that none of the personality measures was significantly related to measures of pain responsivity. Lynn and Eysenck (1961) reported a high correlation between extraversion and high pain tolerance. This view is supported by Shephard (1978) who stated that reducers (people who consistently underestimate size) were capable of tolerating more pain than augmenters (people who consistently overestimate size). Shephard stated that reducers were generally more extroverted than augmenters. Nowlin (1974) used gross pressure and ischemic pain with four athletic groups. Nowlin reported that gross pressure pain does not significantly correlate with 16 personality factors; however, those athletes high in ischemic pain tolerance possessed the personality trait of being self-sufficient, whereas athletes low in ischemic pain tolerance displayed the trait of group dependence.

There is evidence to show that athletes can tolerate more pain than non-athletes (Ryan & Kovacic, 1966; Walker, 1971). Moore (1976) expressed the marathoner's view that the key to overcoming the discomfort of pain was knowing what to expect, and was not related to the fact that these elite athletes might possess increased pain threshold levels which were genetically determined. Moore reported that the elite marathoner preferred to associate with pain, using the physiological signals it gave to make adjustments in pace, length of stride, and other tasks, specific to the event. Non-elite marathoners were reported by Moore (1976) as using cognitive strategies to dissociate from the pain, which they managed to achieve with varying degrees of success. Crossman (1977) examined

cognitive strategies as employed in the performance of a maximum endurance task. The subjects reported a preference for strategy conditions over unaided conditions with the employment of the former resulting in an improved mean performance time. Selkirk (1980) further examined the effects of cognitive strategies in a maximum endurance task. Four strategies were used: (a) unaided; (b) imagery manipulation; (c) task specific condition; and (d) voluntary distraction condition. The strategy conditions showed a percentage improvement in performance time over the unaided condition. Although the voluntary distraction condition was marginally superior, Selkirk (1980) concluded that the task specific strategy would seem to provide the greatest potential as "athletes could concentrate on the maintenance of proper technique in order to direct their thoughts away from noxious stimulations" (p. 38).

The successful implementation of strategies will not necessarily have an immediate positive effect on performance. The athlete may require a number of trials to learn and effectively use the strategies. This learning effect was reported by Rushall (1979) in connection with a world class swimmer, who took 3 days and 5 trials to learn specific mental rehearsal to the extent where it was more effective than not rehearsing.

In conclusion, it is clear that cognitive strategies can be successfully employed to alter the pain coping capacities of: (a) individuals who are subjected to the noxious stimulation applied in laboratory experiments; and (b) individuals suffering clinical pain. It would appear possible that athletes are also capable of reducing the limiting effects that pain may have on performance, by methods similar to those used in the laboratory setting. The demonstration that cognitive strategies could be successfully used to improve performance time in a maximum effort task would be a significant contribution to the field of sports coaching.

Chapter III

METHODS AND PROCEDURES

Experimental Aims

The aim of this experiment was to assess: (a) the effects of various cognitive strategies on the performance of swimmers in a 400 metre maximum effort swim; (b) the degree of difference, if any, between the effects of different cognitive strategies on performance; and (c) whether learning occurred, leading to an improvement in mental control of the strategies.

Experimental Design

The experiment consisted of three replications of a single subject alternating treatments design (Hersen & Barlow, 1976). This design was utilized to avoid the intersubject variability that exists in group designs, and the problems associated in generalizing results from the group average to the individual subject. The design eliminated intersubject variability and allowed effects, if any, to be directly observed. Statements about other individuals can be made through the process of replication and "logical generalization" (Barlow & Hayes, 1979). The design consists of two distinct stages:

1. Baseline stage. During the baseline stage the performance time of each individual was recorded until stability was reached.

2. Experimental stage. During the experimental stage the two treatment conditions were applied as well as maintenance of the original baseline condition. One condition per session was presented. The order of the administration of the treatment conditions was randomized using a 3 x 3 Latin square.

It should be noted that when the subject was unable to perform a trial on a particular day then the treatment condition as specified for that trial was missed out completely. On the next trial, the subject would perform using the treatment condition as previously determined by the Latin square.

It should be noted also that if it became obvious that the subject performed better under one particular treatment condition then that condition was to be applied more frequently. The unaided condition then assumed a "probe" status being given periodically to assess the stability of extraneous variables.

Rogue scores, if any, were determined as those performances which differed greatly from the norms for that condition. The occasions when illness or injury greatly impaired performance were considered as rogue scores. Such scores were not included in the visual inspection for trends in the experimental data.

Independent and Dependent Variables

The independent variable comprized three conditions under which the subjects performed. They were as follows: (a) unaided condition; (b) task specific condition; and (c) voluntary distraction condition. In the unaided condition, the subject was to think of those things, apart from technique, that were his usual thoughts whilst swimming the event. This is the "normal" circumstance for swimming. In the task specific condition, the subject was instructed to concentrate on the specific technique aspects and performance requirements of freestyle swimming. In the voluntary distraction condition, the subject was instructed to use a strategy or strategies of his own design.

These three conditions were selected because: (a) they have been used in similar experiments by Crossman (1977), and Selkirk (1980); (b) they have been successfully used in pain reducing experiments; (c) they are simple to understand and employ; and (d) they have been used in sporting situations.

One major dependent variable, performance time, was measured. Changes in performance time would be the best measure of the effects, if any, of the independent variable. It has direct relevance to the actual competitive swimming situation.

Posttest and postexperiment questionnaires (see Appendix A) were adapted from Selkirk (1980), and administered to obtain information regarding the following: (a) the amount of discomfort (pain) experienced by the subject; (b) the degree of the subject's pretrial expectancy; (c) the percentage of time that the subject was able to employ the developed strategy; (d) what the subject's thoughts were whilst performing the unaided condition; (e) the subject's preference and estimate of effectiveness of each condition; and (f) a description of extraneous factors that might have confounded the performance.

Subjects

Three male swimmers from the Thunder Bay Thunderbolts Swim Club were selected by the coach of the club on the basis of suitability, availability, and reliability. The subjects were tested in the swimming pool of the C. J. Sanders Fieldhouse at Lakehead University. The swimmers were all young males aged 14, 15 and 16 years, and had been assessed by their coach as good swimmers for their age group, that is, they were ranked in the top 10 swimmers for their age group in Canada.

Controls

A large number of controls were implemented to avoid, distribute, or measure the effects of potential extraneous variables.

Each subject was pretested in the unaided condition to establish a baseline which served as the basis for comparison for the other two treatment conditions. This also allowed the subjects to become acquainted with experimental procedures thereby minimizing possible confusion during the experimental tests. The experiment was conducted at the same time of day, four days a week, Monday to Thursday. Days missed through illness and competitions retarded the application of the testing schedule. A standardized 10 minute warm-up of each swimmer's own design was performed prior to the experimental performance.

To control for sequence effects, the order of the administration of the treatment conditions was randomized according to a Latin square format. Staggered starts were implemented to avoid pacing during each testing. This was necessary because of the limited time for testing. The importance of performing a maximum effort was emphasized prior to each individual swim.

The subjects were asked not to look at the clocks, thereby eliminating visual cues as to the length of performance. No performance feedback was given to any subject.

Standardized recording sheets, (see Appendix D) and one timing device were used to minimize recording and measurement errors. Instructions for developing each strategy were standardized on handout sheets (see Appendix B). Each subject was provided with examples of words and phrases for the task specific and voluntary distraction strategies (Appendix C).

To facilitate employment and measure the amount of use of the requested strategy the following procedures were undertaken: (a) the subjects made a written preparation prior to the first employment of each directed strategy with the assistance of the experimenter if requested; (b) the subjects were allowed adequate time, prior to each performance, to rehearse and memorize the prepared strategy; (c) at the termination of each performance, the subjects were asked if any adjustments to their strategies were required; and (d) posttest subject examinations of the percentage of time the strategies were employed was undertaken.

Performance measure. Performance time was measured from when the experimenter shouted "Go!" to when the subject touched the side of the pool at the finish of the 400 metre swim. A previously prepared recording sheet was used to record the performance time of each test as registered on the stop watch.

Experimental Procedure

Pilot study. A pilot study was undertaken with one subject over a two week period. The subject swam eight trials for the purpose of seeing whether a baseline could be established.

Baseline. Each subject swam in the unaided condition until at least stable conditions were established. The criterion for determining stability was either consistent patterns of response or persistent, similar performance levels. The conclusion of baseline assessments was likely to vary with each individual.

Stages of Experimental Testing

The experiment consisted of several stages.

Instructional stage. Experimental tests commenced the week immediately following the termination of the baseline phase. Each subject was handed an instruction sheet (see Appendix B) with information concerning the nature of the experiment. Assistance was offered to any subject in the preparation of their task specific and voluntary distraction strategies.

Testing stage. On testing days each subject was informed of the individual strategy to be performed in that particular swim. The subject performing under the unaided condition was advised to perform the 10 minute warm-up, and was then timed on the 400 metre swim. The two remaining subjects who were to perform under the task specific and voluntary distraction conditions were given adequate time to review their strategies prior to the warm-up.

Immediately following completion of their strategy preparation, the two subjects performed a 10 minute self-developed standardized warm-up. They were then allowed time to review the main points of their strategies. At a signal from the experimenter, the 400 metre maximum effort swim commenced after the command "On your mark, Go!" had been given.

Posttest evaluation stage. Immediately following each maximum effort swim, the two subjects who had performed under aided conditions were asked if they wished to make any revisions to their strategies for following performances. The assistance of the experimenter was provided if requested.

All subjects were asked to complete a posttest questionnaire at the end of each test, and a postexperiment questionnaire at the end of the experiment. Testing continued until stability was reached, or until it was obvious that no stability would be achieved.

Apparatus

Performance time was measured in seconds using a digital stopwatch (Accusplit Digital 760 Memory).

Data Analysis

Time for individual performance for each treatment was recorded in seconds. Fractions of a second were rounded to the nearest second. This was undertaken because of the manual timing employed.

Performance improvements for treatments for all subjects were calculated by expressing the mean performance of the task specific and of the voluntary distraction strategies, as a percentage of the unaided condition if stable performance levels were achieved in each.

The following parameters were graphed.

(a) Performance time in seconds for each subject for each condition.

(b) The subject's estimate of the percentage of time that he was able to use the instructed strategy.

(c) The subject's estimate of the degree of discomfort experienced.

(d) Performance time in seconds for each subject for each day of the week.

Regarding analysis of the data, Hersen and Barlow (1976) stated that:

> The experimental criterion for evaluating applied interventions with intra-subject designs is retained by the experimental design (intra-subject replication) rather than by the design and statistical comparisons characteristic of traditional between group research. By alternating baseline and experimental phases, systematic changes in trend strongly argue for the experimental reliability of the effect (p. 268).

Therefore, significant differences or effects were declared if visual inspections of the data indicated obvious trends. In the absence of obvious visual trends, an analysis of overlapping points was conducted.

