THE EFFECTS OF COGNITIVE STRATEGIES ON ERGOMETER PERFORMANCE OF FEMALE ROWERS

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

ELIZABETH L. McKINNON ©

1985

Acknowledgments

I would like to express my sincere thanks and appreciation to Dr. Brent Rushall for his encouragement and his undying patience during the course of this study. His insight and guidance were always within reach.

I would also like to deeply thank the four subjects who participated in the study. Neither snowstorms nor Christmas holidays could keep them from the lab. Their cooperation was greatly appreciated.

Abstract

The purpose of this study was to examine the effects of cognitive strategies on the performance of four female rowers. The independent variables were the three strategy conditions. The major dependent variable was the total number of revolutions of the ergometer flywheel per three minutes. The minor dependent variables were the total number of strokes completed per three minutes and the stroke efficiency for each trial. Several other variables were studied from information collected on pretest, posttest, and postexperiment questionnaires. Four replications of a single subject alternating treatments design were used. The responses of the athletes to the utilization of the strategies was very individual. Two of the four subjects performed best under the task specific strategy. Higher stroke rating was linked to superior performances. Three of the subjects had their highest stroke ratings with their most successful condition. Stroke efficiency did not appear to be related to performance. The percentage of time the subject felt she was able to concentrate on the strategy, the degree of discomfort perceived, and the perception of the trial as painful or non-painful all appeared to have no relationship with performance. The subjects generally performed best under their preferred condition, and generally perceived that condition to be the most effective for improving their rowing performance. The number of factors influencing each athlete's performance varied greatly.

Table of Contents

Table of Contents (cont'd.)

List of Figures

Figure

CHAPTER I

Introduction

Statement of Purpose

The purpose of this study was to examine the effects of cognitive strategies on ergometer performance in female rowers.

Significance of the Study

As athletic performances improve and physical training becomes increasingly demanding, coaches and athletes are continually looking for ways to ensure that they get the best possible result during each competition. It is now evident that the proper psychological preparation is as important as the proper physiological training. One area of psychological preparation that is being seriously explored is the use of cognitive strategies during the performance of an athletic event.

Studies have been done examining the effects of cognitive strategies on running performance (Crossman, 1977; Selkirk, 1980), and swimming performance (Chorkawy, 1982; Ford, 1983). This study was a replication and extension of these studies in a new environment, rowing on a rowing ergometer. This had the value of determining if what was found in swimming and running was appropriate for rowing. It was also original in investigating new parameters.

Previous studies have had dependent variables of time to complete a fixed distance (Chorkawy, 1982; Ford, 1983) and time to exhaustion in a maximum effort run (Crossman, 1977; Selkirk, 1980). This study was original in looking at a fixed time task. The major dependent variable was work output in a three minute time period.

The manner in which the task was performed was analysed, as well. The number of actions completed in the fixed time for the varying conditions were examined to determine if there were any differences in this area of performance.

Another original variable examined was the quality of performance under each of the treatment conditions. An estimate of the efficiency of each action was calculated by dividing the athlete's overall efficency by the total number of strokes. This allowed a comparison between the quality and the quantity, or total output, for each of the conditions. Coaches could find this value to be useful for intersubject comparisons.

The previous studies in this area have used experienced athletes as subjects. In this study novice athletes were used as subjects to determine if cognitive strategies could be successfully employed to improve performance in less-skilled athletes.

Significant results from this study could be useful to both athletes and coaches for increasing performance. The results could have practical implications for altering overall performance, the manner of the performance, and/or the quality of the performance.

This study was also undertaken to satisfy the investigator's curiosity in this area.

Delimitations

This study was delimited to testing four female rowers on a three minute maximum effort row on a rowing ergometer. The subjects' ages ranged from 19 to 25 years. The rowers were at the novice to intermediate level.

The independent variables were the three cognitive strategies employed by the rowers. These strategies were: a) unaided, b) task specific, and c) voluntary distraction. These strategies were selected because of their successful use in past studies (Crossman, 1977; Selkirk, 1980; Chorkawy, 1982; Ford, 1983).

The major dependent variable was the total revolutions of the ergometer flywheel per three minutes. The minor dependent variables were the total number of strokes per three minutes, and the overall stroke efficiency for each trial.

Limitations

This study was limited to the following assumptions: a) the subjects were able to understand and plan the strategies, b) the strategies were employed as planned, c) any changes in performance were due to experimental variables, d) the rowing ergometer was reliable, e) the unaided condition served as a calibration and reliability check, f) stability for a condition occurred when four successive trials under the same condition fell within 50 revolutions of the flywheel (approximately 3%), and g) an effect occurred when one strategy was superior to the other two strategies in four successive blocks.

Definitions

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

Task Specific Strategy refers to the instructed plan which involved total concentration on technique and commands 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 the numerous uninstructed self-chosen plans such as counting backwards, goal-setting, or singing, as a thought control procedure during an athletic feat (Selkirk, 1980).

Pain Tolerance refers to the ability to endure the physical and physiological noxious stimuli which result from a maximal athletic performance (Selkirk, 1980).

Maximum Effort refers to the highest degree of effort that can be given during the performance of a three minute row.

Work Output refers to the number of revolutions of the flywheel that a rower can complete in a three minute row.

Efficiency refers to the number of revolutions of the flywheel per minute multiplied by the load, divided by the subject's weight.

Stroke Efficiency refers to the efficiency divided by the number of strokes per minute.

CHAPTER II

Review of Literature

Pain

Pain is something with which everyone is familiar. However, it is difficult to determine if one person's concept of pain is the same as another person's. Steinbach (1968) described pain as "an abstract concept which refers to (1) a personal, private sensation of hurt; (2) a harmful stimulus which signals current or impending tissue damage; (3) a pattern of responses which operates to protect the organism from harm" (p. 12).

Cautela (1977) conceptualized pain as a response with one or more of the following characteristics: a verbal report of pain, behavioural expressions such as moaning, groaning, or grimacing, and avoidance of stimuli perceived as noxious by the subject. The relevance of pain research in rowing is upheld by this concept of pain as all three of these characteristics are typical responses to a maximum effort row. In the sporting world pain is often known as 'discomfort'.

Pain threshold and pain tolerance are two parameters of experimentally induced human pain responses. Wolff (1971) defined pain threshold as the minimum pain level, or the point at which pain is just perceived. He defined pain tolerance as the maximum pain level, or the point at which one can no longer voluntarily tolerate the pain and withdrawal from the painful stimulus occurs. Gelfand (1964) found a low correlation betwween pain threshold and pain tolerance. Scott and Barber (1977a) concluded that pain tolerance can be changed more easily than the perception of pain or the distress caused by it.

There are varying opinions on the generalization of pain tolerance with differing types of noxious stimuli, such as pressure, shock, cold, and heat. Ryan and Kovacic (1966) found a high correlation between two measures of pain tolerance, gross pressure and muscle ischemia. Scott and Barber (1977b) found that subjects had similar responses to the pain stimuli of cold and pressure. Davidson and McDougall (1969) compared the pain tolerances of subjects to four pain stimuli, pressure, shock, cold, and radiant heat. While a correlation existed between pressure and cold, and between pressure and shock, their results indicated no consistent generalization of pain tolerance.

Attitudinal differences between subjects can account for a great part of the differences in pain tolerance between individuals (Clarke & Bindra, 1956; Hall & Stride, 1954). Zborowski (1952) stated that pain expectancy and pain acceptance, two culturally determined attitudes, are important to differences in pain response. People can sometimes be labelled as augmenters, those who exaggerate or overestimate their response to pain, or as reducers, those who inhibit their response and are more tolerant of pain (Neufeld & Davidson, 1971; Shephard, 1978). Shephard noted that athletes tend to be reducers.

Athletes have been found to have significantly higher pain tolerances than non-athletes, although the two groups do not differ significantly on measures of pain threshold (Ryan & Kovacic, 1966; Walker, 1970, 1971). Ryan and Kovacic also found that contact athletes had significantly higher tolerances than non-contact athletes who, inturn, had significantly higher tolerances than non athletes. However, Ellison and Greischlag (1975) found no difference in the pain tolerance of athletes and non-

athletes. Scott and Barber (1977b) found no differences in the responses of males and females to pain stimuli.

Pain has been described as having three domains, psychological, physiological, and behavioural (Davidson & Neufeld, 1974). In many sports the physiological pain may be attributable to discomforting levels of fatigue caused primarily by high levels of lactic acidosis (NCCP, 1981). This fatigue manifests itself in a reduced work capacity (Yakovlev, 1979). Total body fatigue may be caused by a combination of low blood glucose levels, liver glycogen depletion, dehydration, loss of body electrolytes, and high body temperature (Fox, 1979).

Altering the Perception of Pain

The perception of pain can be affected by psychological factors. Blitz and Dinnerstein (1971) stated that the experience of pain may be affected by motivational, perceptual, and cognitive processes. This is demonstrated by the 'placebo effect'(Zimbardo, Cohen, Weisenberg, Dworkin, & Firestone, 1966). Cautela (1977) found subjects could alleviate pain through covert conditioning.

Pain can be manipulated by attentional and cognitive processes (Blitz & Dinnerstein, 1971; Brucato, 1978; Gelfand, 1964; Turk, 1978). These processes can take many forms. Research has shown some of these to be successful and others not. Hypnotically suggested analgesia was effective in reducing pain reactivity, but no more so than waking imagined analgesia (Barber & Hahn, 1962). Relaxation was found to be more effective than rehearsal in increasing pain tolerance (Bobey & Davidson, 1970; Davidson & Neufeld, 1974). Subject

control over the pain stimulus resulted in increased pain tolerance (Ball & Volger, 1971; Kanfer & Goldfoot, 1966; Staub, Tursky, & Schwartz, 1971). Pain tolerance increased when the subject was given knowledge about the stimulus apparatus and sensation (Staub & Kellett, 1972). Chaves and Barber (1974) found that an expectation of pain reduction did result in a reduction of pain but experimenter modelling was ineffective in reducing pain. Walker (1971) found that distraction did not raise pain tolerance.

Imaging ability was shown to have an effect on pain perception. Subjects who scored higher on imaging abilities measures had higher pain tolerances than low scorers (Anderson, 1975). Subjects who were highly involved in their imagings had greater increases in their pain thresholds than those who were not highly involved in their imagings (Spanos, Horton, & Chaves, 1975).

The National Coaching Certification Program (NCCP, 1981) states that athletes are better able to cope with the pain of fatigue "if they are aware of its severity and the sensations which accompany it, if they are willing to recognize when it will occur, and if they have a strategy for handling it when it occurs" (p. 12-8).

Cognitive Strategies

Cognitive strategies are prepared plans of thinking. Crossman (1977) described them as consistent forms of thinking. According to Rushall (1979), cognitive strategies serve two major purposes. The first is to develop and supply enough information and mental activities to keep the athlete concentrating on task relevant thoughts

for the entire duration of the competition. The second purpose is to have mental activities preplanned so stress is reduced. Cognitive strategies have also been found to increase athletic performance (Chorkawy, 1982; Selkirk, 1980; Ford, 1983).

The various types of cognitive strategies are known by many names. However, some have similar characteristics. There are four main groups of strategies.

The first group includes voluntary distraction (Selkirk, 1980), task irrelevant (Beers & Karoly, 1979), reversal (Jaremko, 1978), and dissociation (Morgan, 1980). The content of strategies in this group includes ideas that are irrelevant to the task to be performed. The purpose of these strategies is to distract the athletes from the task as a way of coping with the pain and discomfort (Morgan, 1980). Examples of this type of strategy may include singing or counting while swimming (Chorkawy, 1982), or building an imaginary house from start to finish during a marathon run (Morgan, 1980).

The second group of strategies includes task specific (Rushall, 1982), rational thinking (Beers & Karoly, 1979; Jaremko, 1978), association (Morgan, 1980), and attentional focus (Weinberg, Gould, & Jackson, 1980). As the name implies, the content of a task specific strategy is completely relevant to the desired behaviour. The content of strategies in this group includes ideas that are directly associated with the task to be performed, such as technique and pace (Rushall, 1982). While using this type of strategy the athlete is tuned into his/her bodily signals (Morgan, 1980). Many of the world's best marathon runners use this type of strategy (Morgan, 1980).

The third group of strategies includes different types of imagery. This imagery can be incompatible or compatible. A subject with his hand immersed in ice water would be using incompatible imagery if he was thinking of a hot summer day at a beach to combat the pain caused by the cold water. If the same subject was thinking of a cool refreshing dip in a stream to combat the pain induced by the ice water, he would be employing compatible imagery (Beers & Karoly, 1979).

The fourth type of cognitive strategy is an unaided condition (Rushall, 1982). This is actually a control condition as it is a self-developed strategy consisting of the subject's usual or typical thoughts (Selkirk, 1980). The subject is given no guidelines as to what he/she should concentrate on while using this strategy.

Rushall (1979) stated that the content of strategies should be planned, predictable, and controlled. The content may include mood words, positive self-statements, and coping behaviours.

Suinn (1980) noted that relevant or irrelevant thought patterns could be used to distract subjects from pain or boredom. This was based on the idea that two thoughts cannot exist in the same space at the same time. Therefore, if the athlete is thinking positively, whether it is related to the task or not, he/she cannot also be thinking about pain. It is possible to switch back and forth from relevant to irrelevant thinking, or from association to dissociation (Morgan, 1980).

As with any other skill practice is necessary for the development and use of cognitive strategies. Rushall (1975) advised that race strategies should be developed through training. Strategies should

be studied to aid in the understanding and development of more effective strategies (Rotella, Gansneder, Ojala, & Billing, 1980). An athlete should adjust his/her strategy, if necessary, as soon as possible after the competition (Rushall, 1979).

Cognitive factors (Spanos, Radtke-Bodorik, Ferguson, & Jones, 1979) and coping skills (Turk, 1978) play important roles in the tolerance of noxious stimuli in experimental situations. Blitz and Dinnerstein (1971) found that groups using compatible and incompatible imagery were able to tolerate the pain stimulus of cold water longer than the control group. Chaves and Barber (1974) found that groups using imagery were able to tolerate a pressure pain stimulus longer than groups not employing strategies. Jaremko (1978) found that reversal and rationalization strategies were the most effective for increasing pain tolerance. Spanos, Horton, and Chaves (1975) found relevant strategies to be superior to irrelevant strategies, and irrelevant strategies to be superior to the control group in elevating the pain threshold of a subject with a hand in cold water.

Beers (1976) found subjects could successfully use cognitive strategies to increase pain threshold and pain tolerance. The subjects experienced no differences in discomfort but were able to tolerate it longer. Beers found the subjects' abilities to use strategies varied considerably. He also found strategies can be effective in increasing tolerance of noxious stimuli with even brief training and practice.

Beers and Karoly (1979) compared the effects of four strategies on tolerance of cold water. The strategies did not affect discomfort

ratings but they did facilitate endurance of pain. These authors found rational thinking and compatible imagery to be superior to task irrelevant and incompatible imagery.

Cognitive training (DeWitt, 1980), cognitive therapy techniques (Horton & Shelton, 1978), and patterns of thought (Mahoney & Avener, 1977) have been found to improve athletic performance in experimental situations. Gould, Weinberg, and Jackson (1980) demonstrated the importance of cognitive strategies in the performance of muscular strength tasks. They found imagery and preparatory arousal to be better than a control group on a leg strength task. Shelton and Mahoney (1978) found a 'psyching up' strategy produced dramatic increases in grip strength as measured by a hand dynamometer. Weinberg et al. (1980) found the effect of psyching up strategies to be task specific. The strategies improved performance on an isokinetic leg-strength task but had no effect on stabilometer balance and speed-of-arm movement.

Selkirk (1980) had subjects run on a treadmill under four different strategy conditions, voluntary distraction, task specific, imagery manipulation, and unaided condition. All of the aided conditions produced greater mean performance times than the unaided condition. No single treatment proved to be superior to the others. The subjects generally performed best under their preferred condition. The subjects' expectations to do well had little to do with their actual performance.

Chorkawy (1982) and Ford (1983) each studied three swimmers performing a 400 metre swim under three conditions, task specific,

voluntary distraction, and unaided. Two of the three swimmers in each group performed best under the task specific condition.

Cognitive strategies can aid in maximizing performance by reducing anxiety and stress. Wood (1981) stated that relaxation and cognitive strategies can reduce training and pre-competition anxieties. Feltz and Landers (1980) noted that cognitive strategies may combat stress.

Not all studies have found the use of strategies to produce significantly superior results. Scott and Barber (1977b) found no significant differences between three strategy treatment groups and a control group in reducing the pain of a cold water stimulus and a pressure stimulus. Crossman (1977) found no significant differences between four cognitive strategies, including an unaided condition, on a treadmill running task.

The task specific rational thinking strategy appeared to be the most effective condition (Beers & Karoly, 1979; Chorkawy, 1982; Ford, 1983; Jaremko, 1978; Spanos et al., 1975). Although the strategies resulted in increased pain tolerance or improved performance there was no alleviation of the discomfort experienced (Beers, 1976; Beers & Karoly, 1979, Chorkawy, 1982; Ford, 1983).

Generally, cognitive strategies appeared to be beneficial in improving athletic performance for some subjects and were often effective in the control of pain in experimental situations. These strategies seemed to work chiefly by increasing pain tolerance and reducing stress and anxiety.

CHAPTER III

Methods and Procedures

Experimental Aims

The major aim of this experiment was to determine if differing cognitive strategy conditions resulted in improved performance in a fixed time task, a three minute maximum effort on a rowing ergometer. The minor aims were to determine if the varying conditions resulted in differing numbers of actions per trial and different qualities of response in work output. These aims were undertaken to better understand the effects of cognitive strategies on performance.

Experimental Design

A single subject alternating treatments design (Barlow & Hayes, 1979) was utilized for this experiment. This design was employed to eliminate problems encountered in group designs such as intersubject variability and generalizing results from a group average to an individual subject. Looking at each subject individually allowed any experimental effects to be directly observed. This study was comprised of four replications of this design.

There were two stages to the experiment, a baseline stage and an experimental stage. The baseline stage was administered until the subject's performance reached stability. The experimental stage consisted of the application of the two treatment conditions as well as the baseline, or unaided, condition. One condition was applied in each session. The order of the conditions was randomly assigned according to a 3X3 Latin Square to avoid possible sequencing effects.

Independent and Dependent Variables

The independent variables were the three treatment conditions utilized by the subjects during the performance of the maximum effort rows. These were: a) an unaided condition, b) a task specific condition, and c) a voluntary distraction condition. The unaided condition consisted of the subject performing her row while thinking as she normally would while rowing. During the task specific condition the subject concentrated only on technique and specific aspects of rowing. In the voluntary distraction condition the subject concentrated on a strategy of her design aimed at distracting her from thinking of rowing. These conditions were selected because of their use in similar experiments from which this study was adapted (Crossman, 1977; Selkirk, 1980; Chorkawy, 1982; Ford, 1983).

One major dependent variable was measured. That was the total number of revolutions of the ergometer flywheel per three minutes. Two minor dependent variables were measured. These were the total number of strokes completed per three minutes and the stroke efficiency for each trial.

Several other variables were examined. That extra information was collected to better understand the responses of the subjects. The subjects completed pretest and posttest questionnaires at each session, and a postexperiment questionnaire upon completion of the study (see Appendix A). These questionnaires yielded information on the following: a) the subject's pretest expectation of performance (whether the subject felt she would perform better than on her previous

trial), b) the subject's posttest assessment of performance (whether the subject felt she had performed better than on her previous trial), c) the percentage of time the subject felt she was able to concentrate on the content of the prepared strategy, d) the subject's assessment of the trial as painful or non-painful, e) the degree of discomfort perceived by the subject, f) the subject's preferred condition, g) the subject's perceived order of effectiveness of the three conditions, and h) a description of any factors that may have affected performance.

Subjects

The subjects were four female rowers from the Thunder Bay Rowing Club. The study was limited to these subjects because of their availability and suitability. These subjects were assessed to be at the novice to intermediate level. Their ages ranged from 19 to 25 years.

Controls

The effects of extraneous variables were countered through the implementation of various controls.

Each subject performed the unaided condition until a baseline had been established. These trials allowed the subject to familiarize herself with the task before the experimental stage began. These trials also provided a stable base to which the treatment conditions could be compared.

The trials were conducted each Monday, Wednesday, and Friday. Each subject devised her own standard warm-up to be completed

before each trial. The subject selected an appropriate workload which was used for the entire experiment.

The order of the treatment conditions was randomly assigned according to a 3X3 Latin Square. This insured that the strategies were presented in different orders on different weeks, thus avoiding any sequencing effects. Any subject absence delayed the testing schedule.

The flywheel revolution counter was hidden from the subject's sight. The subject received no performance feedback until the experiment had been completed.

Pretest and posttest questionnaires were completed for each performance. This allowed the subject to inform the experimenter of any outside factors that may have affected that day's performance. Each subject also recorded the percentage of time she felt she was able to concentrate on the content of that session's strategy.

Experimental Procedure

This experiment consisted of two stages: a) a baseline stage, and b) an experimental stage.

Baseline

Each subject performed the three minute maximum effort row in the unaided condition until stability had been reached. The baseline was considered stable when four consecutive trials fell within 50 revolutions of the ergometer flywheel. This was a performance variance of approximately three percent.

The subject started each trial on the command 'Go' from the experimenter. She finished each trial at the end of three minutes on the command 'Stop'. The time period was timed with an electronic

stopwatch. The subject was informed when each minute of the three minute time period had elapsed.

The total revolutions of the ergometer flywheel were recorded from the counter attached to the flywheel. After the subject had completed her final stroke the flywheel was allowed to finish spinning before the final reading was taken. The total number of strokes was recorded from the stroke counter affixed to the seat of the ergometer.

Experimental Stage

Immediately following the establishment of baseline the subject was given instruction sheets informing her of the nature of the experiment. The treatment conditions were explained and examples of possible ideas to be included in the strategies were given (see Appendix B). Assistance was available from the experimenter if a subject was unclear as to what was expected for the preparation of the strategies.

The subject was informed as to which condition would be employed at the following session. This allowed the subject time to prepare her strategy. The subject was permitted to write any or all of her prepared strategy on a blackboard in front of the rowing ergometer for reference during her row.

Before each trial the subject completed a pretest questionnaire. Her performance expectancy and any factor that could have affected performance were recorded. Following a standard warm-up the trial was conducted as in the baseline stage. After each trial the subject completed a posttest questionnaire on which she noted whether she felt her performance was painful, the degree of discomfort experienced,

the percentage of time she felt she was able to concentrate on the strategy, and whether she felt she had accomplished her pretest expectancy.

Testing continued until one condition was superior to the others in four consecutive blocks of three trials, or until it became obvious that no condition was superior. A postexperiment questionnaire was completed at the conclusion of the study.

Apparatus

A rowing ergometer with a flywheel revolution counter and a stroke counter was used. The ergometer used was an 'optimal simulating and measuring' Dr. Gjessing Ergo'row. This ergometer was devised in Norway in 1980. It was assumed to be reliable as it is the type used for testing by the Canadian National Rowing Team. A Cronus 2 digital stopwatch was used to time the three minute time periods.

Data Analysis

Five measures were graphed to present a visual record of the subject's results. The measures graphed were the following: a) performance work output in revolutions of the ergometer flywheel for each trial, b) the total number of strokes completed in three minutes for each trial, c) the overall stroke efficiency for each trial, d) the percentage of time the subject reported being able to concentrate on the prepared strategy for each trial, and e) the subject's rating of discomfort experienced for each trial.

These data were analysed visually to determine if any trends were obvious. If differences between condition were so slight that

they were undetectable through visual inspection, they were deemed to be too small to be significant in any decision making concerning the subject's performance.

A Binomial test was done on the level of agreement between the subject's pretest expectation of performance and the actual performance. This was done to determine if the proportion of agreement was better than would be expected by chance alone. Similarly, a Binomial test was also conducted on the subject's posttest assessment of performance and the actual performance to determine if the subject's ability to judge her own performance was better than would be expected by chance.

The effects of extraneous variables on performance were also examined. These variables included the assessment of a trial with regard to the amount oof experienced pain, food consumption before a trial, the adequacy of sleep prior to a trial, and any other factors that the subject felt prevented her from performing her best. Where sufficient data were available the mean performances for trials affected by each of these variables and trials not affected were statistically compared, using a t-test, to determine if any significant differences existed.

Responses from the postexperiment questionnaire were tabulated to determine trends concerning the subject's preference of treatment conditions and her perceived order of effectiveness of the conditions for improving rowing performance.

CHAPTER IV

Subject 1 Results and Discussion

Results

The performance record of S1 is illustrated in Figure 1. A stable baseline was achieved for this subject after five trials.

There were obvious differences among the three treatment conditions in performance work output (total revolutions of the egometer flywheel). The task specific strategy was clearly superior, the unaided condition was next best, and the voluntary distraction strategy was poorest. The results of the task specific and the unaided conditions steadily improved over the course of the study while the voluntary distraction results deteriorated slightly.

S1 was able to complete more strokes in three minutes while employing the task specific strategy, as illustrated in Figure 2. With the exception of one trial, the least strokes were completed under the voluntary distraction condition.

The stroke efficiencies for S1 are illustrated in Figure 3. There were no differences in the stroke efficiencies produced by the task specific and unaided conditions. The voluntary distraction condition produced the poorest efficiency level.

Figure 4 presents this subject's self-perceived ability to concentrate during the two strategy conditions. She reported being able to concentrate on the task specific strategy to a very high degree (range - 95 to 100%). She reported not being able to concentrate as intensely during the voluntary distraction strategy. This subject also had greater

FIGURE 1. TOTAL PERFORMANCE S1.

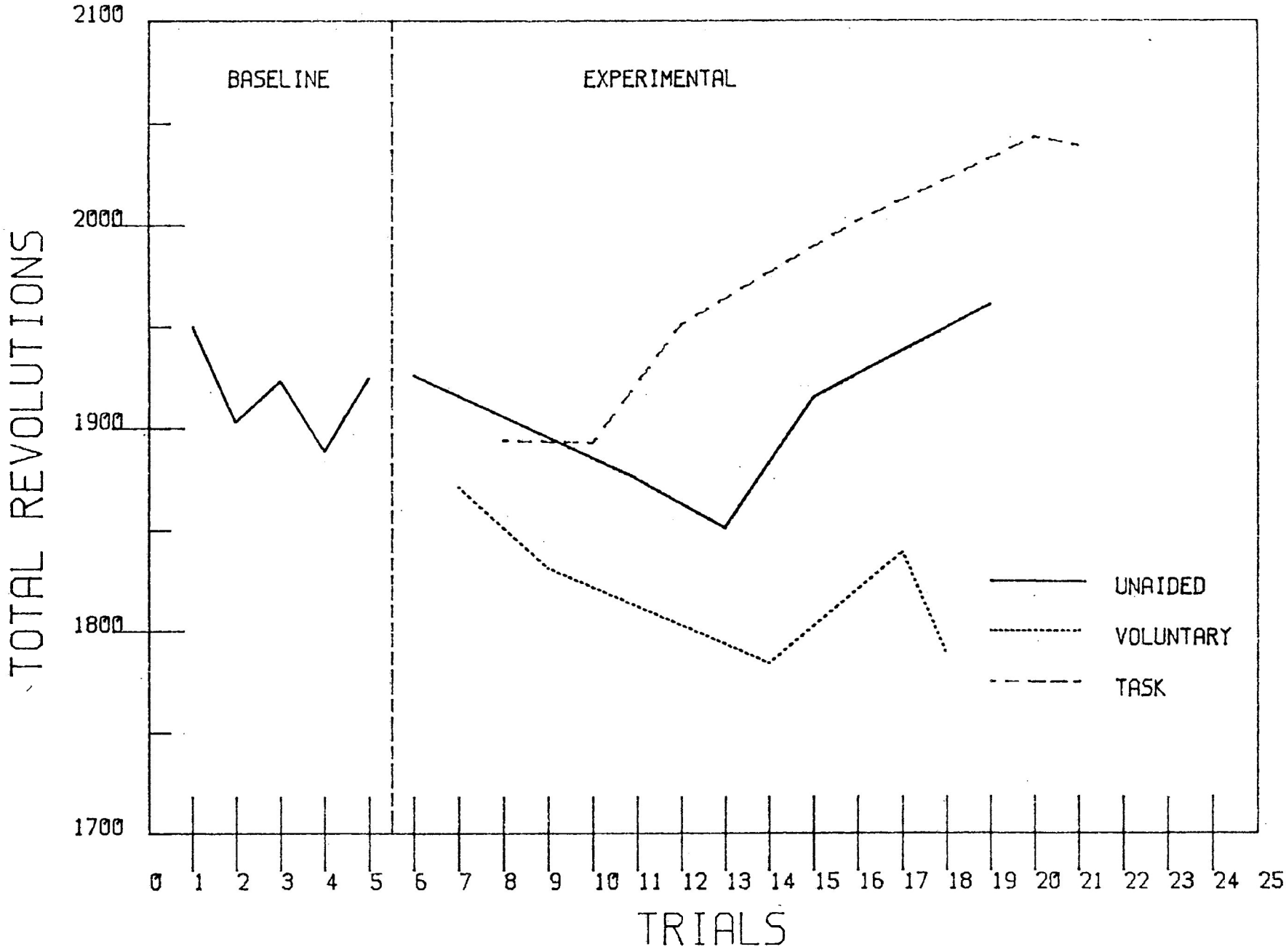


FIGURE 2. TOTAL STROKES S1.

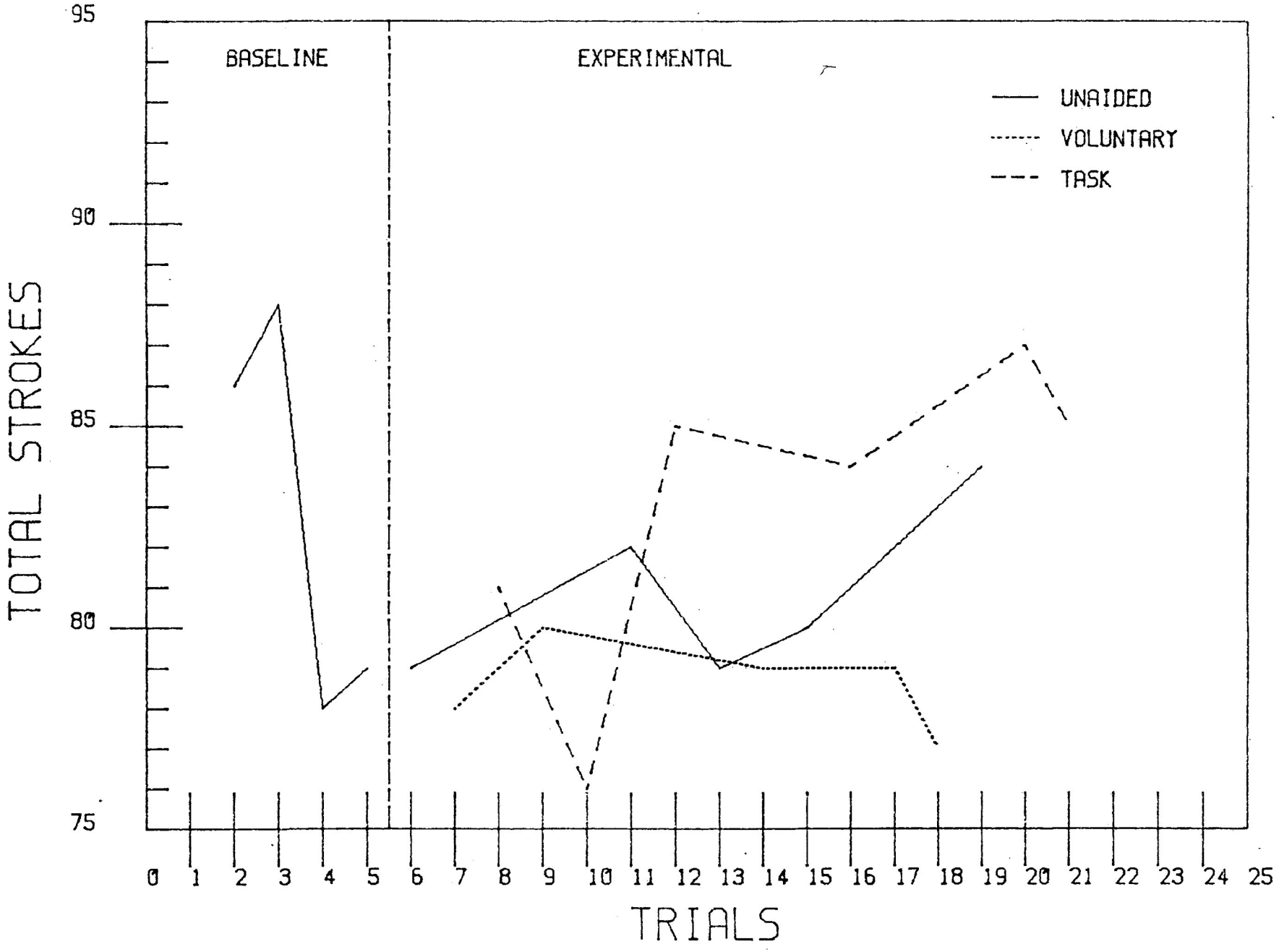


FIGURE 3. STROKE EFFICIENCY S1.

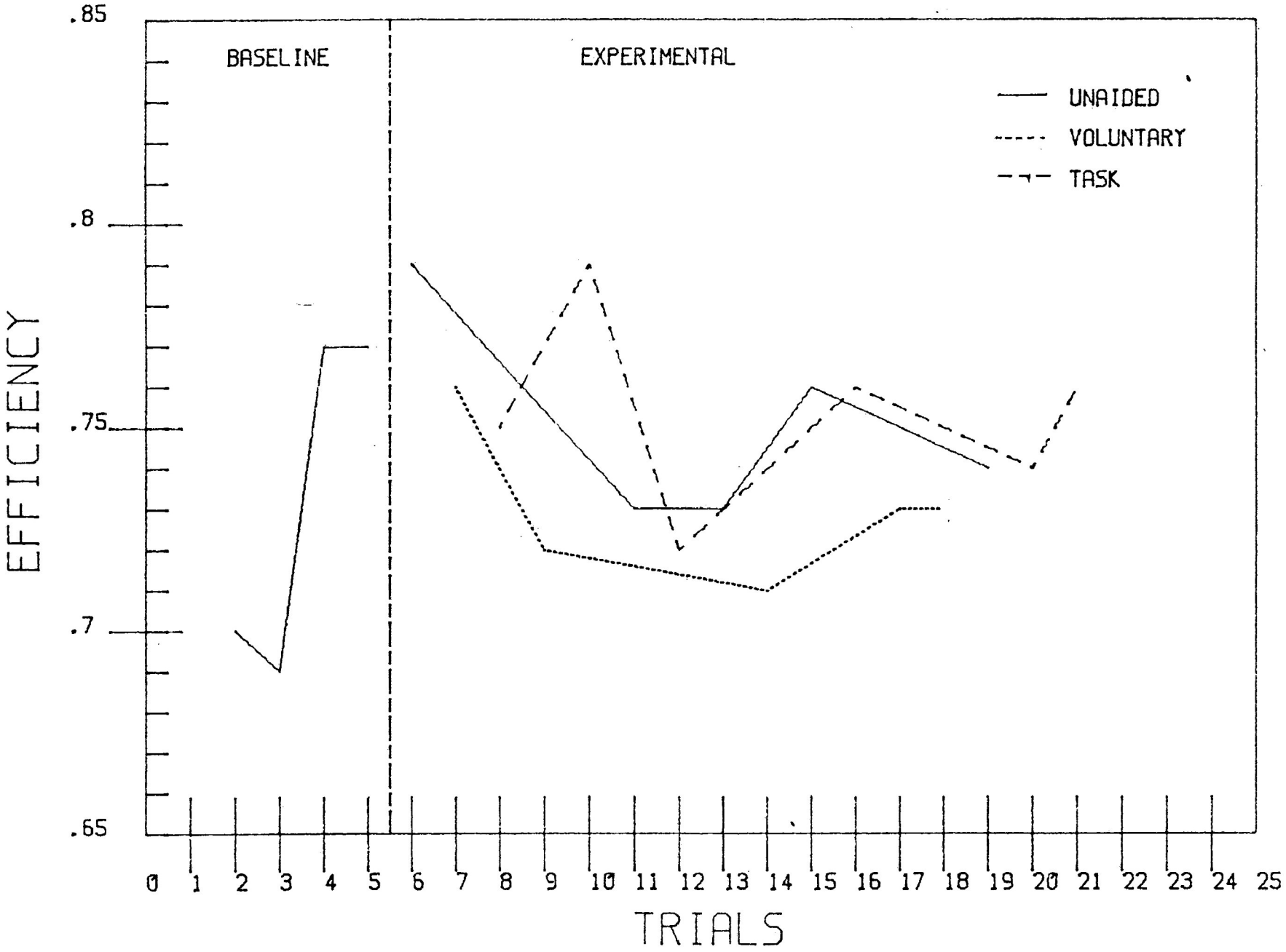


FIGURE 4. CONCENTRATION S1.