An overlap of 40% was declared as non-significant (Hersen & Barlow, 1976).

Information derived from the subject's responses to the posttest and postexperiment questionnaires were tabulated in order to determine an index for each of the following: (a) the subject's preference for condition; (b) the subject's estimate of which condition was most effective for improving performance; (c) whether there was a relationship between subject expectations of performance and actual performance; and (d) the subject's ability to discriminate between the quality of successive performance trials. A phi-coefficient was computed to assess the relationships of (c) and (d) with an alpha level of .05 (Champion, 1970).

Chapter IV

SUBJECT 1: RESULTS AND DISCUSSION

Pilot Study

Figure 1 shows the results of the pilot study conducted prior to the baseline and experimental stages. Stable measurements were achieved over the seven trials indicating that the subject was capable of consistent levels of performance. Performance times ranged from 285 seconds to 287 seconds, and the average performance time was 286.7 seconds.

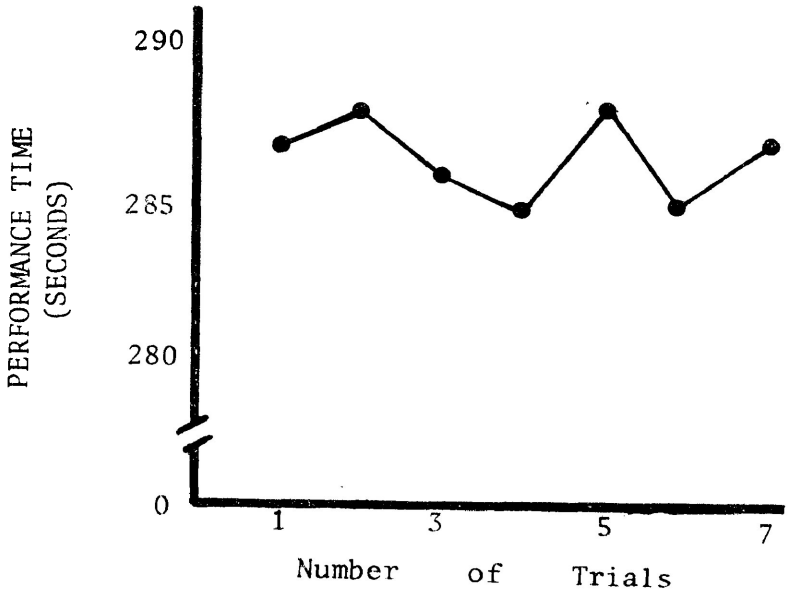


Figure 1. Pilot study conducted with subject 1.

Baseline Stage

The subject swam in the unaided condition and established consistent levels of performance within seven trials (see Figure 2). Performance time ranged from 285 seconds to 287 seconds and the average performance time was 286.0 seconds.

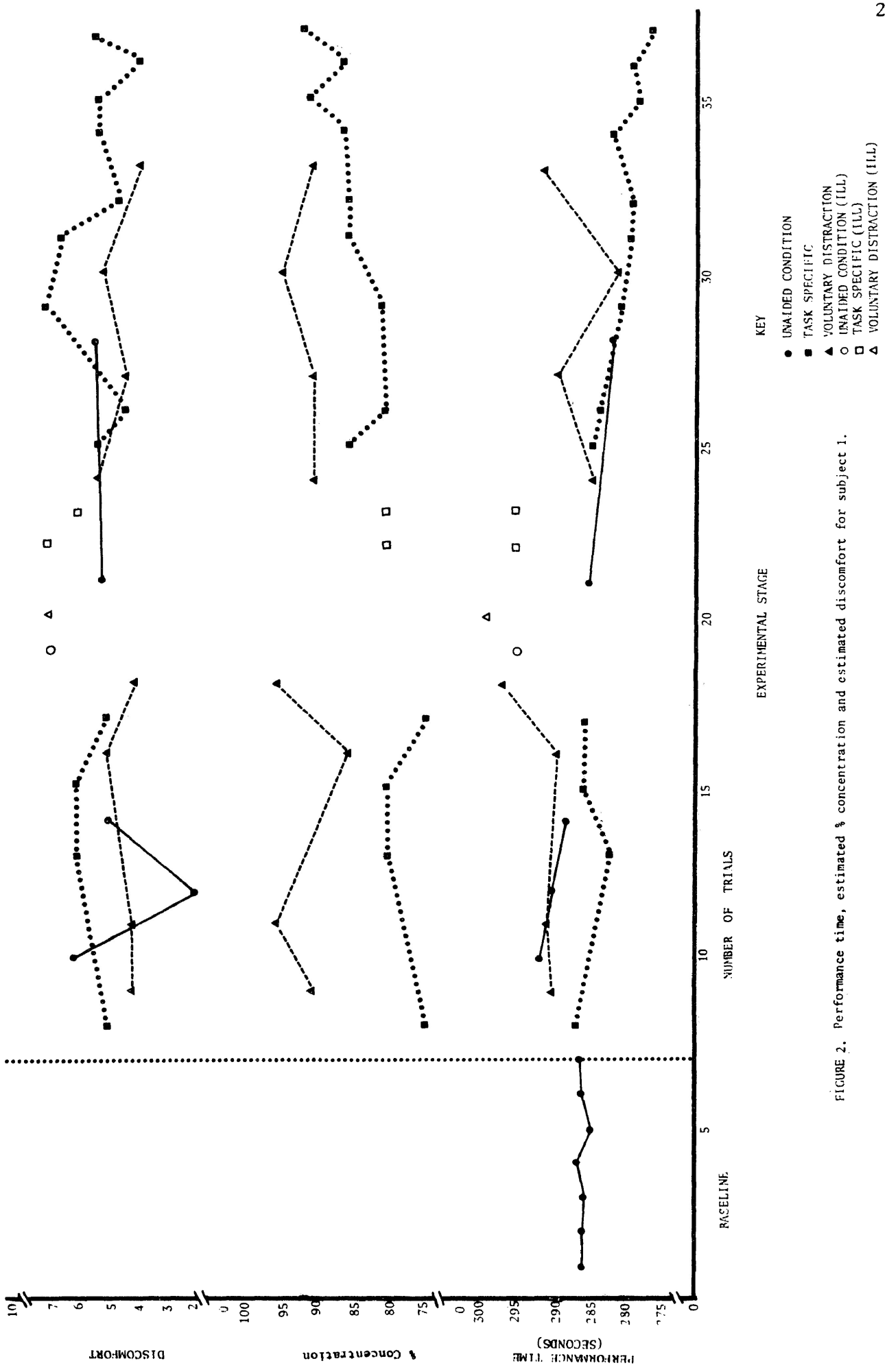


FIGURE 2. Performance time, estimated % concentration and estimated discomfort for subject 1.

Experimental Stage

At the commencement of the experimental stage there was an increase in performance time for the unaided condition. After three trials it declined to the levels achieved during the baseline stage. Further trials showed a continued downward trend. Performance times under both the task specific and voluntary disraction conditions also displayed a gradual downward trend (see Figure 2).

Performances using the task specific strategy were better than performances using the voluntary distraction condition. This difference was visible both before and after the intervening variables of sickness and injury. During the early part of the experimental stage, the task specific strategy displayed a superiority over the unaided condition. However, after the initial three trials for each of these two treatment conditions, the task specific strategy was only slightly better than the unaided condition. This marginal difference was still present in the later stages of the experiment.

Performances employing the voluntary distraction condition were poorer than those using the unaided condition. This difference was noticeable throughout the duration of the experimental stage.

The percentage of time that the subject estimated he was able to concentrate on the content of the task specific and voluntary distraction strategies for each trial, is illustrated in Figure 2. The time for the voluntary distraction condition was indicated as being more than that for the task specific strategy. There was a gradual increase in the subject's ability to concentrate on the content of the task specific strategy. This suggested that a learning effect had taken place.

There was more discomfort experienced whilst performing under the

task specific strategy than under the voluntary distraction and unaided conditions (see Figure 2). The discomfort experienced under the voluntary distraction and unaided conditions was indicated as being similar. Throughout the 30 trials conducted during the experimental stage, the subject described the discomfort as being painful on only one occasion. This was in the unaided condition when the subject was injured.

Performance times for each day of the week showed Wednesday to have the least variation, whereas Tuesday had the fastest as well as the slowest time (see Figure 3). The largest difference in average times for the days was 2.0 seconds. These results suggested that performances were not related to the day of the week. The sleeping and eating habits of the subject suggested that these variables also had no effect on performance times. The results of the posttest questionnaire indicated that no other factors prevented the subject from attempting his best for each performance trial.

In the postexperiment questionnaire, the subject indicated a preference for the task specific strategy and considered this treatment condition to be the best and most effective for improving performance. The unaided condition was rated by the subject as the second most effective, and the voluntary distraction condition as the least effective condition for improving performance. These impressions were supported by the data of the experiment.

The phi coefficient relating the subject's expectancy of performance to actual performance was significant ($r_\theta = 0.37$, $x^2 = 3.95$; df 1, $p < .05$). This result suggests that the subject's expectation of performance was related to actual performance.

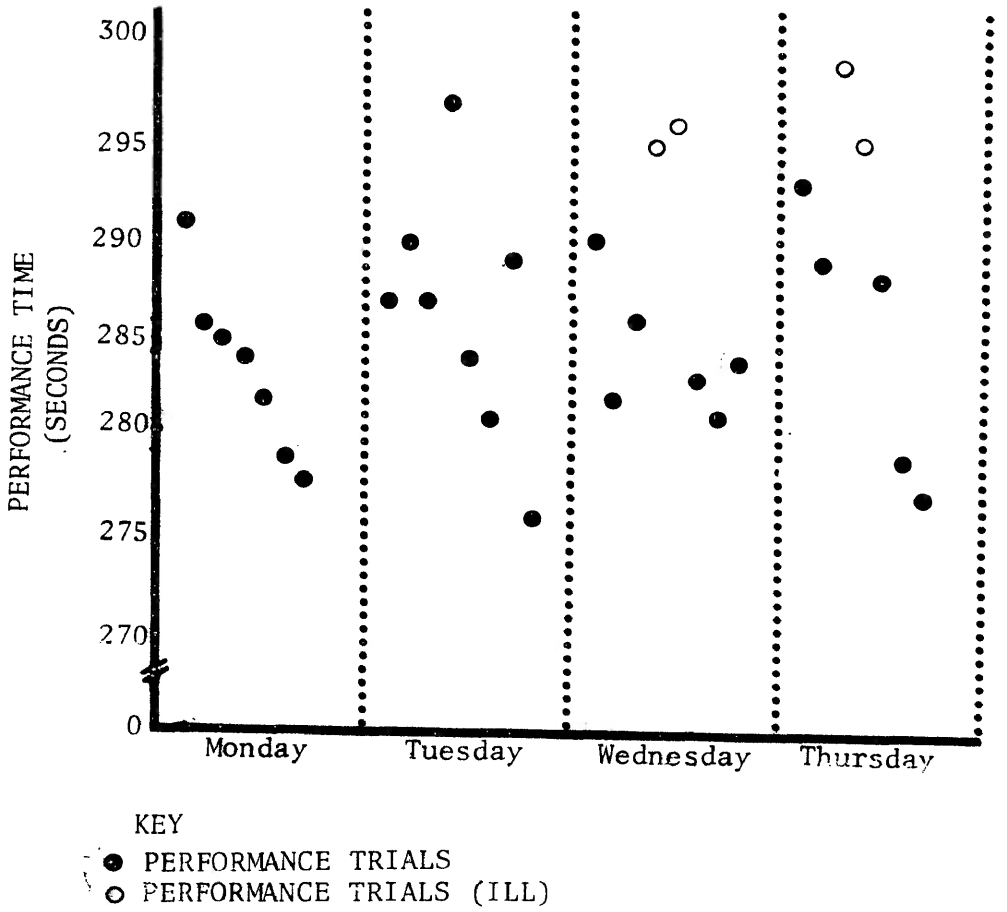


Figure 3. Performance time according to day of the week for Subject 1.

The relationship between actual performance and the subject's assessment of whether he had performed better or worse than the previous trial, was found to be non-significant (r_θ = 0.29; x^2 = 2.43; df 1, $p > .05$).

This result suggested that the subject could not discriminate between the quality of successive performance trials.

This experiment was terminated when there were obvious differences in the effects on performance of the treatment conditions.

Discussion

The results of this study indicated that performance times for a 400 metre maximum effort swim were superior using a task specific strategy than a voluntary distraction condition. The results also indicated that the employment of a task specific strategy had a slightly better effect on performances than using no strategy at all, and that performances using the voluntary distraction condition were poorer than performances using the unaided condition.

The initial increase in performance time of the unaided condition at the start of the experimental stage, and the subsequent downward trend, were presumably caused by extraneous variables outside the control of the experimenter. Such an occurrence is always a potential problem when dealing with human performance. The fact that similar trends were observed in the other two treatment conditions indicated that all performances were affected by these extraneous variables.

An interesting aspect of the experiment was the increase in performance times seen when the subject employed the voluntary distraction condition. Such a phenomenon might be explained by the high levels of concentration achieved by the subject whilst using this condition. These high levels of concentration may have rendered the subject less likely to attend to the technical aspects of the performance, with the result that performance was effectively reduced. The task specific strategy seemingly improved

performance by allowing the subject to concentrate on task-related aspects of performance.

The gradual increase in the amount of time the subject could concentrate on the content of the task specific strategy suggested that a learning effect occurred. The more trials performed, the longer the subject was able to implement the previously prepared strategy. Concentration on the voluntary distraction condition started at a high level and remained there throughout the experiment. It might be that the previous familiarity of the subject with the content of this condition accounted for this occurrence.

The level of discomfort experienced during the 400 metre maximum effort swim would not appear to have limited the quality of performance. The data from this experiment would actually suggest the opposite. This was evident from the high discomfort ratings and faster times recorded with the task specific strategy, and the low discomfort ratings and slower times recorded with the voluntary distraction condition. This viewpoint was supported by the subject who reported a preference for the task specific strategy even though this was accompanied by the highest levels of discomfort. Pain levels did not appear to play a significant role in the 400 metre swim. On only one occasion was the discomfort experienced reported as painful and that was when the subject was injured.

Prior to the experiment, it was considered a possibility that performance would deteriorate during the week as a result of accumulated fatigue. This was found not to be the case as there was little difference in performance times between the days.

The statistically significant relationship between subject expectancy and actual performance may have been confounded by the expectancy question

being asked after, rather than before each trial. The quality of the actual performance might have influenced the subject's answers. If this was the case, then differences in performance times would be indicated as not being the result of expectancies.

The non-significant relationship found between the subject's ability to compare performance on successive trials and actual performance, suggested that the subject was unable to discriminate between the quality of successive performances.

The results of this study suggested that performance time in a 400 metre maximum effort swim would be improved if a task specific strategy was used as opposed to a voluntary distraction or unaided condition.

Chapter V

SUBJECT 2: RESULTS AND DISCUSSION

Baseline Stage

The subject swam in the unaided condition and established stable patterns of performance within nine trials (see Figure 4). Performance time ranged from 278 seconds to 297 seconds, and the mean performance time was 287.7 seconds.

Experimental Stage

The stability of the baseline was maintained throughout the experiment (see Figure 4). No difference in performances was indicated when the subject swam in the unaided or voluntary distraction conditions. Performances were better using the task specific strategy as opposed to the voluntary distraction and unaided conditions.

The percentage of time that the subject estimated he was able to concentrate on the content of the task specific and the voluntary distraction strategies for each trial, is illustrated in Figure 4. The time for both strategies was indicated as being the same. There was an increase in the subject's ability to concentrate on either strategy which suggested that no learning effect had taken place.

There was less discomfort experienced whilst performing under the voluntary distraction condition than under the task specific and unaided conditions. The discomfort experienced under the task specific and unaided conditions was indicated as being similar. Throughout the experimental stage, the subject reported discomfort as being painful during three trials. Two of these trials were in the unaided condition and were recorded as the fastest and slowest times and the highest

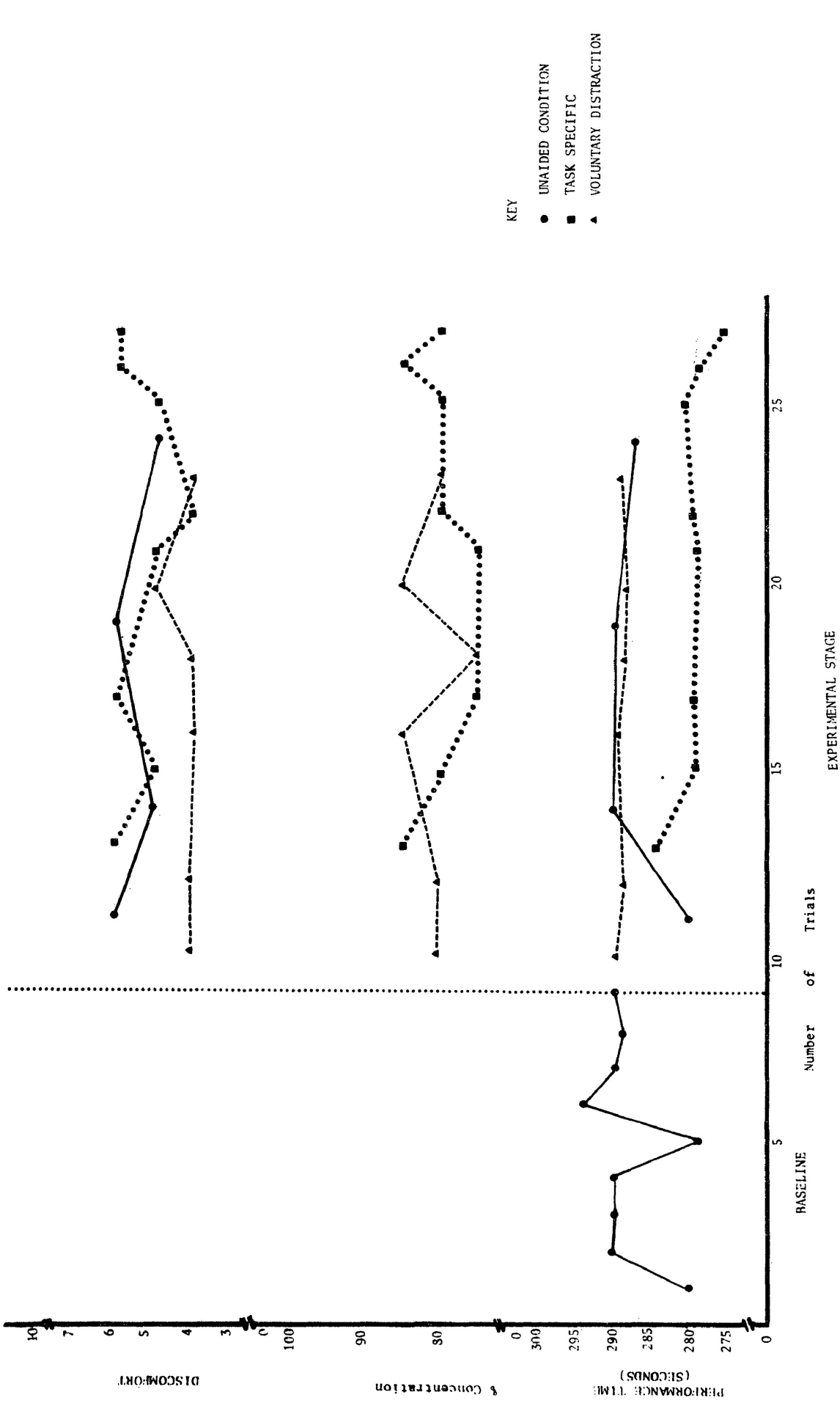


Figure 4. Performance time, estimated % concentration and estimated discomfort for subject 2.

discomfort ratings for that condition. In the other trial, the task specific strategy was used. The reported discomfort rating was the lowest and performance time was average for that condition.

Performance times for each day of the week showed Wednesday to have the most variation as well as the fastest time (see Figure 5). The largest difference in average times was 5.3 seconds. These results suggested that performances were not related to the day of the week. The sleeping and eating habits of the subject suggested that these variables also had no effect on performance times. The results of the posttest questionnaire indicated that no other factors prevented the subject from giving his best for each performance trial.

In the postexperiment questionnaire, the subject indicated a preference for the task specific strategy and rated this treatment condition to be the best and most effective for improving performance. The voluntary distraction and unaided conditions were rated second and third respectively. These impressions were supported by the data of the experiment.

The phi coefficient relating the subject's expectancy of performance to actual performance was non-significant ($r_\theta = 0.34$, $x^2 = 2.01$; df 1, $p > .05$). This result indicated that the subject's expectancy of performance was not related to actual performance.

The relationship between actual performance and the subject's assessment of whether he had performed better or worse than the previous trial, was found to be non-significant ($r_\theta = 0.45$, $x^2 = 3.55$; df 1, $p > .05$). This result indicated that the subject was unable to discriminate between the quality of successive performances.