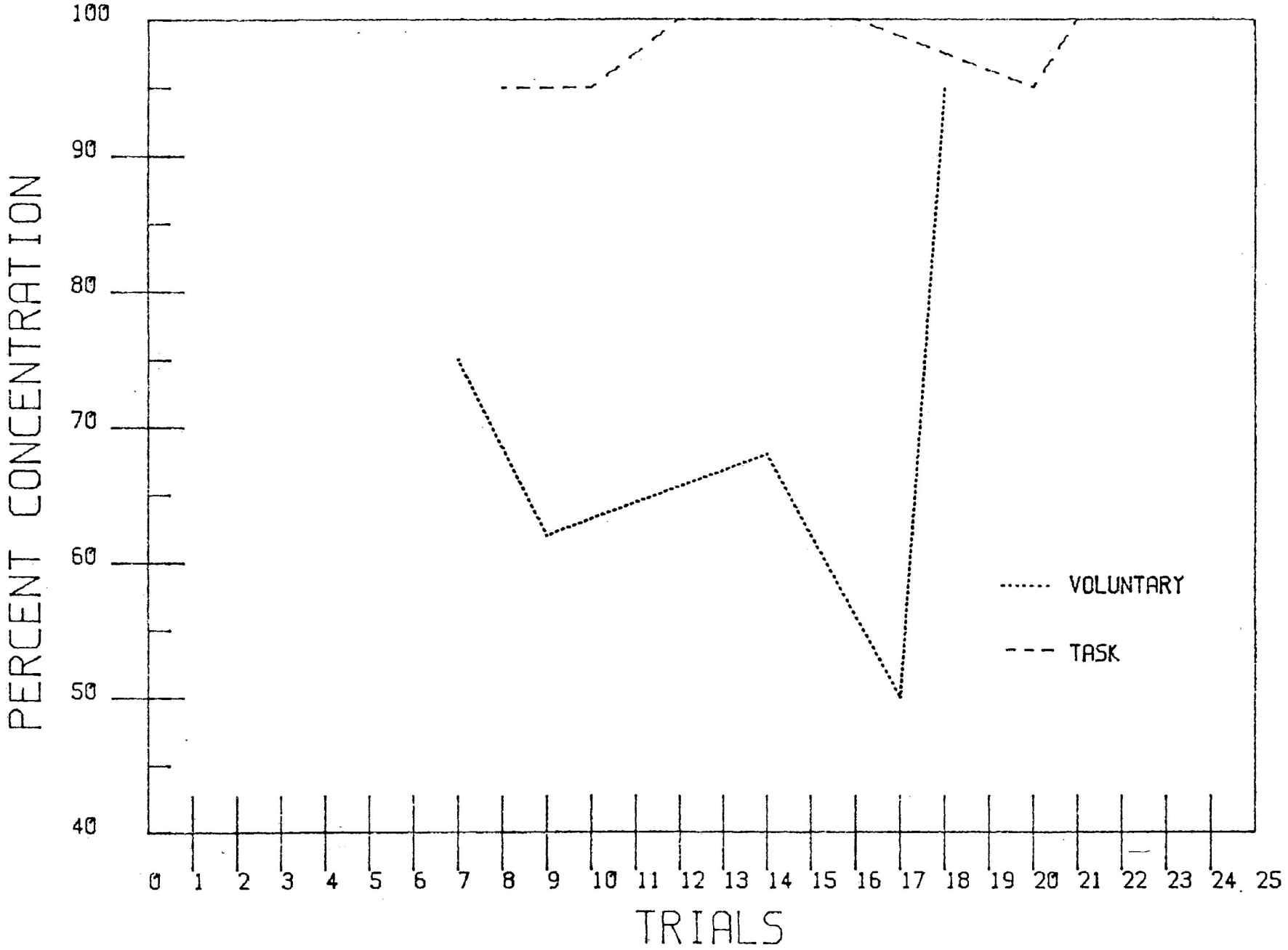
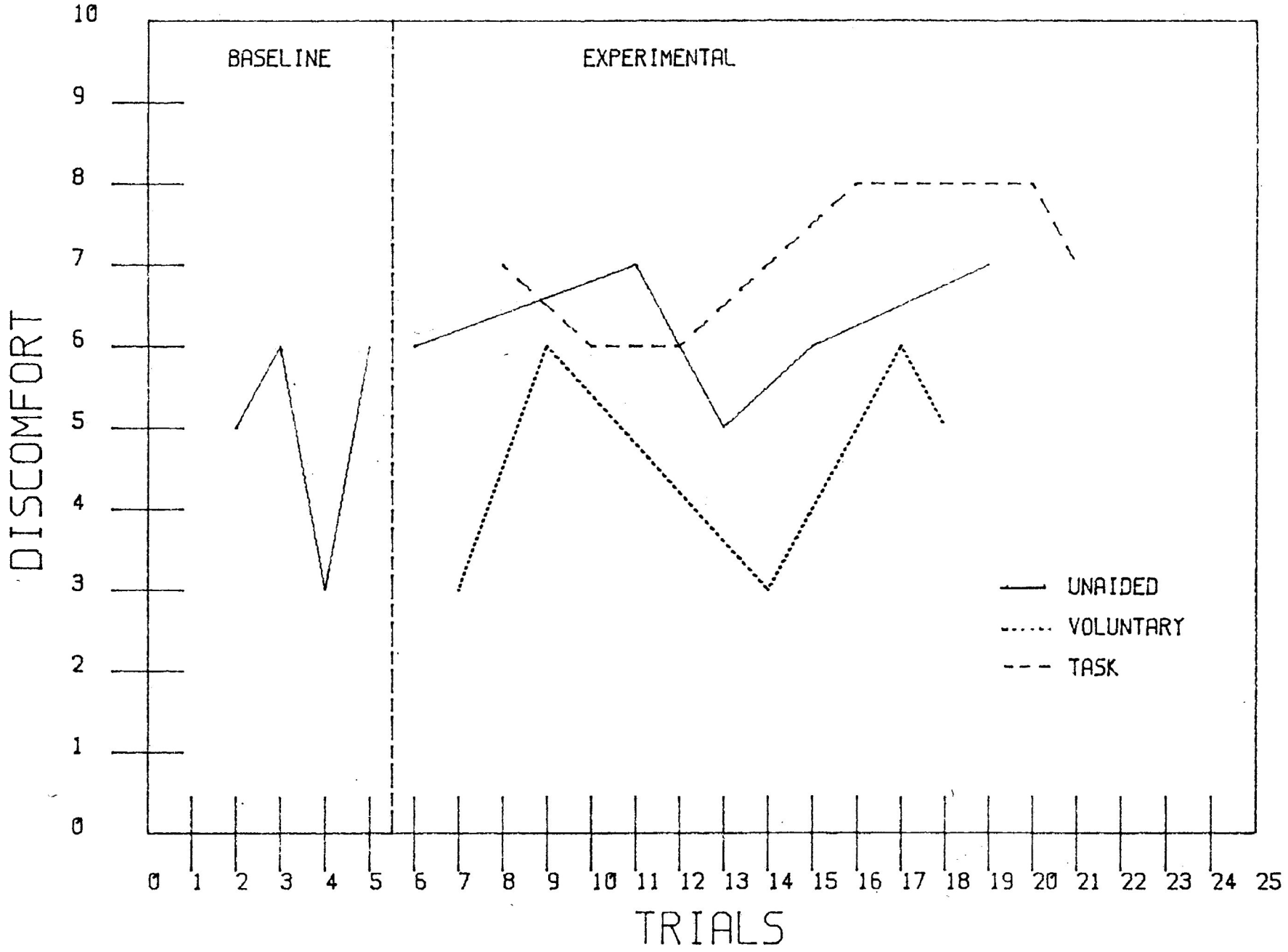


FIGURE 5. DISCOMFORT S1.



variability in self-perceived concentration while employing the voluntary distraction strategy (range - 50 to 95%).

S1's ratings of discomfort are presented in Figure 5. She reported experiencing the highest levels of discomfort during the task specific condition, the next highest during the unaided condition, and the lowest levels during the voluntary distraction condition.

A Binomial test was conducted to test the association betwen the subject's pretest expectation and the actual performance. A Z-score of 1.000 was obtained. This resulted in a one-tailed probability greater than or equal to .159, which was nonsignificant. This indicated that the subject's pretest expectation of performance was not related to performance outcome.

A Binomial test (Z=.500; $p \geq .309$, NSig) was also conducted to test for association betwen the subject's posttest assessment of performance and the actual performance. The result of this test suggested that the subject's evaluation of the performance was not accurate.

The posttest questionnaires revealed that S1 felt the performance was painful in 10 trials and was not painful in six trials. The mean performance during a painful trial was 1932.5 revolutions compared to 1856.3 revolutions during a nonpainful trial. This difference was not statistically significant ($t(14)=1.982$; $p > .05$; NSig). This indicated that performance was not reflected in the assessment of pain by the subject.

It was also revealed through the posttest questionnaires that this subject felt there were other factors preventing her from performing

her best in five of the 16 trials. These factors included a headache on three occasions and sore or stiff muscles on two occasions. The mean performance during these trials was 1840.0 revolutions. The mean performance during trials in which there were no such factors affecting performance was 1933.0 revolutions. This difference was determined to be significant at the .01 level ($t(14)=3.161$; $p<.01$; Sig). This indicated that factors outside of the independent variables were associated with the ergometer performance.

On the postexperiment questionnaire S1 noted a preference for the task specific strategy. She also perceived this condition to be the most effective for improving her rowing performance. She felt the unaided condition was the next most effective and the voluntary distraction condition was the least effective. This matched the actual order of effectiveness of the three conditions recorded for this subject.

Discussion

The results for S1 indicated that a specific cognitive strategy, task specific, was effective in improving rowing performance.

The obvious separation of the three treatment conditions suggested that the independent variable (cognitive strategy) did exert control over the major dependent variable (total revolutions of the ergometer flywheel). The results revealed that the use of a task specific strategy was associated with superior performance. Employment of a voluntary distraction strategy resulted in the poorest performances with this subject.

S1 produced the greatest number of strokes while using the task specific strategy, followed by the unaided condition, with the

least strokes completed under the voluntary distraction condition. For this subject, the number of strokes completed was determined to be a major contributing factor to the overall performance score on the ergometer.

It was evident that S1 perceived that she was able to concentrate much more on a task specific strategy than on a voluntary distraction strategy. This concentration factor may have been a possible reason for better performances while using the task specific strategy.

The greatest discomfort was reported for the task specific condition, followed by the unaided condition, with the least discomfort reported under the voluntary distraction strategy. This was also directly related to the total revolutions of the task. The best performances may have been achieved under the task specific condition because this subject was able to work hardest while using that strategy. She may have found it difficult to work hard while concentrating on the voluntary distraction strategy, resulting in lower discomfort levels and poor performances.

A significant difference, at the .01 level, was found between those trials in which there were no factors affecting performance and those in which there were other factors preventing the subject from performing her best (five of 16 trials). However, 80% of the affected trials occurred during the voluntary distraction condition. This subject disliked this strategy and felt she could not achieve a 'best' performance under this condition. On the postexperiment questionnaire she commented, "I found it very very difficult to get

on the Ergo and go through the motions of rowing and not be able to think about what I was doing - Voluntary Distraction". Before all but one voluntary distraction trial, S1 felt there were factors preventing her from performing her best. These factors may have been intensified because of the subject's appraisal of this condition. This suggested that S1's attitude toward a specific strategy may have been related to performance.

The relationships of several other factors to performance were examined with no association found. Stroke efficiency did not appear to be linked with performance as there were no differences between the stroke efficiencies of the task specific and unaided conditions. Pain did not seem to be connected to performance as there were no significant differences between trials perceived as painful and those perceived as non-painful.

No association was found between the subject's pretest expectation of performance and the actual outcome. Therefore, whether the subject expected to do well or not was not a contributing factor to the level of performance.

The appropriateness of sleeping and eating habits did not seem to be related to overall performance. S1 felt she got enough sleep before every trial and had too little to eat before only one trial.

Results for this subject indicated that superior performances under the task specific condition were affected by a higher stroke rating, the self-perceived ability to concentrate more under this condition, and the ability to work harder producing higher levels of discomfort.

The subject's preference for the task specific strategy and her assessment of it as the most effective condition signified that it would be of value for her to continue using this strategy to improve her rowing performance.

CHAPTER V

Subject 2 Results and Discussion

Results

The performance record of S2 is presented in Figure 6. This subject achieved a stable baseline after seven trials.

There were virtually no differences in total revolutions of the ergometer flywheel between the unaided and voluntary distraction conditions. The task specific treatment produced the best results in work output in all trials. Stability was reached for each of the conditions in the experimental stage of the study.

The greatest number of strokes were completed while the subject was using the voluntary distraction strategy, as illustrated in Figure 7. No differences in strokes completed existed between the task specific and unaided conditions.

Figure 8 illustrates the stroke efficiencies for S2. The best stroke efficiency was achieved under the task specific condition. The unaided condition produced the next most efficient strokes, and with only a single point of overlap, the least efficient strokes were produced under the voluntary distraction condition.

The ability of S2 to concentrate during the two treatment conditions is illustrated in Figure 9. She reported being able to concentrate on the voluntary distraction strategies for a constant 75% of the time. There was much greater variability in her self-perceived ability to concentrate on the task specific strategies (range - 50 to 90%). It appeared she felt she was marginally better at concentrating on the voluntary distraction strategies.

FIGURE 6. TOTAL PERFORMANCE S2.

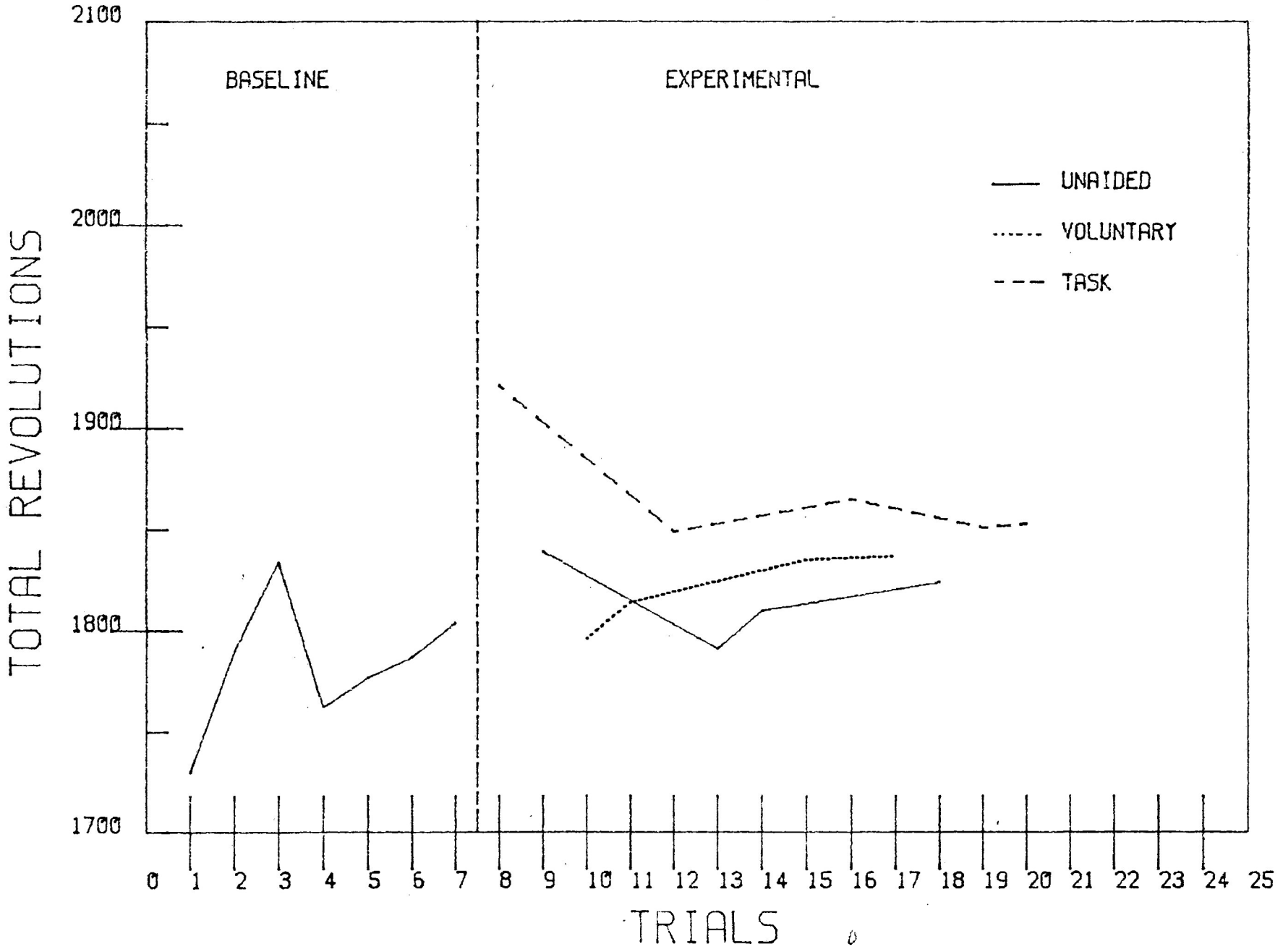


FIGURE 7. TOTAL STROKES S2.

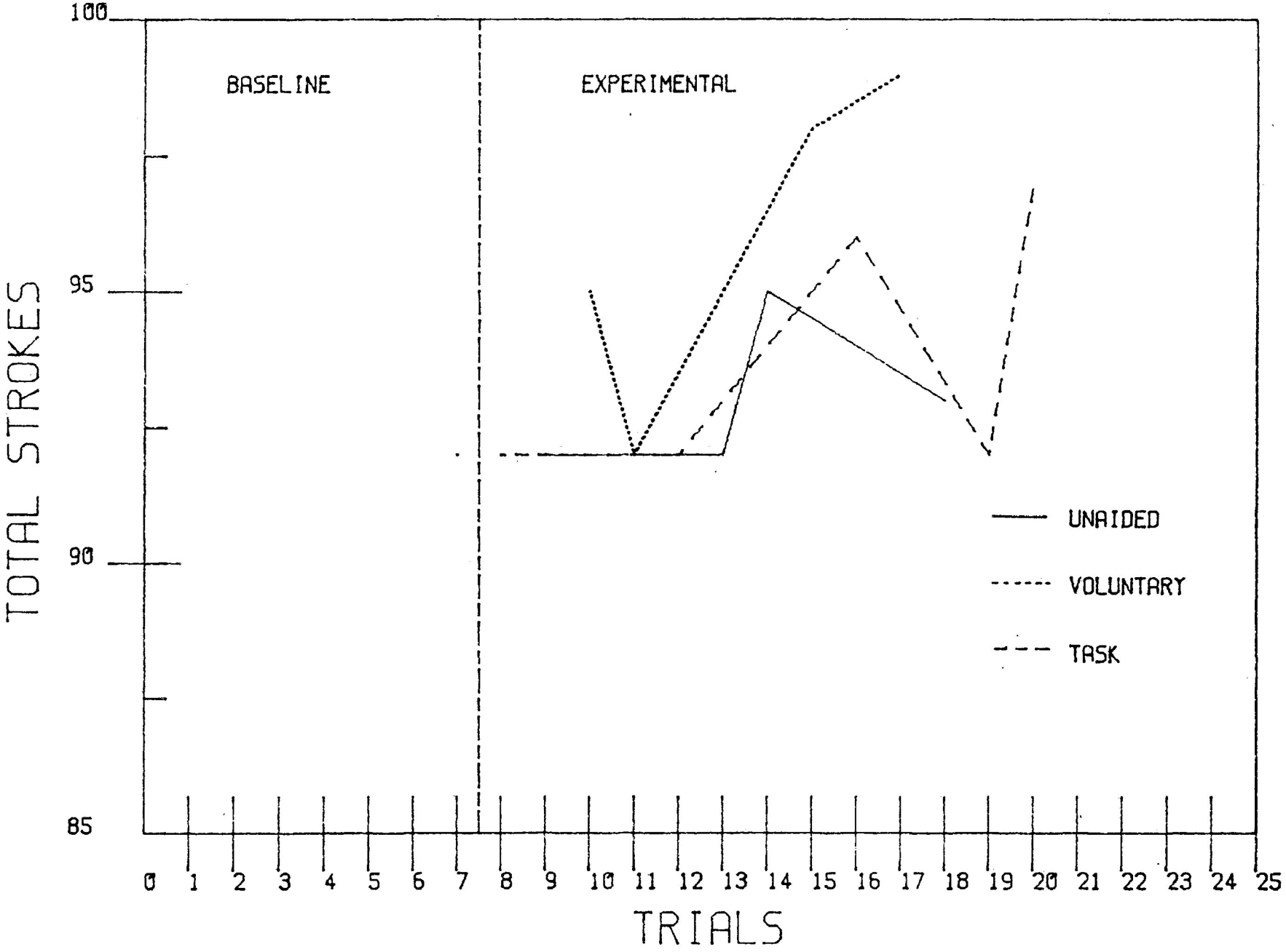


FIGURE 8. STROKE EFFICIENCY S2.

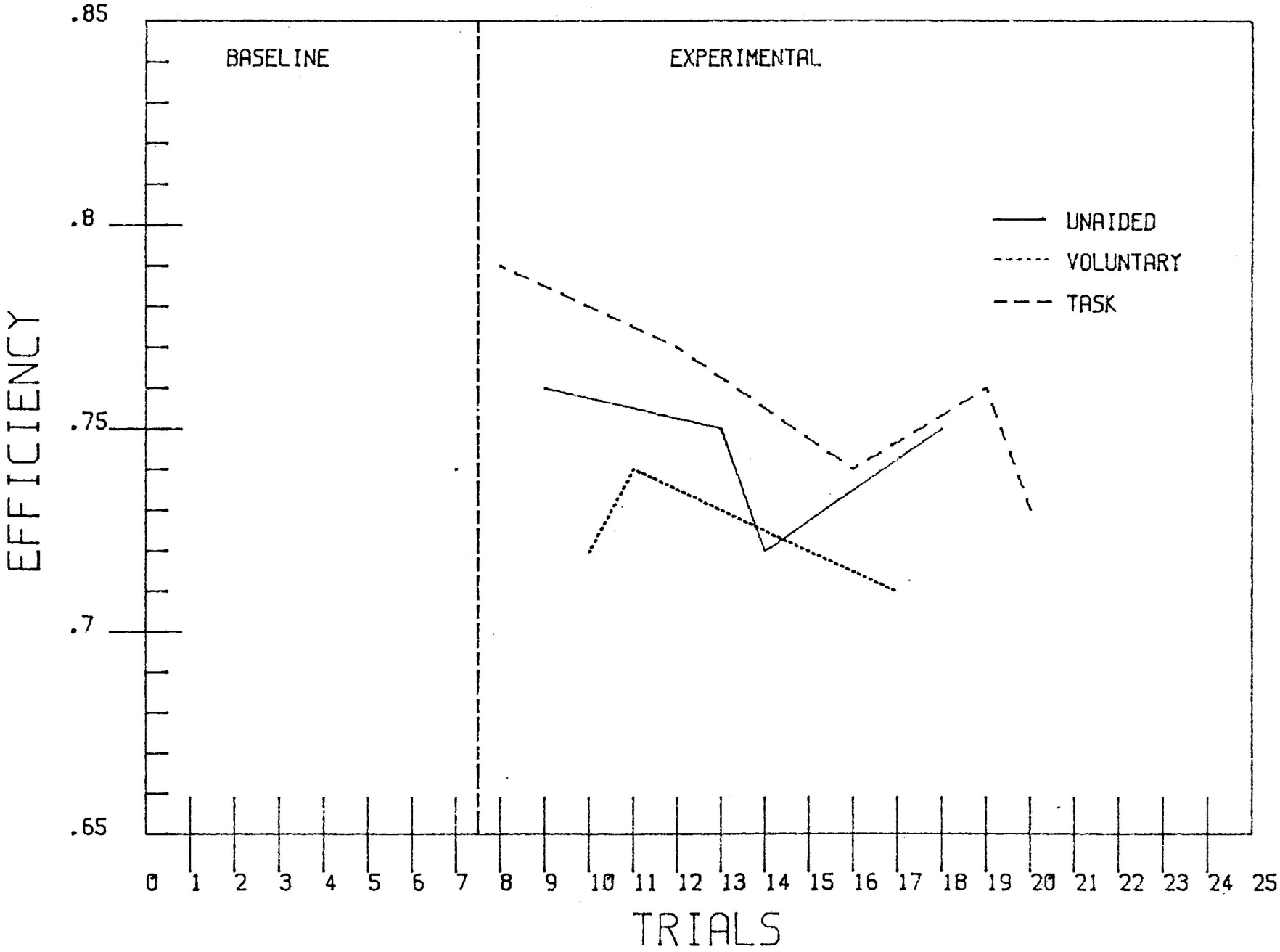


FIGURE 9. CONCENTRATION S2.

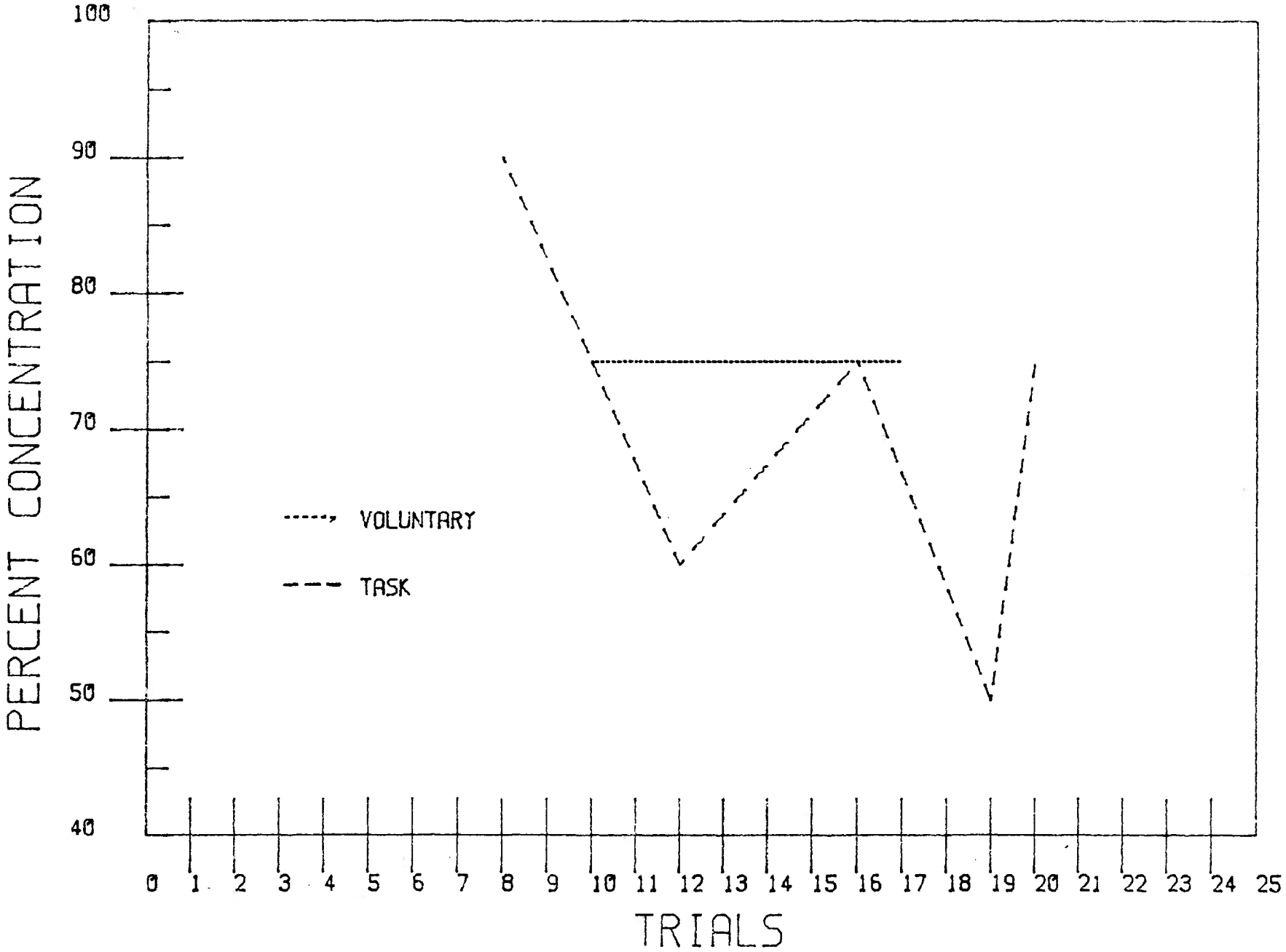


FIGURE 10. DISCOMFORT S2.

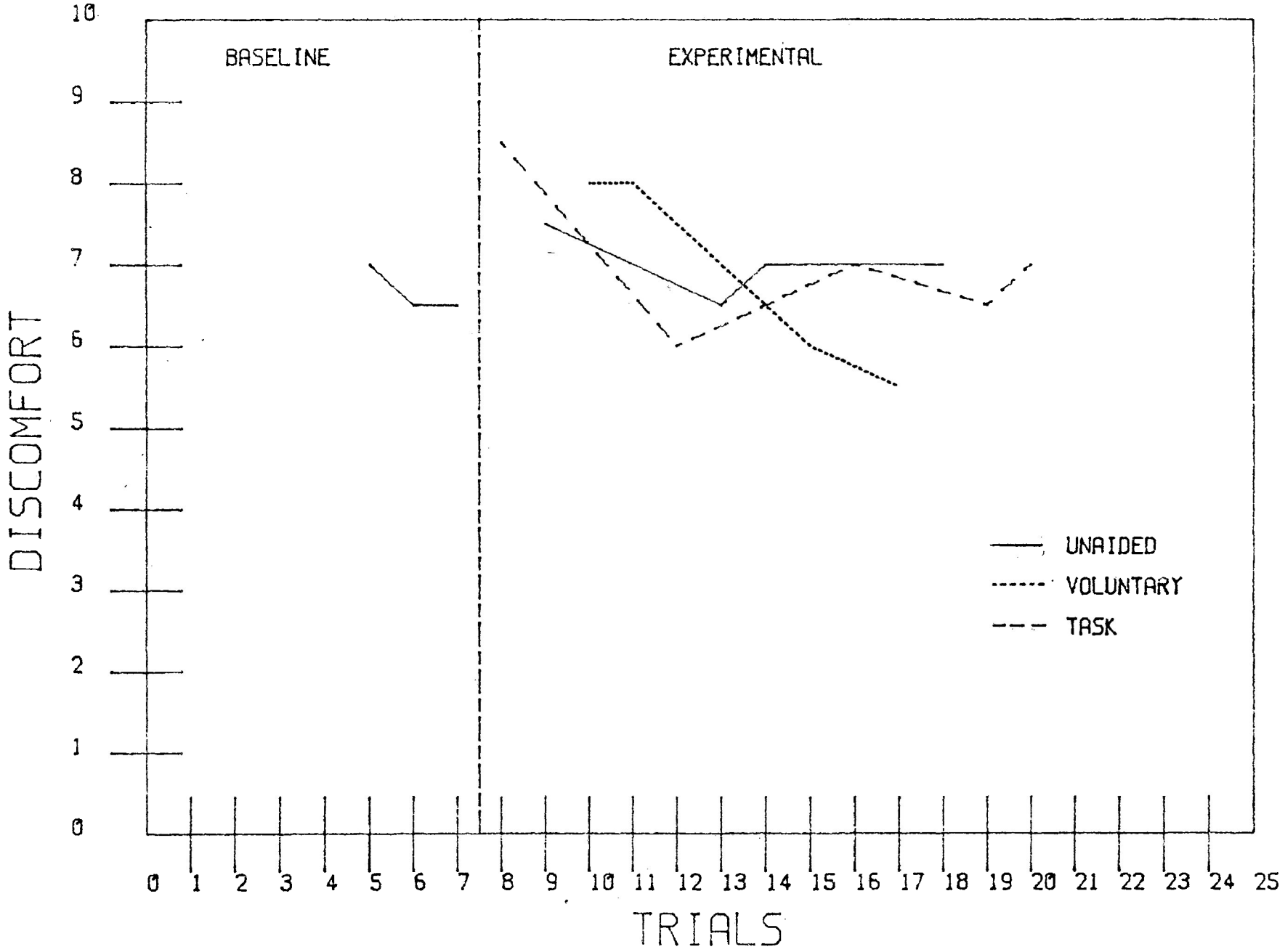


Figure 10 presents S2's ratings of discomfort experienced during the trials. There were no obvious differences among the discomfort levels perceived under each of the three conditions.

The Binomial test (Z=.832; p≥.203; NSig) conducted between S2's pretest expectation and the actual performance produced a nonsignificant result. This indicated that the subject's pretest expectancy was not related to performance.

The Binomial test (Z=2.496; p≥.006; Sig) conducted between S2's posttest assessment of performance and the actual outcome revealed that there was a significant association between the two. This indicated that S2 was able to analyse the standard of her performance to a degree that was statistically superior to that which would be expected by chance alone.

On the posttest questionnaire, S2 evaluated each performance as painful or non-painful. She perceived five trials to be painful and eight trials to be non-painful. The painful trials had a mean performance of 1851.8 revolutions. The mean for the non-painful trials was 1828.3 revolutions. This difference was determined to be nonsignificant ($t(11)$=.992; p>.05; NSig). This indicated that performance was not reflected in the assessment of pain by this subject.

S2 revealed on the posttest questionnaires that she felt she did not get enough sleep prior to four of the 13 trials. The mean performance of these trials was 1824.5 revolutions. The mean performance when she felt she had had enough sleep the night before was 1843.0 revolutions. This was not a statistically significant difference ($t(11)$=.962;

$p > .05$; NSig). This showed that the sleep amounts for S2 were not associated with performance.

On only one occasion did S2 feel she had had too much or too little to eat before a trial. That trial did not affect the stability for the condition in which it occurred.

There were other factors preventing this subject from performing her best in two of 13 trials. Those factors included a feeling of no energy and personal worries unrelated to the task. The mean performance for these two trials was 1826.5 revolutions. The unaffected trials had a mean of 1839.3 revolutions. This difference was not significant ($t(11) = .614$; $p > .05$; NSig). This indicated that outside factors did not affect performance standards.

A preference for the task specific strategy condition was indicated by S2 on the postexperiment questionnaire. In terms of improving rowing performance, she evaluated task specific to be the most effective, followed by the unaided condition, with the voluntary distraction condition perceived as the least effective. This assessment was in concert with the experimental results.

Discussion

The results for S2 revealed that the use of a task specific strategy produced superior rowing performances.

The performances under the unaided condition and the voluntary distraction condition were similar. All trials performed under the task specific strategy were superior to those of the other conditions.

One factor that appeared to contribute to the superiority of performance under the task specific condition was stroke efficiency.

It was the only minor dependent variable that had obviously better results while S2 was employing a task specific strategy. This suggested that thinking about technique allowed this subject to produce more effective work with each stroke.

The relationship between performance and the other minor dependent variable was examined with no association found. The number of strokes completed did not appear to be related to performance since the highest stroke rating was achieved under the voluntary distraction condition.

The self-perceived levels of concentration while using the two treatment strategies did not seem to have any bearing on total revolutions because there was no marked difference in the assessments reported for the two conditions. There was a great amount of overlap in the levels of discomfort reported under each of the three treatment conditions. This suggested that the subject was able to work with a similar range of intensities under all conditions.

The associations between performance and data collected from the pretest and posttest questionnaires were also studied, with no relationships being suggested. Those variables having no effect on performance included the amount of sleep the subject got prior to a trial, the assessment of a trial as painful or non-painful, and other factors that the subject felt prevented her from doing her best. There was insufficient data to determine if an association existed between performance and eating patterns.