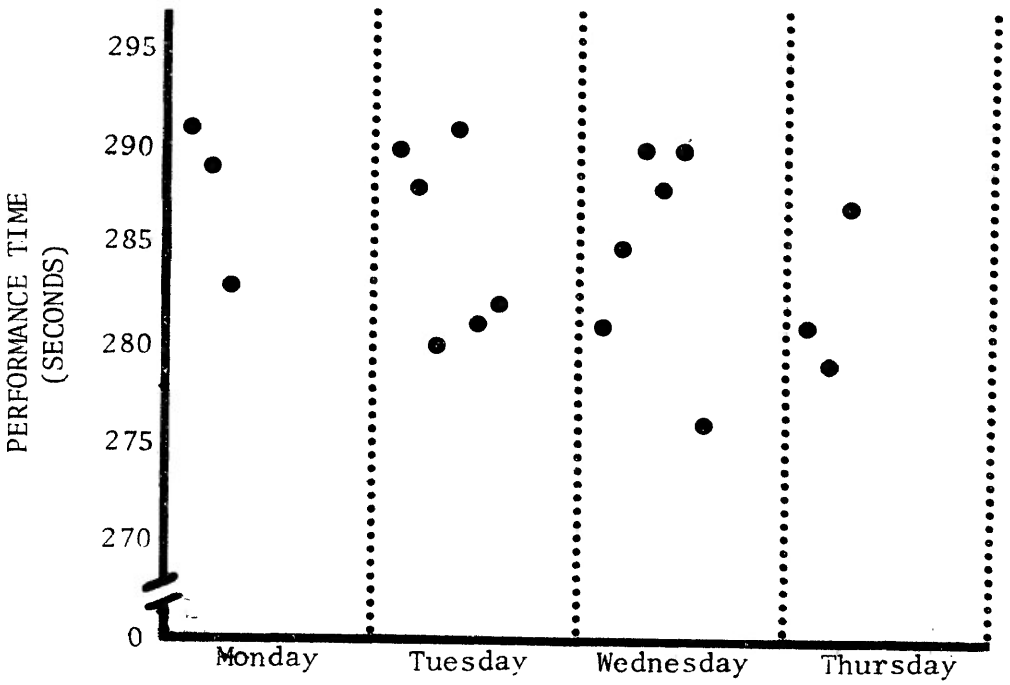


Figure 5. Performance time according to day of the week for Subject 2.

The experiment was terminated when it became obvious that there were differences between the task specific strategy and the two other treatment conditions.

Discussion

The results of this study indicated that performance times for a 400 metre maximum effort swim were superior using a task specific

strategy than a voluntary distraction or unaided condition. The results also indicated that performance times were similar using a voluntary distraction or unaided condition.

The stability of the baseline throughout the experimental stage suggested that improvements in performance times for the task specific strategy resulted from a real effect of this treatment condition. It is conceivable that these improvements resulted from the subject's attention to the task related aspects of performance. It would appear that the poorer performance times displayed using the voluntary distraction and unaided conditions suggested a lesser attention to these task related aspects.

A consistent level of concentration on the content of the task specific and voluntary distraction conditions was indicated. This suggested that no learning effect occurred during the experiment. The initial high levels displayed for both conditions may have accounted for this phenomenon as there was little margin for improvement.

The level of discomfort experienced during the 400 metre maximum effort swim would not appear to have limited the quality of performance. This was suggested from the high discomfort ratings and faster times recorded with the task specific strategy, and the lower discomfort ratings and slower times recorded with the voluntary distraction condition. This viewpoint was supported by the subject who reported a preference for the task specific strategy even though this was accompanied by the highest levels of discomfort.

The similar performance times indicated by the voluntary distraction and unaided conditions contrasted with the lower levels of discomfort experienced in the voluntary distraction condition. This suggested that

the voluntary distraction condition enabled the subject to dissociate more readily from the discomfort experienced. The fact that two out of the four swims in the unaided condition were reported as painful and there were no reports of pain using the voluntary distraction condition, would appear to support this observation.

The single report of pain using the task specific strategy appeared to be a rogue score, as the corresponding discomfort level was the lowest recorded for that condition. Furthermore, on the four trials when the discomfort rating was at its highest, no pain was reported. These four ratings were also identical to the two discomfort ratings reported as painful in the unaided condition. This suggested that the employment of the task specific strategy reduced the pain which accompanied the high levels of discomfort when no strategy was used.

Prior to the experiment, it was considered a possibility that performance would deteriorate during the week as a result of accumulated fatigue. This was found not to be the case as there was little difference in performance times between the days.

The non-significant relationship found between expectancy of performance and actual performance suggested that how the subject felt he would perform had little effect on actual performance. If this was the case then differences in performance times were not the result of expectancies. The non-significant relationship found between the subject's ability to compare successive trials and actual performance, suggested that the subject was not consistently capable of discriminating between the quality of successive performance trials.

The results of this study suggested that this subject was able to improve performance time in a 400 metre swim using a task specific strategy as opposed to a voluntary distraction or unaided condition.

Chapter VI

SUBJECT 3: RESULTS AND DISCUSSION

Baseline Stage

The subject swam in the unaided condition and established consistent levels of performance within seven trials (see Figure 6). Performance time ranged from 271 seconds to 282 seconds, and the mean performance time was 275.4 seconds.

Experimental Stage

At the beginning of the experimental stage, performance time under the unaided condition showed a dramatic increase from the baseline. These higher levels of performance were also evident for the other treatment conditions. No difference in performances was indicated for the three treatment conditions throughout the duration of the experimental stage.

The percentage of time that the subject estimated he was able to concentrate on the content of the task specific and the voluntary distraction strategies for each trial is illustrated in Figure 6. The results indicated there was no difference in the percentage of time the subject was able to concentrate on either of the two strategies. The subject's ability to concentrate on the two strategies was variable, and at the end of the experiment the values were higher than at the beginning. This indicated that a learning effect had taken place.

The subject's ratings of discomfort fluctuated over the course of the experiment (see Figure 6). There were no differences indicated between the three treatment conditions. Towards the end of the experiment the subject reported low values irrespective of treatment. The discomfort was

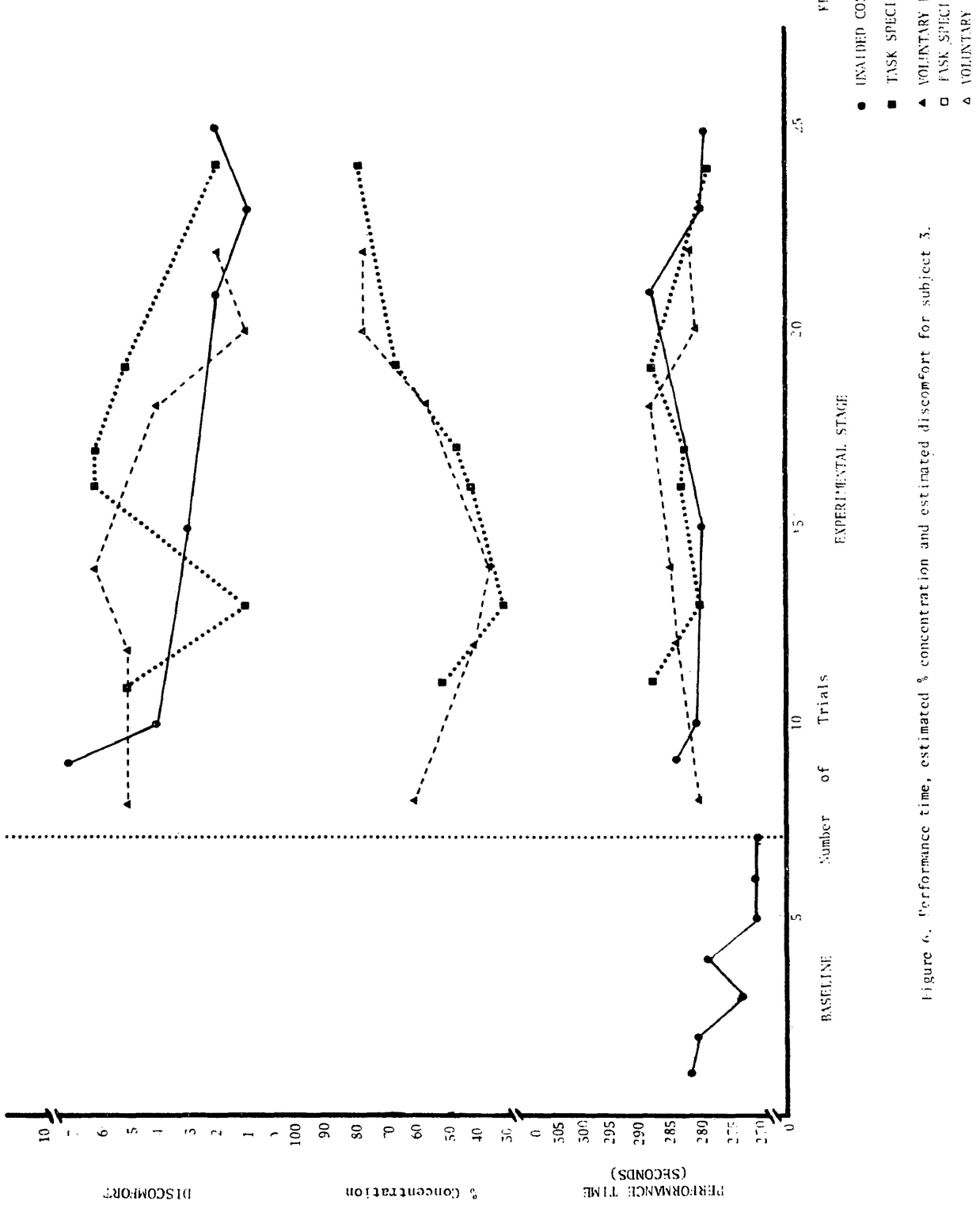


Figure 6. Performance time, estimated % concentration and estimated discomfort for subject 3.

reported as painful on the two final trials when the subject was ill. These two performance times of 292 seconds and 300 seconds were the slowest times recorded during the experimental stage.

Performance times for each day of the week showed that Tuesday had the largest variation in times. The greatest difference in average times was 3.6 seconds. These results indicated that performances were not related to day of the week (see Figure 7).

The effects of the subject's sleeping and eating habits on performance were evaluated from the posttest questionnaire. Of the seven trials when the subject estimated insufficient sleep, mean performance time was 282.8 seconds. This compared favourably with the mean performance time of 283.4 seconds on the eleven trials when the subject reported having sufficient sleep. Of the seven trials when the subject had eaten too much or too little, mean performance time was 284.7 seconds. The mean performance time of 281.7 seconds when the subject ate normally indicated a possible effect of eating habits on performance.

Of the seven occasions when other factors had prevented him from performing his best, e.g., sore shoulders, aching arms, mean performance time was 284.7 seconds. The mean performance time of 281.7 seconds for the eleven remaining trials indicated that performance could have been adversely affected by a number of extraneous variables.

The postexperiment questionnaire indicated a preference for the task specific strategy and rated this treatment condition to be the best and most effective for improving performance. The voluntary distraction and unaided conditions were rated second and third respectively. These impressions were not supported by the data of the experiment.