No relationship was found between the subject's pretest expectation of performance and the actual performance result. This indicated that expectancy was not related to performance outcome. However,

after the trial this subject was able to assess the level of her performance adequacy with a high degree of accuracy.

Results for S2 suggested that optimum performances were achieved with a task specific strategy because she was able to pull harder on every stroke, producing a higher stroke efficiency. This subject judged the task specific condition to be the most effective as well as her preferred condition. It would be beneficial for this subject to continue using a task specific strategy to maximize rowing performance.

CHAPTER VI

Subject 3 Results and Discussion

Results

The performance record of S3 is presented in Figure 11. A stable baseline was achieved after six trials.

The first trials under each of the conditions resulted in similar performances, all within the baseline range. However, as the experimental stage progressed, the performances under the two treatment conditions deteriorated steadily to well below baseline levels. The voluntary distraction strategy produced poorer performances than the task specific strategy. The best performances were achieved under the unaided condition, particularly as the study progressed. All but one unaided performance lay within the baseline range. The final four unaided trials produced a gradual upward trend.

Figure 12 illustrates the number of strokes completed during each trial. With the exception of the first voluntary distraction trial, the highest stroke ratings were achieved under the unaided condition. There was little difference between the stroke ratings of the task specific and voluntary distraction conditions.

S3's stroke efficiencies are illustrated in Figure 13. No single condition produced consistently better stroke efficiencies than the others.

The self-perceived ability of this subject to concentrate on the two treatment conditions is presented in Figure 14. S3 was able to concentrate on the voluntary distraction strategies for 75% of the

FIGURE 11. TOTAL PERFORMANCE S3.

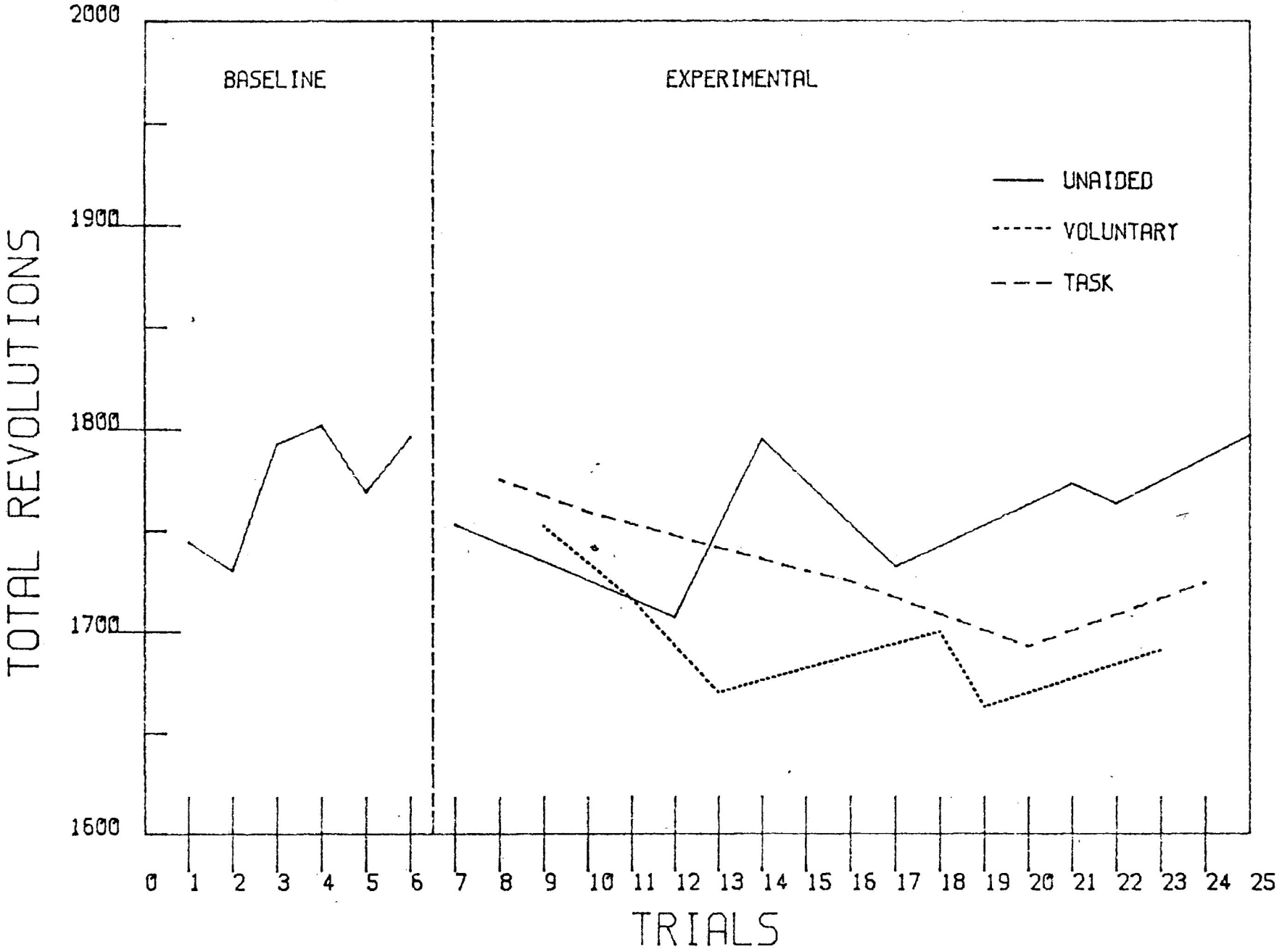


FIGURE 12. TOTAL STROKES S3.

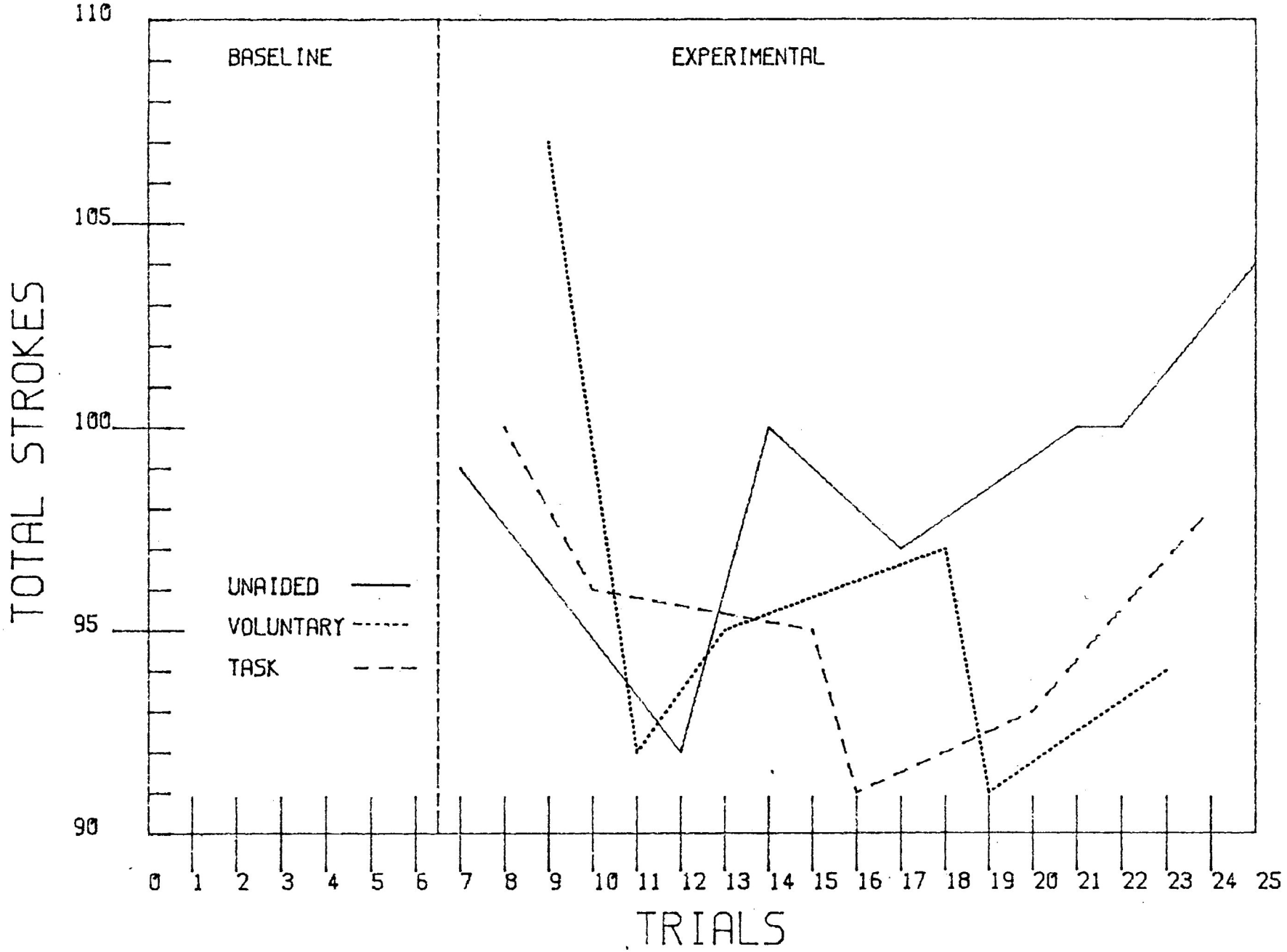


FIGURE 13. STROKE EFFICIENCY S3.

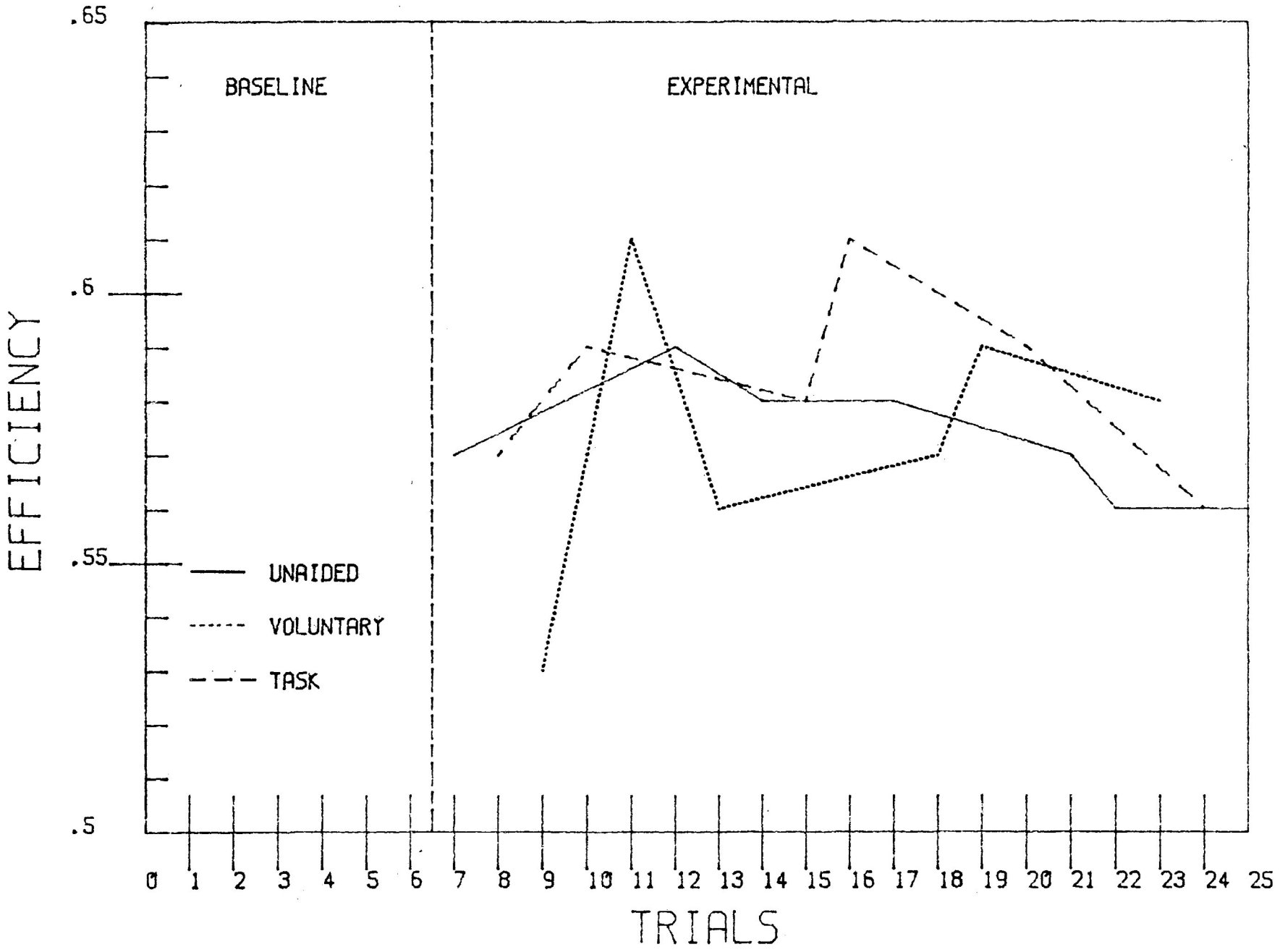


FIGURE 14. CONCENTRATION S3.

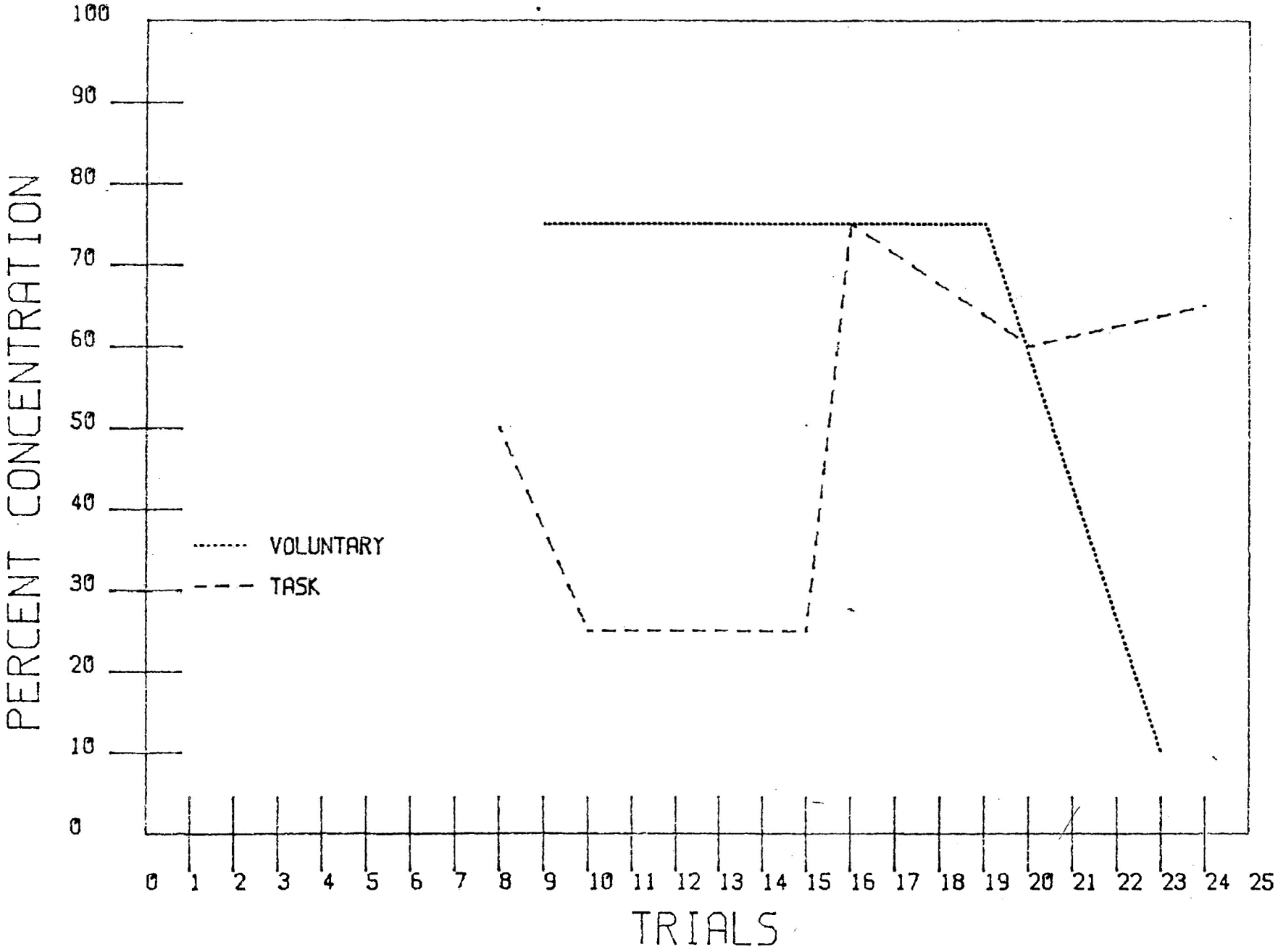
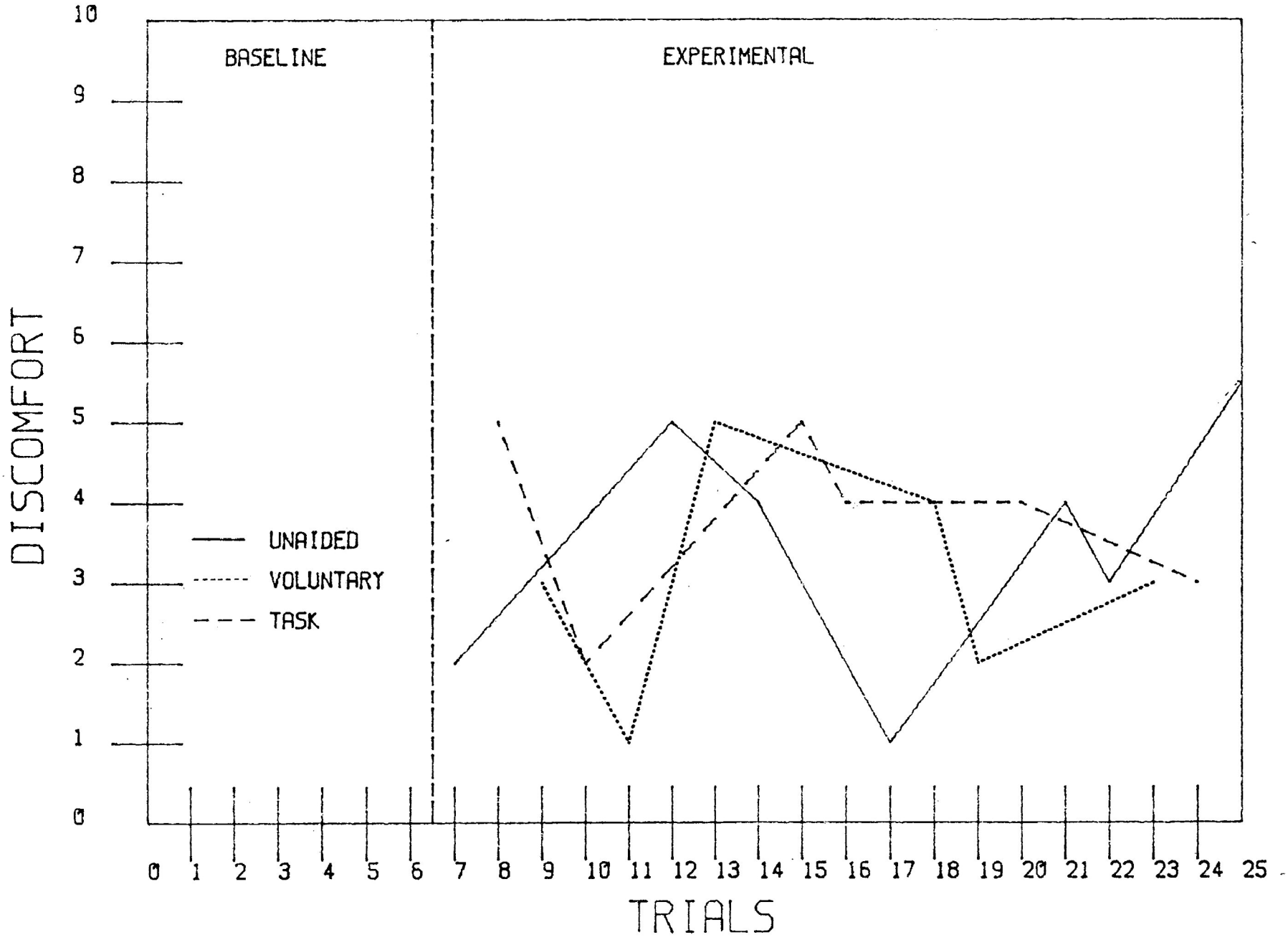


FIGURE 15. DISCOMFORT S3.



time on all the trials but one. Her reported concentration on the task specific strategy was much lower and more variable (range - 25 to 75%).

Figure 15 presents S3's ratings of discomfort experienced during the trials. She reported similar levels of discomfort under all three conditions.

The Binomial test (Z=.728; p≥.236; NSig) conducted between the subject's pretest expectancy and the actual performance produced a nonsignificant result. This indicated that S3's pretest expectation was not related to performance.

The association between S3's posttest assessment of performance and the actual performance was also tested (Z=1.698; p≥.045; Sig) and was found to be significant. This suggested that S3 could evaluate whether her performance was better than her previous trial to a degree that was better than would be expected by chance alone.

On the posttest questionnaires S3 identified four trials as painful and 15 trials as non-painful. The non-painful trials had a mean performance of 1729.9 revolutions. The mean performance during painful trials was 1742.5 revolutions. The difference was determined to be nonsignificant ($t(17)$=.377; p>.05; NSig). This indicated that the assessment of a trial as painful was not associated with performance for this subject.

S3 felt she got enough sleep prior to only one trial. Therefore, the relationship between performance and sleeping patterns could not be determined.

S3 felt she had had an appropriate amount to eat before 17 of the 19 trials. These trials had a mean performance of 1731.8 revolutions.

The two trials before which she felt she had had too little or too much to eat had a mean of 1738.5 revolutions. This difference was not significant ($t(17)= 291$; $p > .05$; NSig). This indicated that the amount of food ingested before a trial was not reflected in performance differences.

S3 reported that there were other factors preventing her from performing her best on 10 of the 19 trials. These factors ranged from sore muscles, being tired, and having a cold, to wearing sweat pants and having exercised before the trial. She actually had a better mean performance (1749.2 revolutions) during those trials than during the trials for which there were no factors preventing her from performing her best (1714.0 revolutions). However, as this difference was not significant ($t(17)=2.015$; $p > .05$; NSig) these outside factors could not be linked to recorded performance.

The subject noted a preference for the unaided condition on the postexperiment questionnaire. She also accurately perceived it as the most effective condition for improving her rowing performance. She judged the task specific condition to be the next most effective, with the voluntary distraction condition the least effective, which was also in accord with the actual results.

Discussion

The results for this subject indicated that cognitive strategies were not effective in improving her rowing performance.

S3 achieved her best results under the unaided condition, although those performances were no better than the baseline performances.

The majority of trials for both cognitive strategy conditions were well below the baseline range.

One variable that contributed to the differences between the conditions was the number of strokes completed during the trial. The best performances for all conditions were those in which the stroke rating was high. The consistently lower stroke ratings for the cognitive strategy trials resulted in poorer performances. This indicated that performance was highly related to stroke rating.

This subject reported being able to concentrate most while employing a voluntary distraction strategy. The poorest performances were produced under this condition. The performances under the task specific condition were better although concentration on the strategy was reported to be lower. The best performances were produced under the unaided condition, which required no planned concentration. For this subject, it appeared that performance was inversely related to concentration.

The other factor that may have contributed to the superiority of performances under the unaided condition was the subject's preference for that condition. She also felt it was the most effective for improving her rowing. This may have put her in a better frame of mind to produce good results under this condition.

There was a great amount of overlap in the stroke efficiencies produced under the three conditions. Therefore, no relationship between the quality of strokes and performance outcome was apparent.

No association was found between performance and a number of other variables. These variables included the following: reported

discomfort ratings, the assessment of a trial as painful or nonpainful, the amount eaten prior to a trial, and other factors that the subject felt prevented her from performing her best. There was insufficient data to determine if the amount of sleep received prior to a trial had any bearing on performance.

S3's pretest expectation of performance did not affect her performance. However, this subject's posttest assessment was accurate in assessing the standard of the performance.

Results for this subject indicated that inferior performances were achieved under the cognitive strategy conditions because she had a lower stroke rating while employing strategies. Requiring this subject to concentrate on prepared content seemed to be a deterrent to good performance. It would not be advisable for this subject to use cognitive strategies, but to continue using an unaided condition for optimum rowing performance. This finding might be reversed if the cognitive strategies, particularly the task specific condition, were oriented to achieving higher stroke ratings.

CHAPTER VII

Subject 4 Results and Discussion

Results

The performance record of S4 is illustrated in Figure 16. This subject required 17 trials to achieve a stable baseline.

S4 achieved the best performances while using a voluntary distraction strategy. There was little difference between trials performed under the unaided condition and the task specific condition. Stability was reached for the two treatment conditions and the unaided condition.

The stroke ratings for S4 are presented in Figure 17. She completed the greatest number of strokes under the voluntary distraction condition. There were no obvious differences between the stroke ratings under the task specific condition and the unaided condition.

Figure 18 depicts the stroke efficiencies of this subject. All three conditions produced very similar stroke efficiencies. No single condition appeared to be superior in this area.

S4's self-perceived ability to concentrate on the two treatment conditions is not illustrated in graph form. No differences occurred here as she felt she was always able to concentrate on both strategies 100% of the time.

The reported levels of discomfort experienced for the trials are presented in Figure 19. There were no differences in self-perceived discomfort ratings among the three conditions.

The Binomial test (Z=.258; $p \geq$.397; NSig) conducted between S4's pretest expectation and the actual performance produced a nonsignificant

FIGURE 16. TOTAL PERFORMANCE S4.

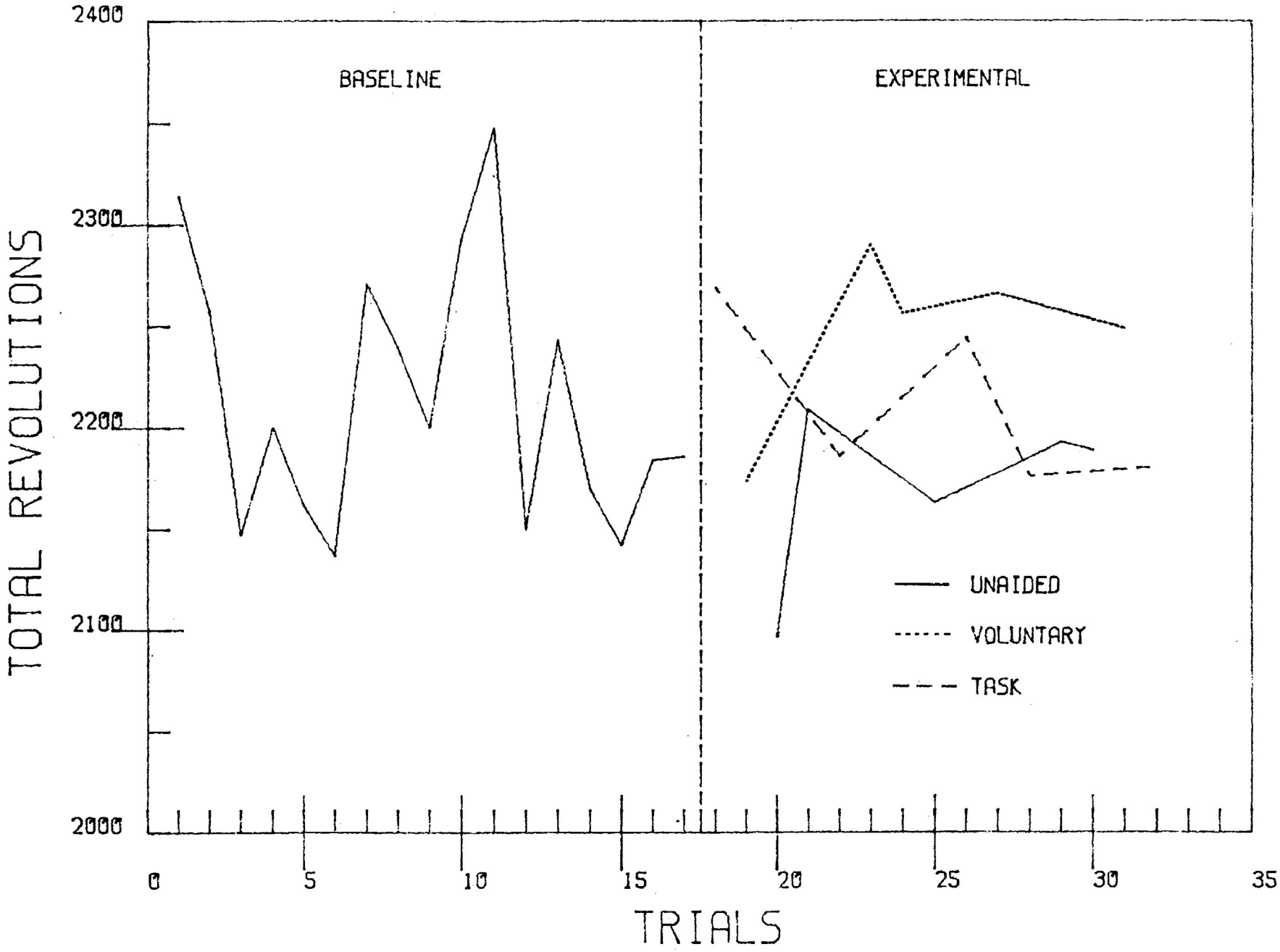


FIGURE 17. TOTAL STROKES S4.

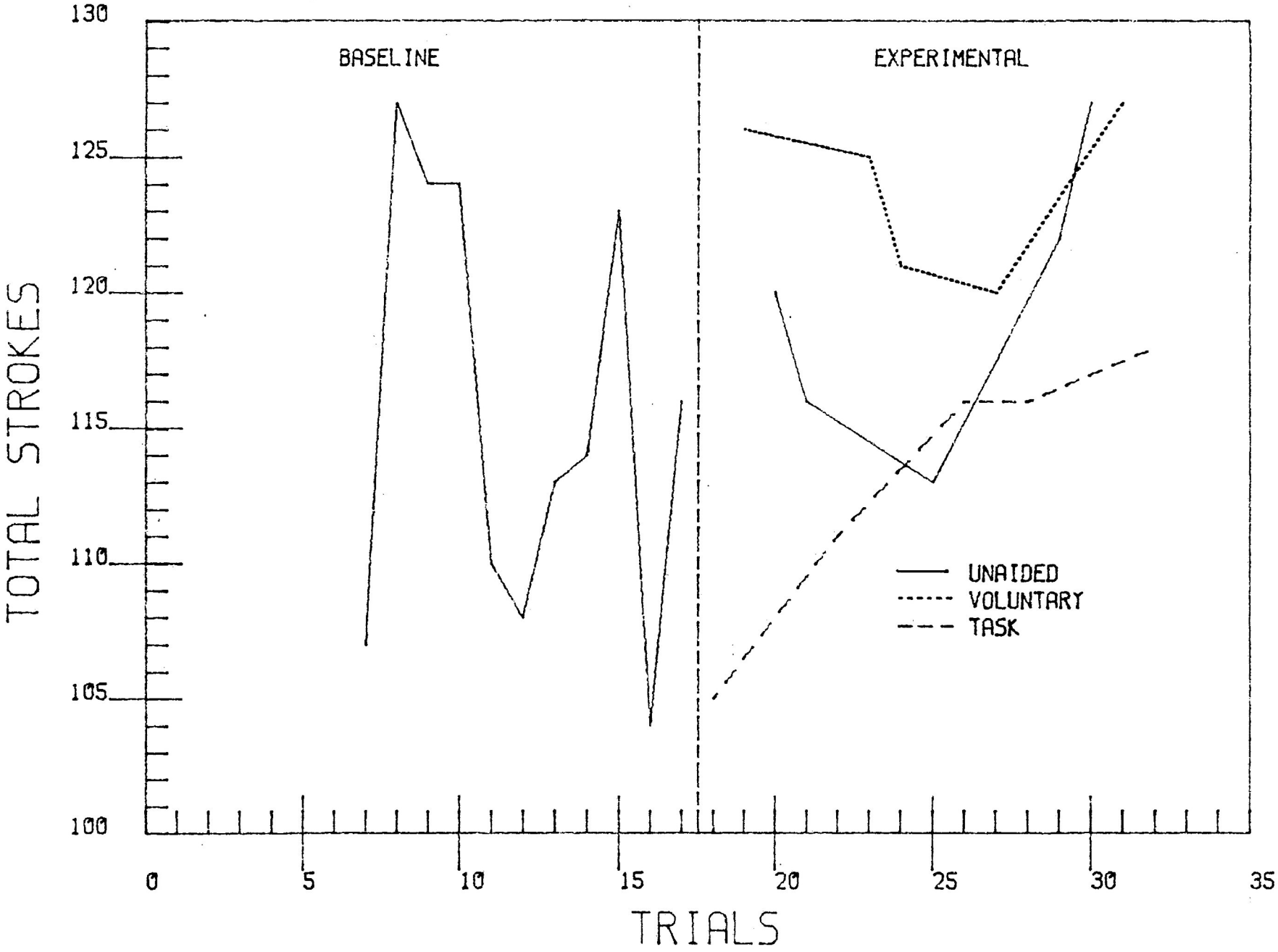


FIGURE 18. STROKE EFFICIENCY S4.