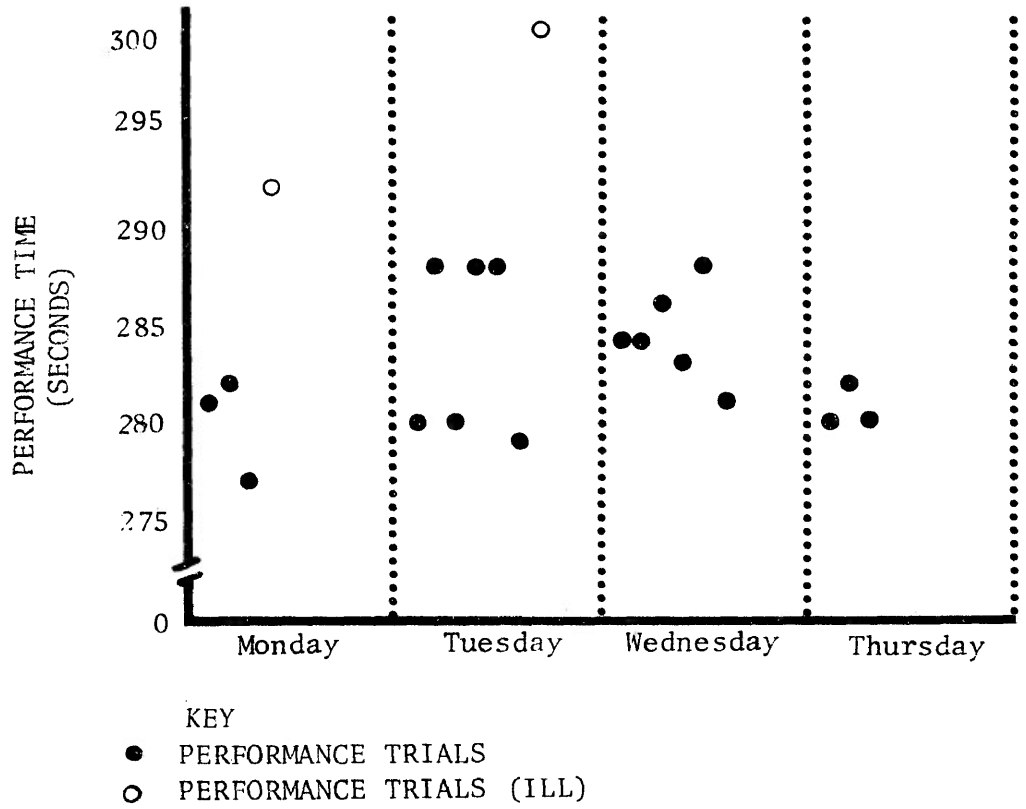


Figure 7. Performance time according to day of the week for Subject 3.

The phi coefficient relating the subject's expectancy of performance to actual performance was significant (r_θ = 0.50, x^2 = 4.86; df 1, $p < .05$). This result indicated that the subject's expectancies were related to actual performance.

The relationship between actual performance and the subject's assessment of performance was found to be significant (r_θ = 0.50, x^2 = 4.86; df 1, $p \leq .05$). This result indicated that the subject was able to discriminate between the quality of successive performances.

The experiment was terminated when it became obvious that there were no performance differences between the treatment conditions.

Discussion

The results of this study indicated that performance times for a 400 metre maximum effort swim would be similar irrespective of whether the subject employed a task specific, voluntary distraction or unaided condition.

The increase in performance time of the unaided condition at the start of the experimental stage, was presumably caused by extraneous variables outside the control of the experimenter. Such an occurrence is always a potential problem when dealing with human performance in a naturally occurring environment. The fact that these increases occurred in the other two treatment conditions indicated that all performances were affected by these unknown variables.

The results indicated an improvement during the later stages of the experiment in the amount of time the subject could concentrate on the content of the task specific and voluntary distraction conditions. This would suggest that a learning effect had taken place.

The variability in the levels of discomfort indicated by the results either suggested that these differences were real or that the subject was unable to discriminate correctly between the levels of discomfort experienced. Prior to the experiment, it was considered a possibility that lower levels of discomfort would be experienced using the voluntary distraction condition. This possibility was not evidenced with this subject. Pain levels did not appear to play a significant role in the 400 metre swim. On only two occasions was the discomfort experienced reported as painful, and those were when the subject was ill.

Before the start of the experiment, it was thought that performance might deteriorate during the week as a result of accumulated fatigue.

This was found not to be the case as there was little difference in performance times between the days.

The amount of sleep the subject received did not appear to play a significant role in performance time. In fact, the results indicated that performance times were marginally better when the subject reported insufficient sleep. This phenomenon might have been the result of a real difference, or possibly the subject's inability to discriminate between levels of sufficient sleep.

The subject's eating habits appeared to have affected performance times. This suggested a lack of consistency in the subject's preparation for the various performance trials involved in the experiment.

The occasions when the subject complained of sore arms and shoulders appeared to have adversely affected performance times. These injuries were real and not imagined, as the subject suffered two physical breakdowns during the experimental stage.

The significant relationship found between expectancy of performance and actual performance suggested that any performance differences might have been due, in part, to expectancies and not to the treatment conditions. However, this result may have been confounded by the expectancy question being asked after, rather than before each trial. The quality of the actual performance could therefore have influenced the subject's answers.

The significant relationship found between the subject's ability to compare performance on successive trials and actual performance, suggested that the subject was capable of discriminating between the quality of successive performance trials.

The results of this study showed no differences in performance times

irrespective of treatment condition. The inability to control a variety of extraneous variables such as eating habits, injury, and expectancy might account for the fact that no differences were observed.

Chapter VII

GENERAL DISCUSSION

The results of these studies indicated that performance times for subjects 1 and 2 were better using a task specific strategy than a voluntary distraction or unaided condition. The results also indicated that there were no differences in treatment effects for subject 3.

One of the major problems in the investigation of human performance is the control of extraneous variables within the sporting environment. This thesis was no exception. Real-life, uncontrolled factors might provide a possible explanation for the differences in results indicated between subjects 1 and 2, and subject 3. Although all three subjects achieved stable baseline levels, only subject 2 maintained that stability throughout the experiment. That instance indicated the effective control of extraneous variables and suggested that differences in performance times were the result of real differences between the treatment conditions. The results for subject 1 suggested a similar conclusion as the unaided condition reestablished baseline levels during the early stages of the experiment. The subsequent downward trend, which was also evident in the task specific and voluntary distraction strategies, suggested that any extraneous variables were having similar effects across all treatment conditions.

A control of extraneous variables was not; however, indicated for subject 3. During the experimental stage, the unaided condition never returned to baseline levels and large variations were indicated for all three strategy conditions. Inconsistent eating habits and constant reports of injury might have contributed to the absence of distinguishable

effects between the treatment conditions. Such factors were not evidenced with subjects 1 and 2 suggesting a possible explanation for the differing results. Although the experimental data for subjects 1 and 2 indicated a superiority of the task specific strategy over the other two conditions, clear differences over the unaided condition were only displayed by subject 2. The results of subject 1 indicated the task specific strategy was only marginally superior to the unaided condition. The presence of extraneous variables with subject 1, although it was indicated that the effects were similar across all three conditions, and their absence with subject 2, might have accounted for the differences in the magnitude of effect for the task specific condition. There was also the possibility that subject 1 employed aspects of the task specific strategy whilst performing in the unaided condition. However, such occurrences, if any, were never reported by this subject.

Differences between the task specific and voluntary distraction strategies were indicated for both subjects 1 and 2 for the duration of the experimental stage. The task specific strategy was indicated as being superior. These differences suggested that the successful implementation of the two strategies had contrary effects on performance. It was conceivable that the task specific strategy improved performance by allowing the subject to concentrate on the task-related aspects of performance. The voluntary distraction condition failed to improve or even degraded performances (subject 1), by seemingly dissociating from such task-related aspects. This impression is consistent with the interviews conducted by Moore (1976) with elite and non-elite marathoners.

The role that discomfort and pain played in the 400 metre maximum

effort swim is unclear. The marathoners interviewed by Moore reported that employment of cognitive strategies similar to those used in this experiment, effectively alleviated the discomfort and pain associated with distance events. Crossman (1977) and Selkirk (1980) investigated cognitive strategies in the laboratory setting and suggested similar results. With regard to these studies this investigator considered that performance might be improved in the 400 metre swim by employing cognitive strategies to reduce the accompanying pain and discomfort. However, the results indicated with subjects 1 and 2 suggested an opposite effect. When performances were improved using the task specific strategy, higher discomfort levels were indicated. When performances were unimproved or worsened whilst using the voluntary distraction condition, lower discomfort levels were indicated. This suggested that discomfort for these two subjects was not the major limiting factor in the 400 metre swim, but a possible consequence of improvements in the quality of performance.

This suggestion does not completely eliminate the likelihood that implementation of the task specific strategy might have a limiting effect on the increased discomfort associated with performance improvements. For subject 2 there were no discernible differences indicated between discomfort levels for the task specific and unaided conditions. However, performances in the task specific condition were noticeably better. This suggested that employment of the task specific strategy resulted in faster performance, and at the same time limited the increased discomfort to tolerable but noticeable levels. The possibility therefore exists that the task specific strategy could have performed a dual function. The inclusion of the "speed" and "explosive" words might have enabled the subject to swim faster. The concentration on the overall technical

content of the strategy might have permitted a dissociation from the resulting discomfort. These findings would suggest support for Selkirk (1980) and Moore (1976), who reported that the task specific strategy would seem to have the best potential for improving performance in athletic events.

The experimental data for subject 2 suggested the possibility that the voluntary distraction strategy alleviated some of the discomfort associated with performance, but with no corresponding improvements in performance times. There were no obvious differences in performance times between the voluntary distraction and unaided conditions, but the discomfort levels for the voluntary distraction condition were indicated at a consistently lower level. Moore reported similar effects with those non-elite marathoners who used this type of thought content. A high involvement in this condition was also displayed which is consistent with the findings of Jaremko (1978). Discomfort levels were lowered for subject 1 whilst using this condition. However, performance times were prolonged. This suggested that the low discomfort levels were an effect of reductions in the quality of performance, and not an alleviation of the discomfort involved.

The minimal reports for all three subjects of the discomfort being painful suggested that pain was not a significant factor in the performances. However, the results from subject 2 for the unaided and task specific condition, suggested that the successful implementation of the task specific strategy might prevent high levels of discomfort from being reported as a painful experience. This would be consistent with the findings of Spanos, Horton and Chaves (1975).

A learning effect was suggested for two out of the three subjects. Subject 1 displayed this effect for the task specific strategy, and subject 3 for both the task specific and voluntary distraction conditions. However, only subject 1 displayed a corresponding decline in performance time. This coincides with the view of Rushall (1979) who suggested that an athlete might require a number of trials to learn and effectively use mental rehearsal techniques. The fact that the data for subject 3 indicated no corresponding improvements in performance time might have been a consequence of the low levels of concentration reported in the early stages of the experiment. At no point did this subject achieve the levels of concentration indicated for the other two subjects. The fact that no learning effects were suggested for subject 2 might have resulted from the high levels of concentration achieved at the start of the experiment. The same conclusion was suggested for subject 1 in the voluntary distraction condition. The initial high levels of concentration indicated for both these subjects suggested a previous familiarity with both the task specific and voluntary distraction conditions.