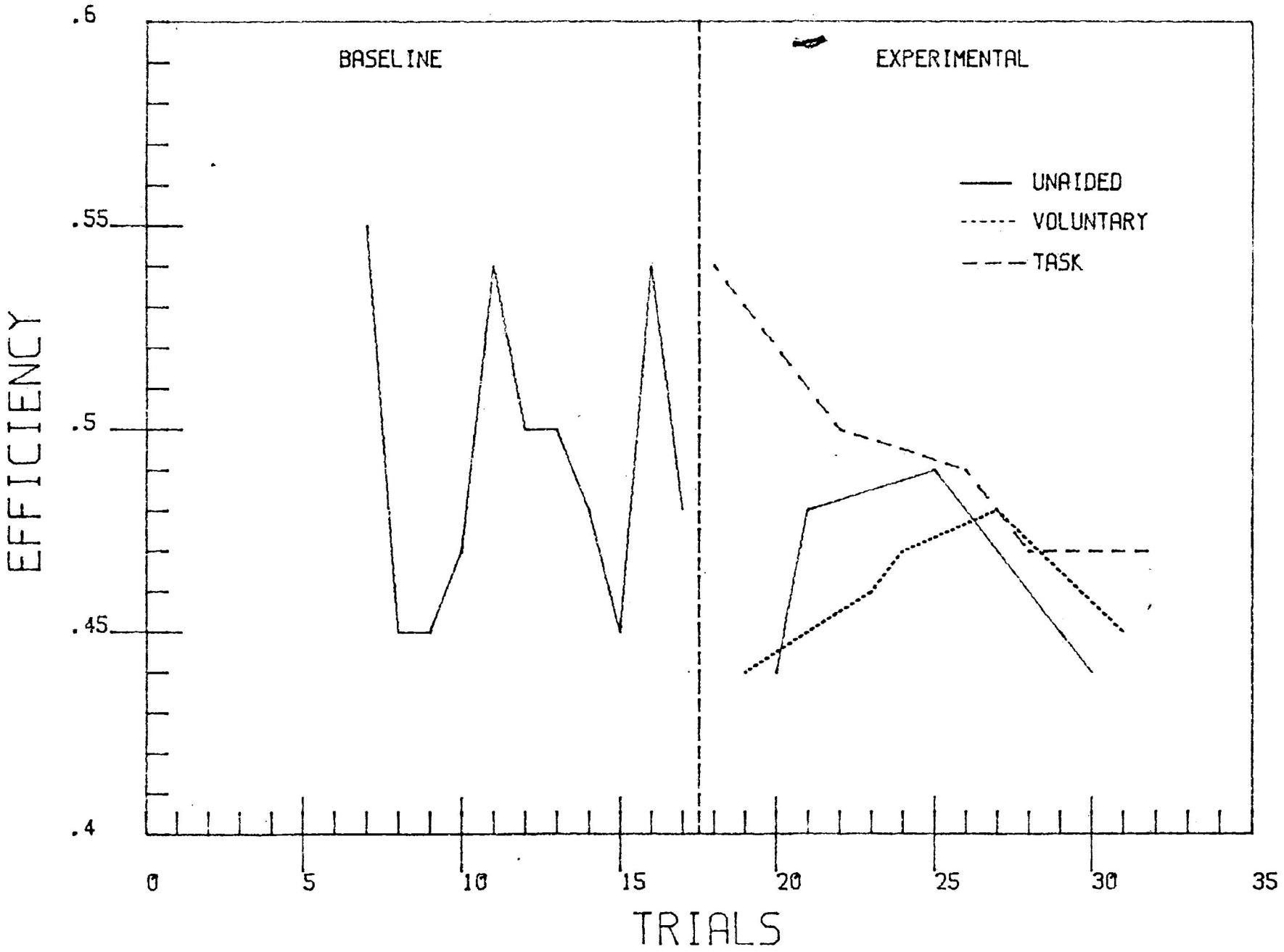
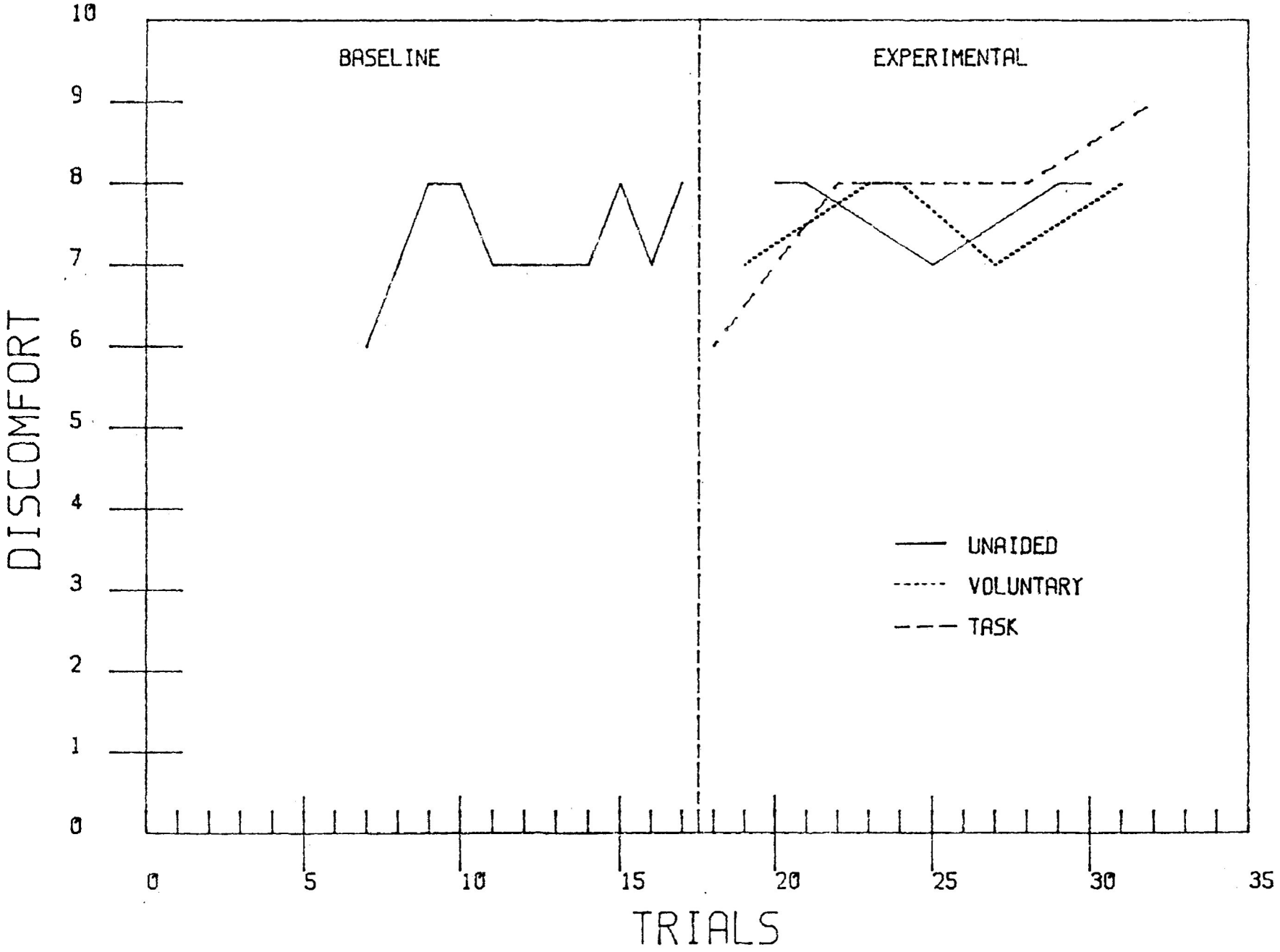


FIGURE 19. DISCOMFORT S4.



result. This indicated that the subject's pretest expectancy was not associated to actual performance outcome.

The relationship between S4's posttest assessment of performance and the actual performance was also tested (Z=1.291; $p \geq .099$; NSig). This was not significant and suggested that the subject's evaluation of the performance standard was not accurate.

The data collected from the posttest questionnaires revealed that S4 felt seven of the 15 trials were painful. The mean performance for painful trials was 2197.6 revolutions and 2219.9 revolutions for non-painful trials. This difference was not significant ($t(13)$=.749; $p > .05$; NSig). This suggested that the assessment of pain was not manifested in performance.

The relationships between eating and sleeping patterns and performance could not be determined because of insufficient data. S4 felt she got enough sleep prior to every trial. She did not report eating too much or too little before any trial.

The subject felt there were other factors preventing her from performing her best before two of the 15 trials. These factors included fatigue and a sore leg. The mean performance for those trials was 2181.5 revolutions. The mean performance for trials which had no factors affecting performance was 2213.8 revolutions. The difference was not significant ($t(13)$=.269; $p > .05$; NSig). This indicated that these other factors were not reflected in performance outcomes.

On the postexperiment questionnaire, S4 reported a preference for the task specific strategy. She also perceived it to be the most effective for improving rowing performance. This did not concur

with the actual results; which showed the voluntary distraction strategy to be the most effective for this subject. She judged voluntary distraction to be the second most effective condition, with the unaided condition perceived as the least effective.

Discussion

The results for this subject indicated that a voluntary distraction strategy was effective in improving performance.

S4 achieved her best results while using a voluntary distraction strategy. Performances under the task specific and unaided conditions were similar.

The only factor examined that appeared to be related to performance was stroke rating. This subject completed the greatest number of strokes under her most effective condition, voluntary distraction. This suggested that S4 obtained her results by emitting differential levels of stroking, that is, the more strokes taken the higher the total number of flywheel revolutions.

The other minor dependent variable, stroke efficiency, did not seem to be associated with performance. There were few differences in the quality of the strokes for the three conditions.

The discomfort levels reported for each condition also could not be differentiated. In fact, the majority of all three conditions were rated as 8 out of 10 for discomfort. The effects of concentration on performance could not be determined as this subject felt she was able to concentrate completely on both treatment strategies.

The relationships between performance and other variables were determined by analysing the data collected from the questionnaires.

No associations were found between performance and the following: the assessment of a trial as painful or non-painful, other factors that the subject felt prevented her from performing her best, the pretest expectation of performance, a preference for a specified condition, and the perception of the effectiveness of a specified condition. The connections between eating and sleeping patterns and total revolutions of the flywheel could not be determined as there was insufficient data.

In conclusion, the better results achieved by this subject under the voluntary distraction condition appeared to be a result of her ability to complete more strokes while using this strategy. The question is raised as to whether the overall performance under the task specific condition could be enhanced if the prepared content included an emphasis on elevated stroke ratings.

CHAPTER VIII

General Discussion

No single strategy condition was superior for all subjects. The individual nature of the subjects, and their responses to this sporting task, was evident in the different patterns of variables found for each.

Two of the four subjects achieved their best performances while using a task specific strategy (Z=1.100, $p \geq .133$). The small number of subjects made this finding nonsignificant due to a lack of statistical power. For example, if 50% of 10 subjects had performed best under the task specific condition it would have been determined to be significantly better than the other conditions.

Three of the four subjects had increased stroke ratings while employing their most effective condition (Z=2.77, $p \geq .0028$, Sig). This demonstrated that performance will likely be increased through increased stroking associated with the strategy used.

Only one subject had her highest stroke efficiencies during her best performances. This suggested that strategies are generally not likely to increase performance through increases in stroking efficiency. Similarly, both the percentage of time the subject felt she was able to concentrate on the strategy and the degree of discomfort perceived appeared to be related to performance for only one subject. These factors do not appear to be differentially related to the type of thinking that is employed by a novice female rower.

The perception of the trial as painful or non-painful was not related to performance for any of the subjects. As well, the relationship between pretest expectation and performance was nonsignificant for all subjects. These factors did not affect the resulting performance any more than would be expected by chance.

Three of the subjects performed best under the condition they preferred. These subjects also correctly perceived the order of effectiveness of the three conditions for themselves. This suggested the athlete's outlook on a specific strategy was related to successful performance.

It was interesting to note the varying number of factors that appeared toaffect each subject's performance. Twelve factors were examined to determine if they had any association with performance. Seven of these factors seemed to have some relationship with the performance of at least one subject. For S1, six of the seven factors were found to have some association with performance. These were stroke rating, degree of self-reported concentration, the degree of discomfort perceived, other factors that may have affected performance, preference of condition, and the perceived effectiveness of the condition. S3 had four factors that may have influenced her performance, stroke rating, an inverse relationship with the degree of concentration, preference of condition, and the perceived effectiveness of the condition. There were three such factors for S2, stroke efficiency, preference of condition, and the perceived effectiveness of the condition. Only a single factor, stroke rating, had any significant connection with S4's performance. These unique perceptions and responses underscore the complexity and individuality of the components which affect an athlete's performance.

The results of this study have implications for the practitioner. Task specific strategies were most effective for the greatest proportion of the subjects. This agreed with the findings of previous researchers (Chorkawy, 1982; Ford, 1983; Selkirk, 1980). However, because some subjects respond better under other conditions it would be prudent to construct some testing protocol that would evaluate the effectiveness of each strategy for each athlete. This would allow a coach to prescribe the most effective thought patterns and concentrations for each athlete.

A simple coaching action might be to assess all athletes under some standard performance protocol to establish a form of baseline performance on a task that is related highly to the sport. Since task specific strategies most likely will affect the largest proportion of athletes, the instruction to all athletes to concentrate on them would be appropriate. After a period of time that would allow for learning, adjustment, and development of the task specific strategies, those athletes who have not improved in performance should be given the opportunity to experiment with unaided and voluntary distraction strategies. This would produce a series of elimination trials that, hopefully, would result in all athletes eventually using thought strategies which are associated with their most effective performance. The development of the testing protocols and the procedures for determining which strategy is effective are topics for future studies.

A more sweeping interpretation of the results has the potential to be disruptive to current sport science thinking. The fact that the best levels of performance could be manipulated by the type of thinking that an athlete employed was demonstrated. However, other

reportedly important variables that affect performance, such as expectation, degree of discomfort, amount of concentration, etc. were not shown to be associated in any consistent or significant way with rowing performance. This raises the possibility that strategy development and concentration suppress the affects of these other variables. This is a possibility for future research. In none of the literature reviewed for this study was the nature of the thought control (strategy) controlled when these other factors were the major emphasis of investigators. This suppression possibility is strengthened when the results of Chorkawy, Crossman, Ford, and Selkirk are contemplated. In their studies the effects of the extra variables were not demonstrated, but those of strategies were. Allowing for one further large step in this deductive line of reasoning, it is possible that strategy development and employment suppresses the effect of lesser and weaker performance associated factors. Clearly, this is an exciting potential area for research.

CHAPTER IX

Summary, Conclusions, and Recommendations

Summary

This thesis studied the effects of three cognitive strategies on ergometer performance of four female members of the Thunder Bay Rowing Club.

Four replications of a single subject alternating treatments design were used. A baseline stage was conducted until the subject's performance reached stability. Each rower then alternately utilized one of three conditions. This continued until one strategy was superior to the others in four consecutive blocks of three trials.

The independent variables were the three strategies employed by the subjects. The major dependent variable was the total number of revolutions of the ergometer flywheel per three minutes. The minor dependent variables were the total number of strokes completed per three minutes and the stroke efficiency for each trial. Supporting information from pretest, posttest, and postexperiment questionnaires was also examined. This included the following: a) the subject's pretest expectation of performance, b) the subject's posttest assessment of performance, c) the percentage of time the subject felt she was able to concentrate on the content of the strategy, d) the subject's assessment of the trial as painful or non-painful, e) the degree of discomfort perceived by the subject for each trial, f) the subject's preferred condition, g) the subject's perceived order of effectiveness of the three conditions, and h) a description of any factors that may have affected performance.

These data were graphed and analysed visually to determine if any trends were obvious. Binomial tests were done on the pretest expectation of performance and the actual performance, and on the performance and the posttest assessment of it. This was done to determine if any relationships existed between them. T tests were used to determine if any extraneous variables affected performance.

Conclusions

1. Responses of the athletes to the utilization of cognitive strategies was very individual.
2. The task specific strategy appeared to be the most successful, although this could not be generalized because of the small number of subjects.
3. Higher stroke rating was linked to superior performances. Three of four subjects had their highest stroke ratings with their most successful strategy condition.
4. Stroke efficiency was not generally related to better performance.
5. The percentage of time the subject felt she was able to concentrate on the strategy generally was not pertinent to performance.
6. Neither the degree of discomfort perceived nor the perception of the trial as painful or non-painful appeared to be related to performance.
7. The subjects generally performed best under their preferred condition. They also generally perceived that condition as the most effective.
8. The number of factors influencing each athlete's performance varied greatly.

Recommendations

1. The study should be replicated with a greater number of subjects. This would increase the external validity of the data as well as the power of any statistical analyses.
2. A testing protocol for evaluating the effects of strategies for each sport should be developed with the aim to produce an assessment procedure that could be used by coaches to determine strategy effects.
3. A procedure for assessing the best strategy for an athlete that can be used by practitioners should be developed. A possible framework for such a procedure was suggested in this study.
4. An evaluation of the hypothetical suppressor effect of strategies over lesser variables should be conducted.

References

Anderson, M.P. Imaging as a self-control response to enhance voluntary tolerance of an aversive stimulus. Dissertation Abstracts International, 1975, 36 (2-B), 899-900. (Abstract)

Ball, T. S., & Volger, R. E. Uncertain pain and the pain of uncertainty. Perceptual and Motor Skills, 1971, 33 (3 Pt. 2), 1195-1203.

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 treatment designs: one strategy for comparing the effects of two treatments in a single subject. Journal of Applied Behavioural Analysis, 1979, 12 (2), 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, M., & Davidson, P. O. Psychological factors affecting pain tolerance. Journal of Psychosomatic Research, 1970, 14, 371-376.

Brucato, D. B. The psychological control of pain: the role of attentional focusing and capacity on the experience of pain. Dissertation Abstracts International, 1978, 39 (5-B), 2488. (Abstract)

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

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

Chorkawy, A. L. The effects of cognitive strategies on the performance of female swimmers. Unpublished master's thesis, Lakehead University, 1982.

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.

Davidson, P. O., & Neufeld, R. Response to pain and stress: a multivariate analysis. Journal of Psychosomatic Research, 1974, 18, 25-32.

DeWitt, D. J. Cognitive and biofeedback training for stress reduction with university athletes. Journal of Sport Psychology, 1980, 2, 288-294.

Ellison, K., & Freischlag, J. Pain tolerance, arousal and personality relationships of athletes and nonathletes. Research Quarterly, 1975, 46 (2), 250-255.

Feltz, D. L., & Landers, D. M. Stress management techniques for sport and physical education. Journal of Physical Education and Recreation, 1980, 51 (2), 41-43.

Ford, D. The effects of cognitive strategies on swimming performance. Unpublished master's thesis, Lakehead University, 1983.

Fox, E. L. Sports physiology. Philadelphia: Saunders College Publishing, 1979.

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

Gould, D., Weinberg, R. S., & Jackson, A. Effects of mental preparation strategies on a muscular endurance task. Journal of Sport Psychology, 1980, 2, 329-339.

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.

Horton, A. M., Jr., & Shelton, J. K. The rational wrestler: a pilot study. Perceptual and Motor Skills, 1978, 46, 882.

Jaremko, M. E. Cognitive strategies in control of pain tolerance. Journal of Behaviour Therapy and Experimental Psychiatry, 1978, 9 (3), 239.

Kanfer, F. H., & Goldfoot, D. A. Self-control and tolerance of noxious stimulation. Psychological Reports, 1966, 18 (1), 79-85.

Mahoney, M. J., & Avener, M. Psychology of the elite athlete: an exploratory study. Cognitive Therapy and Research, 1977, 1, 135-141.

Morgan, W. Contemporary readings in sport psychology. Springfield, Illinois: Thomas, 1970.

Morgan, W. P. The mind of the marathoner. In Suinn, R. M. (ed.), Psychology in Sports: Methods and Applica tions, Minneapolis, Minn.: Burgess Publishing Company, 1980.

National Coaching Certification Program. Coaching Theory: Level 3. Ottawa: Coaching Association of Canada, 1981.

Neufeld, R., & Davidson, P. O. The effects of vicarious and cognitive rehearsal on pain tolerance. Journal of Psychosomatic Research, 1971, 15, 329-335.

Rotella, R. J., Gansneder, B., Ojala, D., & Billing, J. Cognitions and coping strategies of elite skiers: an exploratory study of young developing athletes. Journal of Sport Psychology, 1980, 2, 350-354.

Rushall, B. S. Psycho-social factors in performance, In J. Taylor (ed.), Science and the athlete. Ottawa: Coaching Association of Canada, 1975.

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

Rushall, B. S. The content of competition thinking- strategies. Paper presented at the Annual Symposium of the Canadian Society for Psychomotor Learning and Sport Psychology, Edmonton, October 1982.