Whichever day of the week the subjects performed did not appear to influence performance. This was an unexpected result. This investigator expected increases in performance times towards the later stages of the week as the effects of fatigue accumulated. Such an effect was not indicated .

All three subjects stated a preference for the task specific strategy and rated it the best and most effective for improving performance. For subjects 1 and 2 these preferences were related to the impressions by the experimental data. Although there was no similar relationship indicated for subject 3, it was an interesting observation that all three

subjects preferred a strategy containing task-related elements. These findings differed from those by Selkirk (1980) who reported that the majority of athletes in that study preferred the voluntary distraction condition. Selkirk did suggest that these preferences were possibly the result of previous familiarity with this condition, and that more trials using the task specific strategy might witness a change in subject preferences.

The effects of expectancies on actual performance were inconsistent across the three subjects. The non-significant result for subject 2 suggested that differences in performance times were the result of real differences in the treatment conditions, and not the subject's expectancies. There was the possibility that the differing effects of the treatment conditions suggested for subject 1, may have been masked by the subject's expectancies. A similar result was indicated for subject 3. The fact that the question "Did you expect to do better today than on your previous swim?", was asked after rather than before each trial, may have confounded the results of the expectancy factor. If this was the case, the quality of the performance trial may well have influenced the subject's answer.

The purpose of this thesis was to investigate the effects of cognitive strategies on swimming performance. At a practical level the study was aimed at producing permanent changes in the performance of swimmers who had the desire for improvement. The results of this study suggested that this purpose was achieved with two out of the three subjects, using the task specific strategy. This strategy would seemingly have the greatest potential for improving performance within the swimming environment.

Chapter VIII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This thesis investigated the effects of cognitive strategies on the performance of three male swimmers in a 400 metre maximum effort swimming task.

The independent variable was three forms of cognitive strategies used by the subjects. They were: (a) unaided; (b) task specific; and (c) voluntary distraction. The major dependent variable was the length of time it took each subject to perform a 400 metre swim.

The experiment consisted of three replications of a single subject design. This design consisted of two distinct stages. They were: (a) the baseline stage, when the performance time using the unaided condition of each subject was recorded until stability was reached; and (b) the experimental stage, when the two treatment conditions were applied as well as the maintenace of the original, unaided condition. One treatment per session was presented. Treatment conditions were randomized according to a 3 x 3 Latin square format. Where performance was indicated as being superior for one particular condition, then that condition was applied more frequently.

Posttest and postexperiment questionnaires were used to obtain information pertinent to the experiment. These observations and the performance times were visually inspected for trends.

It appeared that higher discomfort levels accompanied improvements in performance, and that pain was not apparently a limiting factor. A learning effect was also indicated for two of the three subjects.

All three subjects preferred the task specific strategy and considered it to be the best and most effective for improving performance. Expectancy of performance was suggested as a possible extraneous variable with two of the three subjects.

The experimental data indicated that the task specific strategy was effective in reducing performance time for two of the three subjects. No differences between the three treatment conditions were indicated for the other subject.

Conclusions

The results of this investigation suggested that the task specific strategy had the most potential for improving performance in a 400 metre swimming task. This was supported by the results of two of the three subjects and the preference by all subjects for that condition.

Prior to this investigation, it was assumed that cognitive strategies would improve performance by alleviating the pain and discomfort which accompanied a 400 metre swimming task. The data from this experiment contradicted that assertion. They indicated that the task specific strategy resulted in higher levels of discomfort. The results of subject 2 suggested that the task specific strategy was capable of a dual function--enabling the subject to swim faster and at the same time limiting the resulting increase in discomfort to tolerable levels. Coaches and future investigators should be aware of this possibility.

High levels of concentration would appear to be necessary to effectively implement the content of the task specific strategy. These levels may not be achieved when the strategy is first used, but might be achieved after a number of trials. Coaches should be cognizant of this

possible learning effect and have their swimmers practise strategy content prior to competition.

This thesis would offer some support to previous studies which suggested that the task specific strategy has the most potential for improving performance. Future investigations of this nature are therefore recommended.

Recommendations

This author recommends that:

1. Future studies control, record, and analyse the effects (if any), of the amount of rehearsal time spent on the cognitive strategies prior to each performance trial.

2. Questions related to the subject's expectancy of performance should be asked prior to and not after each performance trial.

3. The effects of cognitive strategies should be investigated over distances longer as well as shorter than the 400 metre swim used in this study.

4. Some consideration should be given to discovering those factors which were not measured in this study, but affect performances of this type.

References

Ball, S. T. & Vogler, R. E. Uncertain pain and the pain of uncertainty. Perceptual and Motor Skills, 1971, 33, 1195-1203.

Barber, T. X. Toward a theory of pain: relief of chronic pain by prefrontal leucotomy, opiates, placebos, and hypnosis. Psychological Bulletin, 1959, 56 (6), 430-460.

Barber, T. X. & Hahn, K. W. Physiological and subjective response to pain producing stimulation under hypnotically-suggested and waking-imagined "analgesia". Journal of Abnormal and Social Psychology, 1962, 65, 411-418.

Barlow, D. H. & Hayes, S. C. Alternating treatments design: one strategy for comparing the effects of two treatments in a single subject. Journal of Applied Behavior Analysis, 1979, 12, 199-210.

Beers, T. M. Cognitive factors in self-control. Dissertation Abstracts International, 1976, 37 (5-B), 2493-2494. (Abstract)

Beers, T. M. & Karoly, P. Cognitive strategies, expectancy, and coping style in the control of pain. Journal of Consulting and Clinical Psychology, 1979, 47 (1), 179-180.

Blitz, B. & Dinnerstein, A. J. Role of attentional focus in pain perception: manipulation of response to noxious stimulation by instructions. Journal of Abnormal Psychology, 1971, 77, 42-45.

Bobey, B. J. & Davidson, O. P. Psychological factors affecting pain tolerance. Journal of Psychosomatic Research, 1970, 14, 371-376.

Bowers, K. Pain, anxiety, and perceived control. Journal of Consulting and Clinical Psychology, 1968, 32, 596-602.

Bronzo, A. & Powers, G. Relationship of anxiety to pain threshold. Journal of Psychology, 1967, 66, 181-183.

Brown, R., Fader, K. & Barber, T. X. Responsiveness to pain: stimulus specificity versus generality. The Psychological Record, 1973, 23, 1-7.

Champion, D. J. Basic Statistics for Social Research. Scranton, Penn.: Chander, 1970.

Cautela, J. R. The use of covert conditioning in modifying pain behavior. Journal of Behavioral Therapy and Experimental Psychiatry, 1977, 8, 45-52.

Chaves, J. & Barber, T. X. Cognitive strategies, experimenter modelling, and expectation in the attenuation of pain. Journal of Abnormal Psychology, 1974, 83, 356-363.

Clarke, J. & Bindra, D. Individual differences in pain thresholds. Canadian Journal of Psychology, 1956, 10, 69-76.

Crossman, J. The effects of cognitive strategies on the performance of athletes. Unpublished Master's thesis, Lakehead University, 1977.

Davidson, P. O. & McDougall, E. The generality of pain tolerance. Journal of Psychosomatic Research, 1969, 13, 83-89.

Feurerstein, M. Specific and non-specific factors in the control of the analogue and clinical pain. Dissertation Abstracts International, 1978, 38 (8-B), 3876. (Abstract)

Gelfand, S. The relationship of experimental pain tolerance to pain threshold. Canadian Journal of Psychology, 1964, 18, 36-42.

Greene, R. J. Stimulus tolerance in hypnotic analgesia and imagination states. Dissertation Abstracts International, 1971, 31 (11-B), 6901. (Abstract)

Hall, K. R. L. & Stride, E. The varying response to pain in psychiatric disorders. A study of abnormal psychology. British Journal of Medical Psychology, 1954, 27, 48-60.

Hassett, J. Why dentists are a pain in the mind? Psychology Today, January, 1978, pp. 60; 63-65.

Hersen, M. & Barlow, D. H. Single case experimental designs: strategies for studying behavior change. Toronto: Pergammon Press, 1976.

Jaremko, M. F. Cognitive strategies in control of pain tolerance. Journal of Behavior Therapy and Experimental Psychiatry, 1978, 9 (3), 239-244.

Johnson, R. F. Q. Suggestions for pain reduction and response to cold-induced pain. The Psychological Record, 1974, 24, 161-169.

Kane, J. Cognitive aspect of performance. British Journal of Sports Medicine, 1979, 12, 201-207.

Levendusky, P. & Pankratz, L. Self-control technique as an alternative to pain medication. Journal of Abnormal Psychology, 1975, 84 (2), 165-168.

Lynn, R. & Eysenck, H. J. Tolerance for pain, extraversion, and neuroticism. Perceptual and Motor Skills, 1961, 12, 161-162.

Moore, K. Watching their steps. Sports Illustrated, May, 1976, pp. 80-84; 86; 89; 90.

Morgan, W. D. & Pollock, L. M. Psychologic characterization of the elite distance runner. Annals of the New York Academy of Sciences, 1977, 301, 382-403.

Nowlin, T. B. The relationship between experimental pain tolerance and personality traits among four athletic groups. Dissertation Abstracts International, 1974, 35 (2a), 874-875. (Abstract)

Peterson, L. The use of self-control procedure to minimize pain and anxiety in hospitalized children. Dissertation Abstracts International, 1978, 39 (6-B), 3000. (Abstract)

Ribstein-Blinchik, E. D. The treatment of chronic pain through the use of cognitive strategies. Dissertation Abstracts International, 1978, 39 (2-B), 996-997. (Abstract)

Rushall, B. S. Psyching in sport. London: Pelham, 1979.

Ryan, E. D. & Kovacic, C. Pain tolerance and athletic participation. Perceptual and Motor Skills, 1966, 22, 383-390.

Scott, D. S. & Barber, T. X. Cognitive control of pain: effects of multiple cognitive strategies. The Psychological Record, 1977, 27, 373-383.

Selkirk, R. The effects of cognitive strategies on running performance. Unpublished Master's thesis, Lakehead University, 1980.

Shephard, R. J. The Fit Athlete. New York: Oxford University Press, 1978.

Spanos, N., Horton, C. & Chaves, J. The effects of two cognitive strategies on pain threshold. Journal of Abnormal Psychology, 1975, 84, 677-681.

Spanos, H., Radtke-Bodorik, H., Ferguson, J., & Jones, B. The effect of hypnotic susceptibility, suggestions of analagesia, and the utilization of cognitive strategies on the reduction of pain. Journal of Abnormal Psychology, 1979, 88 (3), 282-292.

Staub, E. & Kellett, D. S. Increasing pain tolerance by information about aversive stimuli. Journal of Personality and Social Psychology, 1972, 21, 198-203.

Staub, E., Turksy, B. & Scharwtz, G. Self-control and predictability. Their effects on reaction to aversive stimulation. Journal of Personality and Social Psychology, 1971, 18, 157-162.

Sternbach, R. A. Pain: A psychophysiological analysis. New York: Academic Press, 1968.

Taylor, D. Human endurance: mind or muscle? British Journal of Sports Medicine, 1979, 12 (14), 179-184.

Walker, J. Pain distraction in athletes and non-athletes. Perceptual and Motor Skills, 1971, 33, 1187-1190.

APPENDIX A

Examples of Posttest Questionnaires

1) Unaided - first trial

2) Unaided - second and subsequent trials

3) Strategy - first trial

4) Strategy - second and subsequent trials

Example of Postexperiment questionnaire

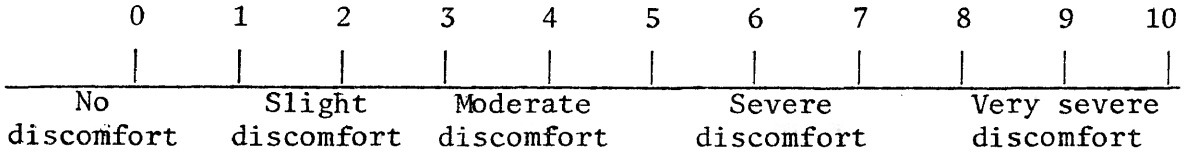
POSTTEST QUESTIONNAIRE (1)

Instructions: Please read and circle your response.

1. Did you: a) get enough sleep last night? YES NO

   b) eat too much or too little before this trial? YES NO

2. Rate yourself on the following scale as to the degree of discomfort you experienced during your swim.



3. Would you say your discomfort was painful? YES NO

4. Was there anything preventing you from performing your best today? If answer is "YES" please explain. YES NO

5. What were you thinking of during your swim today?

Name: _____

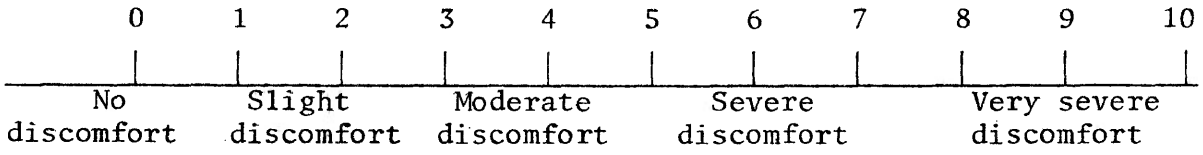
POSTTEST QUESTIONNAIRE (2)

Instructions: Please read and circle your response.

1. Did you: a) get enough sleep last night? YES NO

   b) eat too much or too little before this trial? YES NO

2. Rate yourself on the following scale as to the degree of discomfort you experienced during your swim today.



3. Would you say your discomfort was painful? YES NO

4. Did you expect to do better today than on your previous swim? YES NO

   Do you feel that you did do better today than on your previous swim? YES NO

5. Was there anything preventing you from performing your best today? If answer is "YES" please explain. YES NO

6. What were you thinking about during your swim today?

Name: _____

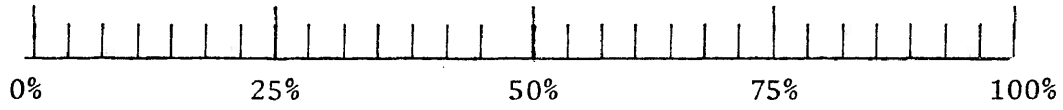
POSTTEST QUESTIONNAIRE (3)

Instructions: Please read and circle your response.

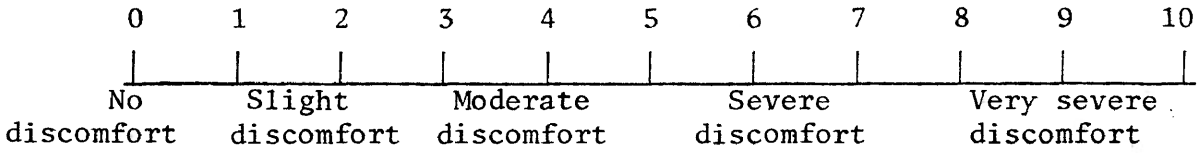
1. Did you: a) get enough sleep last night? YES NO

   b) eat too much or too little before this trial? YES NO

2. Rate yourself on the following scale as to the percent of time you were able to think of the content that you prepared.



3. Rate yourself on the following scale as to the degree of discomfort you experienced during your swim today?



4. Would you say your discomfort was painful? YES NO

5. Was there anything preventing you from performing your best today? If answer is "YES" please explain. YES NO

Name: _____

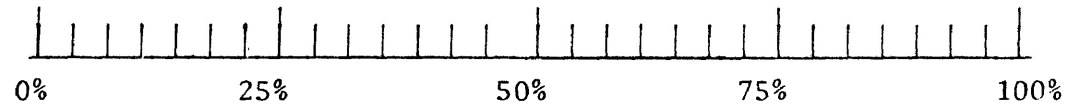
POSTTEST QUESTIONNAIRE (4)

Instructions: Please read and circle your response.

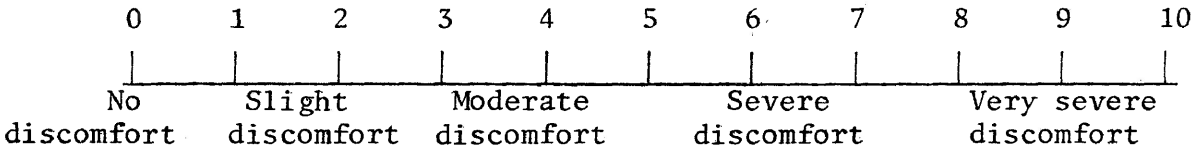
1. Did you: a) get enough sleep last night? YES NO

   b) eat too much or too little before this trial? YES NO

2. Rate yourself on the following scale as to the percent of the time you were able to think of the content that you prepared.



3. Rate yourself on the following scale as to the degree of discomfort you experienced during your swim today.



4. Would you say your discomfort was painful? YES NO

5. Did you expect to do better today than on your previous swim? YES NO

   Do you feel that you did do better today than on your previous swim? YES NO

6. Was there anything preventing you from performing your best today? If answer is "YES" please explain. YES NO

Name: _____

POSTEXPERIMENT QUESTIONNAIRE

Name: _____

Instructions: Please answer the following questions carefully. Take some time to think over your answer.

During your 400 metre maximum effort swims you were asked to think of different things while you swam. You were instructed to:

A. Perform your warm-up, and following a brief rest, begin your 400 metre swim. (Unaided)

B. Perform your warm-up, and following a brief rest, begin your 400 metre swim. During this swim concentrate entirely on your swimming, technique and 'power' words. (Task Specific)

C. Perform your warm-up, and following a brief rest, begin your 400 metre swim. During this swim think of things that will take your mind away from your swimming, but do not concentrate on your swimming technique. (Voluntary Distraction)

1. Which of the three conditions did you prefer? Why?

2. Which of the three conditions did you feel was the best for improving your swim time?

3. List in order from most effective (1) to least effective (3) the conditions that improved your performance.

   ( ) Unaided ( ) Task Specific ( ) Voluntary Distraction

4. Write down anything that you feel would be of value for me to know regarding your participation in this experiment.

APPENDIX B

Instructions for unaided condition.

Instructions for employment of voluntary distraction strategy.

Instructions for employment of task specific strategy.

INSTRUCTIONS

During the next few weeks you will be asked to swim a 400 metre maximum effort using one of three different thought strategies. These will be called: 1) unaided condition

2) task specific strategy

3) voluntary distraction strategy.

1) Unaided condition: In the unaided condition you will perform your standard 10 minute warm-up. Following a brief rest you will start your 400 metre swim.

2) Task specific strategy: In the task specific strategy condition you will perform your standard 10 minute warm-up. Following a brief rest you will start your 400 metre swim. During this swim you will focus your attention and concentrate entirely on your swimming technique combined with going faster. As you swim always think of your technique and going faster. For your entire swim concentrate on your arm action, head position, body alignment, breathing and kicking action and words associated with going faster, e.g. blast, explode, etc. Remember, you are to think only of your technique and going faster. Concentrate, at all times, on rhythm, arm action, breathing, power, speed, and any other features of your technique with which you are familiar.

3) Voluntary distraction strategy: In the voluntary distraction strategy condition you will perform your standard 10 minute warm-up. Following a brief rest you will start your 400 metre swim. During this swim you will think of things that will take your mind away from your swimming. Please do not concentrate on your technique as in the task specific situation. Think of anything you wish that will distract you from your swimming. You may sing, count, recite poetry, or think of anything you wish, except your swimming.

APPENDIX C

Examples of phrases and words for task specific strategy.

Example of phrases and words for voluntary distraction strategy

TASK SPECIFIC STRATEGY

Instructions: Using the following words and any others you can think of, write down statements you will concentrate on during your swim.

Key Words:			
	start	hand, arm, shoulder positions	blast
	turns	streamlining	explode off the turns
	arm action	head position	speed
	stroke length	kicking	faster
	breathing	rhythm	pull harder

Note: Plan enough content to fill the entire swim. Ideas can be repeated.

VOLUNTARY DISTRACTION STRATEGY

Instructions: Using the following ideas or any others you can think of, write down statements you will concentrate on during your swim.

Ideas:

singing	recite poetry
counting	skiing
games	T.V.

Note: Plan enough content to fill the entire swim. Ideas can be repeated. Do not concentrate on your swimming technique as you did in the task specific situation.

APPENDIX D

Sample sheet for recording performance information

NAME: _____

EVENT: _____

DATE	POOL TEMP.	STRATEGY	PREP. TIME	400 m. TIME	EST. % CONC.	DISCOM-FORT	EXPEC-TATION	COMMENTS

APPENDIX E

Table of performance times for the pilot study and baseline stage for subject 1

Table of performance times for the baseline stages for subjects 2 and 3

Table of performance times for the pilot study and the baseline stage for subject 1.

PILOT STUDY

Trials	Date	400 metre time (seconds)
1	08/12/80	287
2	09/12/80	288
3	10/12/80	286
4	11/12/80	287
5	15/12/80	288
6	16/12/80	286
7	17/12/80	285
8	18/12/80	287

BASELINE STAGE

Trials	Date	400 metre time (seconds)
1	06/01/81	286
2	07/01/81	286
3	08/01/81	286
4	12/01/81	287
5	13/01/81	285
6	14/01/81	286
7	15/01/81	286

Table of performance times during the baseline stage for subject 2 and subject 3.

	Trials	Date	400 metre time (seconds)
Subject 2	1	07/01/81	280
	2	08/01/81	290
	3	09/01/81	289
	4	14/01/81	289
	5	15/01/81	278
	6	20/01/81	297
	7	21/01/81	289
	8	22/01/81	288
	9	26/01/81	289
Subject 3	1	06/01/81	282
	2	07/01/81	281
	3	08/01/81	273
	4	08/01/81	279
	5	13/01/81	271
	6	14/01/81	271
	7	15/01/81	271

APPENDIX F

Table of results of posttest and postexperiment questionnaires for each trial and treatment condition for subjects 1, 2, and 3

Table of results of posttest and postexperiment questionnaires for each trial and treatment condition for subject 1.

Trials	Date	Day	Treatment condition	400 metre time (seconds)	A	B	C	D	E	F	G	H	I
1	20/01/81	T	T.S.	287	75	5 (no)	N/A	N/A	Yes	No	No	T.S.	T.S.
2	21/01/81	W	V.D.	290	90	4 (no)	N/N	N/N	Yes	No	No		U
3	22/01/81	Th	U	293	N/A	6 (no)	Y/N	Y/N	Yes	No	No		V.D.
4	26/01/81	M	V.D.	291	95	4 (no)	N/Y	N/Y	Yes	No	No		
5	27/01/81	T	U	290	N/A	2 (no)	Y/Y	N/Y	Yes	No	No		
6	28/01/81	W	T.S.	282	80	6 (no)	Y/Y	Y/Y	Yes	No	No		
7	03/02/81	T	U	287	N/A	5 (no)	N/N	Y/N	Yes	No	No		
8	04/02/81	W	T.S.	286	80	6 (no)	N/Y	N/Y	Yes	No	No		
9	05/02/81	Th	V.D.	289	85	5 (no)	N/N	N/N	Yes	No	No		
10	09/02/81	M	T.S.	286	75	5 (no)	Y/Y	N/Y	Yes	No	No		
11	10/02/81	T	V.D.	297	95	4 (no)	N/N	N/N	Yes	No	No		
12	11/02/81	W	U	295	N/A	7 (yes)	N/Y	N/Y	Yes	No	Injured		
13	12/02/81	Th	V.D.	299	95	7 (no)	N/N	N/N	Yes	No	Injured		
14	16/02/81	M	U	285	N/A	5 (no)	Y/Y	Y/Y	Yes	No	No		
15	18/02/81	W	T.S.	296	80	7 (no)	N/N	N/N	Yes	No	Sick		
16	19/02/81	Th	T.S.	295	80	6 (no)	Y/Y	Y/Y	Yes	No	Sick		
17	23/02/81	M	V.D.	284	90	5 (no)	Y/Y	Y/Y	Yes	No	No		
18	24/02/81	T	T.S.	284	85	5 (no)	Y/N	Y/N	Yes	No	No		
19	25/02/81	W	T.S.	283	80	4 (no)	Y/Y	Y/Y	Yes	No	No		

CONTINUED ON NEXT PAGE

Table of results of posttest and postexperiment questionnaires for each trial and treatment condition for subject 1 (continued).

Trials	Date	Day	Treatment condition	400 metre time (seconds)	A	B	C	D	E	F	G
20	26/02/81	Th	V.D.	288	90	4 (no)	N/N	N/N	Yes	No	No
21	02/03/81	M	U	282	N/A	5 (no)	Y/Y	Y/Y	Yes	No	No
22	03/03/81	T	T.S.	281	80	7 (no)	Y/Y	Y/Y	Yes	No	No
23	04/03/81	W	V.D.	281	95	5 (no)	N/Y	Y/Y	Yes	No	No
24	05/03/81	Th	T.S.	279	85	6 (no)	N/Y	Y/Y	Yes	No	No
25	09/03/81	M	T.S.	279	85	4 (no)	Y/N	Y/N	Yes	No	No
26	10/03/81	T	V.D.	289	90	3 (no)	N/N	N/N	Yes	No	No
27	11/03/81	W	T.S.	284	85	5 (no)	Y/Y	Y/Y	Yes	No	No
28	12/03/81	Th	T.S.	277	90	5 (no)	Y/Y	Y/Y	Yes	No	No
29	16/03/81	M	T.S.	278	85	3 (no)	Y/N	Y/N	Yes	No	No
30	17/03/81	T	T.S.	276	90	4 (no)	Y/Y	Y/Y	Yes	No	No

KEY ON PAGE 77

Table of results of posttest and postexperiment questionnaires for each trial and treatment condition for subject 2.

Trials	Date	Day	Treatment condition	400 metre time (seconds)	A	B	C	D	E	F	G	H	I
1	27/01/81	T	V.D.	290	80	4 (no)	N/A	N/A	Yes	No	No	T.S.	T.S.
2	28/01/81	W	U	281	N/A	6 (yes)	N/N	Y/Y	Yes	No	No		U
3	03/02/81	T	V.D.	288	80	4 (no)	N/N	Y/N	Yes	No	No		V.D.
4	04/02/81	W	T.S.	285	85	6 (no)	N/Y	Y/Y	Yes	No	No		
5	08/02/81	M	U	291	N/A	5 (no)	N/N	N/N	Yes	No	No		
6	09/02/81	T	T.S.	280	80	5 (no)	N/Y	N/N	Yes	No	No		
7	10/02/81	W	V.D.	290	85	4 (no)	N/N	N/N	Yes	No	No		
8	11/02/81	Th	T.S.	281	75	6 (no)	N/Y	Y/Y	Yes	No	No		
9	16/02/81	M	V.D.	289	75	4 (no)	N/N	N/N	Yes	No	No		
10	17/02/81	T	U	291	N/A	6 (yes)	N/N	N/N	Yes	No	No		
11	18/02/81	W	V.D.	288	85	5 (no)	N/Y	N/Y	Yes	No	No		
12	19/02/81	Th	T.S.	279	75	5 (no)	Y/Y	Y/Y	Yes	No	No		
13	24/02/81	T	T.S.	281	80	4 (yes)	N/N	N/N	Yes	No	No		
14	25/02/81	W	V.D.	290	80	4 (no)	N/N	N/N	Yes	No	No		
15	26/02/81	Th	U	287	N/A	5 (no)	N/Y	N/Y	Yes	No	No		
16	02/03/81	M	T.S.	283	80	5 (no)	Y/Y	Y/Y	Yes	No	No		
17	03/03/81	T	T.S.	282	85	6 (no)	N/Y	N/Y	Yes	No	No		
18	04/03/81	W	T.S.	276	80	6 (no)	N/Y	N/Y	Yes	No	No		

KEY ON PAGE 77

Table of Results of posttest and postexperiment questionnaires for each trial and treatment condition for subject 3.

Trials	Date	Day	Treatment condition	400 metre time (seconds)	A	B	C	D	E	F	G	H	I
1	20/01/81	T	V.D.	280	60	5 (no)	N/A	N/A	Yes	Yes	No	T.S.	T.S.
2	21/01/81	W	U	284	N/A	7 (no)	N/N	N/N	No	Yes	Yes		V.D.
3	26/01/81	M	U	281	N/A	4 (no)	Y/Y	Y/Y	No	No	Yes		U
4	27/01/81	T	T.S.	288	50	5 (no)	N/N	N/N	Yes	Yes	Yes		
5	28/01/81	W	V.D.	284	50	5 (no)	N/Y	N/Y	No	Yes	Yes		
6	03/02/81	T	T.S.	280	30	1 (no)	Y/Y	Y/Y	No	No	No		
7	04/02/81	W	V.D.	286	35	6 (no)	N/N	N/N	Yes	Yes	Yes		
8	05/02/81	Th	U	280	N/A	3 (no)	Y/Y	N/Y	Yes	No	No		
9	11/02/81	W	T.S.	283	40	6 (no)	N/N	N/N	Yes	Yes	No		
10	16/02/81	M	T.S.	282	45	6 (no)	N/Y	N/Y	No	No	Yes		
11	17/02/81	T	V.D.	288	55	4 (no)	N/N	N/N	Yes	No	No		
12	18/02/81	W	T.S.	288	65	5 (no)	Y/Y	N/Y	Yes	No	Yes		
13	19/02/81	Th	V.D.	283	75	1 (no)	Y/Y	Y/Y	Yes	No	No		
14	23/02/81	T	U	288	N/A	2 (no)	N/N	N/N	No	Yes	No		
15	25/02/81	W	V.D.	281	75	2 (no)	N/Y	Y/Y	No	No	No		
16	26/02/81	Th	U	280	N/A	1 (no)	Y/Y	Y/Y	Yes	No	No		
17	02/03/81	M	T.S.	277	75	2 (no)	N/Y	Y/Y	Yes	No	No		
18	03/03/81	T	U	279	N/A	2 (no)	Y/N	Y/N	Yes	No	No		
19	09/03/81	M	T.S.	292	75	5 (yes)	N/N	N/N	No	No	Sick		
20	10/03/81	T	V.D.	300	50	7 (yes)	N/N	N/N	Yes	No	Sick		

KEY ON PAGE 77

Key for preceding tables in Appendix F.

A. The subject's estimate of the percentage of the performance time that he was able to concentrate on the assigned strategy.

B. The subject's estimate of the degree of discomfort experienced and the interpretation of that discomfort as painful (yes or no).

C. The subject's expectation compared to the performance result (e.g., expected to do better but did not).

D. The subject's assessment of whether he performed better compared to the performance result (e.g., stated he did perform better but did not).

E. Whether the subject had enough sleep the night before the trial.

F. Whether the subject ate too much or too little before the trial.

G. Whether the subject indicated any other factors (e.g., sore or stiff muscles) that prevented his best performance.

H. Subject's preferred condition.

I. Subject's ordering of treatment conditions according to effect on performance.

T.S. - Task specific

V.D. - Voluntary distraction

U - Unaided condition

M - Monday

T - Tuesday

W - Wednesday

Th - Thursday

APPENDIX G

Tabulated values of performance time according to day of the week for subjects 1, 2, and 3

Tabulated values of performance time (seconds) according to day of the week.

		Monday	Tuesday	Wednesday	Thursday
Subject 1	Number of trials	7	8	6	5
	Average time	284.7	286.3	284.3	285.2
	Slowest time	291	297	290	293
	Fastest time	278	276	281	277
	Variation in time	13	21	9	16
Subject 2	Number of trials	3	6	6	3
	Average time	287.6	285.3	285.0	282.3
	Slowest time	291	291	290	287
	Fastest time	283	280	276	279
	Variation in time	8	11	4	8
Subject 3	Number of trials	3	6	6	3
	Average time	280.0	283.8	284.3	280.6
	Slowest time	282	288	288	282
	Fastest time	277	279	281	280
	Variation in time	5	9	7	2