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, 2, 373-383. (a)

Scott, D. S., & Barber, T. X. Cognitive control of pain: 4 serendipitous results. Perceptual and Motor Skills, 1977, 44, 569-570. (b)

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

Shelton, A. O., & Mahoney, M. J. The content and effect of "psyching-up" strategies in weight lifters. Cognitive Therapy and Research, 1978, 2, 275-284.

Shephard, R. J. Mind over matter. In The fit athlete. Toronto: 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, N., Radtke-Bodorik, H., Ferguson,J., & Jones, B. The effect of hypnotic susceptibility, suggestions for analgesia, and the utilization of cognitive strategies on the reduction of pain. Journal of Abnormal Psychology, 1979, 88 (3), 282-292.

Staub, e., Tursky, B., & Schwartz, G. Self-control and predictability: Their effects on reaction to aversive stimulation. Journal of Personality and Social Psychology, 1971, 18, 157-162.

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

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

Suinn, R. M. Psychology and sports performance: Principles and applications. In Suinn, R. M. (ed.), Psychology in sports: Methods and applications. Minneapolis, Minnesota: Burgess Publishing Company, 1980.

Turk, D. C. A coping skills-training approach for the control of experimentally-produced pain. Dissertation Abstracts International, 1978, 39 (94-B), 1972. (Abstract)

Walker, J. Pain parameters of athletes and non-athletes. Dissertation Abstracts International, 1970, 31 (4-A), 1607. (Abstract)

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

Weinberg, R. S., Gould, D., & Jackson, A. Cognition and motor performance: Effect of psyching-up strategies on three motor tasks. Cognitive Therapy and Research, 1980, 4, 239-245.

Wolff, B. Factor analysis of human pain responses: Pain endurance as a specific factor. Journal of Abnormal Psychology, 1971, 78, 292-298.

Wood. M. M. Psychological and behavioural techniques in facilitating sports performance. Sports Coach, 1981, 5 (1), 10-12.

Yakovlev, N. N. Fatigue in sports: its basis and significance. Soviet Sports Review, 1979, 14 (3), 105-108.

Zborowski, M. Cultural components in response to pain. Journal of Social Issues, 1952, 8, 16-30.

Zimbardo, P., Cohen, A., Weisenberg, M., Dworking, L., & Firestone, I. Control of pain motivation by cognitive dissonance. Science. 1966, 151, 217-219.

APPENDIX A

Examples of Pretest and Posttest Questionnaires

1) unaided - first trial

2) unaided - later trials

3) strategy - first trial

4) strategy - later trials

Example of Postexperiment Questionnaire

NAME_____

DATE_____

PRETEST QUESTIONNAIRE (1)

Instructions: Please read and circle your response.

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

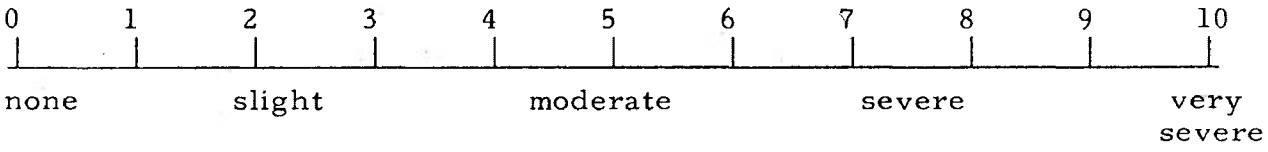
   b) eat too much or too little before this trial? YES NO

2. Is there anything preventing you from performing your best today? YES NO

   If answer is 'YES' please explain.

POSTTEST QUESTIONNAIRE (1)

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



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

3. What were you thinking about during your row today?

NAME_____

DATE_____

PRETEST 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

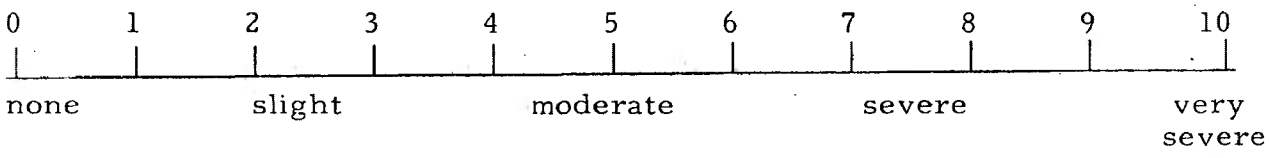
2. Do you expect to do better today than on your previous row? YES NO

3. Is there anything preventing you from performing your best today? YES NO

   If answer is 'YES' please explain.

POSTTEST QUESTIONNAIRE (2)

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



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

3. Do you feel that you did do better today than on your previous row? YES NO

4. What were you thinking about during your row today?

NAME_____

DATE_____

PRETEST QUESTIONNAIRE (3)

Instructions: Please read and circle your response.

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

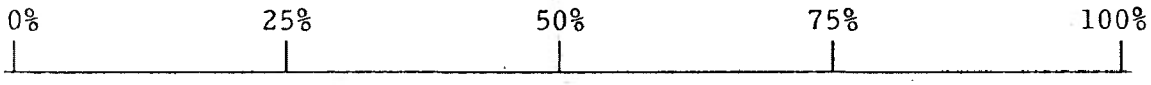
   b) eat too much or too little before this trial? YES NO

2. Is there anything preventing you from performing your best today? YES NO

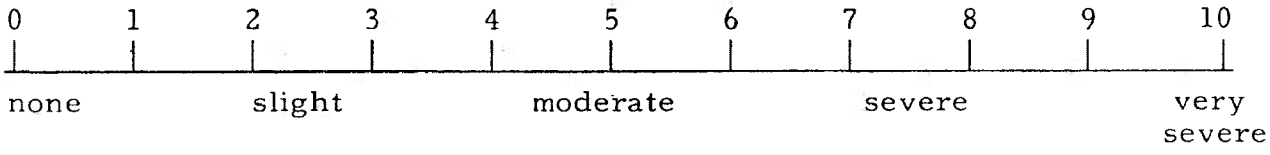
   If answer is 'YES' please explain.

POSTTEST QUESTIONNAIRE (3)

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



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



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

NAME_____

DATE_____

PRETEST 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

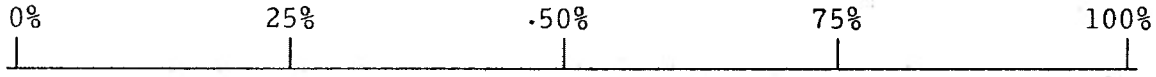
2. Do you expect to do better today than on your previous row? YES NO

3. Is there anything preventing you from performing your best today? YES NO

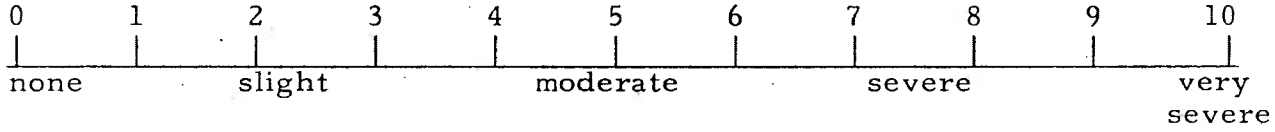
   If answer is 'YES' please explain.

POSTTEST QUESTIONNAIRE (4)

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



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



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

4. Do you feel that you did do better today than on your previous row? YES NO

POSTEXPERIMENT QUESTIONNAIRE

NAME_____

Instructions: Please answer the following questions carefully.

Take some time to think over your answers.

During your three minute maximum effort rows you were asked to think of different things while you rowed. The three strategies you were asked to use were:

A. Unaided - Complete your three minute as you normally would.

B. Task Specific - Complete your three minute row concentrating entirely on your rowing technique.

C. Voluntary Distraction - Complete your three minute row concentrating on things that will take your mind away from rowing. Please do not concentrate on your technique.

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 performance?

3. List in order from most effective to least effective (1 to 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

Sample Instruction Sheet

Sample Sheets Containing Key Words and Ideas

for Use in Formulating Cognitive Strategies

1) Task Specific Strategy

2) Voluntary Distraction Strategy

INSTRUCTIONS

During the next few weeks you will be asked to row a three minute maximum effort using one of three different thought strategies. These will be called: 1) Unaided condition, 2) Task Specific strategy , and 3) Voluntary Distraction strategy.

1) Unaided Condition: In the unaided condition you will perform your standard warm-up. You will then start your three minute row.

2) Task Specific Strategy: In the task specific strategy condition you will perform your standard warm-up. You will then start your three minute row. During this row you will focus your attention and concentrate entirely on your rowing technique. As you row always think of your technique. For your entire row concentrate on driving with your legs, good posture, a quick catch, a good swing over the handle, and accelerating the handle. Remember, you are to think only of your technique. Concentrate, at all times, on the movements you are making 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 warm-up. You will then start your three minute row. During this row you will think of things that will take your mind away from rowing. Please do not concentrate on your technique as in the task specific situation. Think of anything you wish that will distract you from your rowing. You may sing, count, recite poetry, or think of anything you wish, except your rowing.

TASK SPECIFIC STRATEGY

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

Key Words:

posture	drive with legs first
quick catch	finish with the legs
spin the wheel	transfer momentum to handle
relax on recovery	accelerate the handle
rhythm	good swing over the seat
hang the weight on	

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

VOLUNTARY DISTRACTION STRATEGY

Instructions: Using the following ideas, and any others you can think of, write down statements for you to concentrate on during your row.

Ideas:
- Singing
- Counting
- Games
- Reciting Poetry
- T.V.

Note: Plan enough content to fill the entire three minutes. Ideas can be repeated. Do not concentrate on your rowing technique as you did in the task specific condition.

APPENDIX C

Tables Containing Performance Data, Pretest, Posttest, and Postexperiment questionnaire Data

1) Subject 1

2) Subject 2

3) Subject 3

4) Subject 4

5) Key for tables

Subject 1 - Results

Tr	Dat	Wgt	Con	Revs	Sts	Eff	Conc	Disc	Pain	Slp	Food	OF	PE	PA
1	D 6			1950										
2	8	55.4		1903	86	.70		5	N	Y	N	N		
3	10	55.2		1923	88	.69		6	N	Y	N	N		
4	15	55.2		1889	78	.77		3	N	Y	N	N	Y	N
5	17	55.7		1925	79	.77		6	Y	Y	N	N	Y	N
6	20	54.3	U	1926	79	.79		6	Y	Y	N	N	Y	N
7	22	55.0	V	1871	78	.76	75	3	N	Y	Y	Y	N	Y
8	24	54.9	T	1894	81	.75	95	7	Y	Y	N	N	N	N
9	29	55.7	V	1831	80	.72	62	6	Y	Y	N	Y	N	N
10	31	55.4	T	1893	76	.79	95	6	N	Y	N	N	N	Y
11	J 3	55.0	U	1875	82	.73		7	Y	Y	N	Y	N	Y
12	5	55.7	T	1951	85	.72	100	6	N	Y	N	N	N	Y
13	7	56.1	U	1851	79	.73		5	N	Y	N	N	N	N
14	10	55.6	V	1784	79	.71	68	3	N	Y	N	Y	N	N
15	12	55.4	U	1915	80	.76		6	Y	Y	N	N	Y	N
16	14	55.0	T	2002	84	.76	100	8	Y	Y	N	N	Y	Y
17	17	55.8	V	1839	79	.73	50	6	Y	Y	N	Y	N	N
18	19	55.7	V	1788	77	.73	95	5	N	Y	N	N	N	N
19	21	55.0	U	1961	84	.74		7	Y	Y	N	N	N	N
20	24	55.4	T	2043	87	.74	95	8	Y	Y	N	N	N	N
21	26	55.0	T	2039	85	.76	100	7	Y	Y	N	N	Y	N

Preferred Condition: Task Specific

Perceived Order of Effectiveness:
1. Task Specific
2. Unaided
3. Voluntary Distraction

Subject 2 -- Results

Tr	Dat	Wght	Con	Revs	Sts	Eff	Conc	Disc	Pain	Slp	Food	OF	PE	PA
1	N29			1730										
2	D 1			1790										
3	3			1834										
4	6			1762										
5	8	52.7		1777				7	N	N	N	Y		
6	10	52.7		1787				6.5	N	Y	N	N		
7	13	52.7		1804	92	.74		6.5	N	Y	N	N	Y	Y
8	15	52.7	T	1921	92	.79	90	8.5	Y	Y	N	N		
9	20	52.8	U	1839	92	.76		7.5	Y	Y	N	Y	N	N
10	22	52.3	V	1796	95	.72	75	8	N	N	N	N	N	N
11	27	53.0	V	1814	92	.74	75	8	N	N	N	Y	N	N
12	29	52.3	T	1849	92	.77	60	6	N	Y	N	N	Y	Y
13	31	52.0	U	1791	92	.75		6.5	N	Y	N	N	N	Y
14	J 5	52.8	U	1810	95	.72		7	Y	Y	N	N	N	Y
15	7	52.1	V	1835	98	.72	75	6	N	N	N	N	Y	Y
16	10	52.4	T	1865	96	.74	75	7	Y	Y	N	N	N	Y
17	12	52.3	V	1837	99	.71	75	5.5	N	Y	N	N	Y	N
18	14	52.4	U	1824	93	.75		7	Y	Y	N	N	N	N
19	17	53.0	T	1851	92	.76	50	6.5	N	Y	Y	N	N	Y
20	21	52.5	T	1853	97	.73	75	7	N	N	N	N	Y	Y

Preferred Condition: Task Specific

Perceived Order of Effectiveness:
1. Task Specific
2. Unaided
3. Voluntary Distraction

Subject 3 - Results

Tr	Dat	Wght	Con	Revs	Sts	Eff	Conc	Disc	Pain	Slp	Food	OF	PE	PA
1	N24			1744										
2	26			1730										
3	29			1793										
4	D 1			1802										
5	3			1769										
6	6			1796										
7	8	78.1	U	1753	99	.57		2	N	N	Y	Y		
8	10	77.2	T	1775	100	.57	50	5	Y	N	N	Y		
9	13	77.2	V	1752	107	.53	75	3	N	N	N	Y	N	N
10	15	77.2	T	1759	96	.59	25	2	N	Y	N	N	N	N
11	17	77.0	V	1716	92	.61	75	1	N	N	N	N	Y	Y
12	20	78.0	U	1707	92	.59		5	N	N	N	N	N	N
13	22	78.0	V	1670	95	.56	75	5	Y	N	N	Y	N	N
14	27	78.0	U	1795	100	.58		4	Y	N	N	Y	N	Y
15	29	78.2	T	1730	95	.58	25	5	Y	N	N	Y	N	N
16	31	78.0	T	1725	91	.61	75	4	N	N	N	Y	N	Y
17	J 5	77.6	U	1732	97	.58		1	N	N	N	Y	N	Y
18	7	77.0	V	1700	97	.57	75	4	N	N	N	N	N	N
19	10	77.1	V	1663	91	.59	75	2	N	N	N	N	N	N
20	12	77.5	T	1693	93	.59	60	4	N	N	N	N	N	N
21	14	78.1	U	1773	100	.57		4	N	N	N	N	Y	Y
22	17	77.4	U	1763	101	.56		3	N	N	N	Y	N	N
23	21	78.6	V	1691	94	.58	10	3	N	N	N	N	N	N
24	24	78.0	T	1724	98	.56	65	3	N	N	Y	N	N	N
25	28	77.5	U	1797	104	.56		5.5	N	N	N	Y	N	Y

Preferred Condition : Unaided

Perceived Order of Effectiveness:
1. Unaided
2. Task Specific
3. Voluntary Distraction

Subject 4 - Results

Tr	Dat	Wght	Con	Revs	Sts	Eff	Conc	Disc	Pain	Slp	Food	OF	PE	PA
1	N24			2314										
2	26			2257										
3	29			2147										
4	D 1			2200										
5	3			2162										
6	6			2137										
7	8	68.1		2271	107	.55		6	N	Y	N	N		
8	10	69.0		2239	127	.45		7	N	Y	N	N		
9	13	69.0		2200	124	.45		8	Y	Y	N	Y	N	N
10	15	69.0		2293	124	.47		8	Y	Y	N	N	Y	Y
11	17	69.2		2348	110	.54		7	N	N	N	Y	N	N
12	20	69.0		2150	108	.50		7	N	N	N	Y	N	N
13	22	69.0		2243	113	.50		7	N	Y	N	N	Y	N
14	24	69.1		2170	114	.48		7	N	Y	N	N	N	N
15	27	67.5		2142	123	.45		8	Y	Y	N	Y	N	N
16	29	67.5		2184	104	.54		7	N	Y	N	Y	N	N
17	31	69.0		2186	116	.48		8	Y	N	N	Y	N	N
18	J 3	69.5	T	2269	105	.54	100	6	N	Y	N	N	Y	Y
19	5	69.0	V	2174	126	.44	100	7	N	Y	N	N	Y	Y
20	7	69.3	U	2097	120	.44		8	Y	Y	N	Y	N	N
21	10	69.0	U	2209	116	.48		8	Y	Y	N	N	Y	N
22	12	69.1	T	2186	111	.50	100	8	Y	Y	N	N	Y	N
23	14	69.5	V	2290	125	.46	100	8	Y	Y	N	N	Y	Y
24	17	69.5	V	2256	121	.47	100	8	N	Y	N	N	Y	Y
25	19	68.5	U	2163	113	.49		7	N	Y	N	N	N	N
26	21	69.2	T	2244	116	.49	100	8	Y	Y	N	N	Y	Y
27	24	69.0	V	2266	120	.48	100	7	N	Y	N	Y	N	Y
28	26	69.3	T	2176	116	.47	100	8	Y	Y	N	N	Y	Y
29	31	69.3	U	2193	122	.45		8	N	Y	N	N	N	N
30	F 2	69.0	U	2189	127	.44		8	N	Y	N	N	Y	N
31	4	69.5	V	2249	127	.45	100	8	N	Y	N	N	Y	Y
32	7	69.1	T	2181	118	.47	100	9	Y	Y	N	N	Y	N

Preferred Condition: Task Specific

Perceived Order of Effectiveness:
1. Task Specific
2. Voluntary Distraction
3. Unaided

Key for Table of Results

Tr - Trial

Dat - Date of trial

Wght - Weight of subject (in kilograms)

Con - Treatment condition applied for that trial

Revs - Total revolutions of the ergometer flywheel (in three minutes)

Sts - Total number of strokes completed (in three minutes)

Eff - Stroke efficiency

Conc - Self-reported percent of time spent concentrating on strategy

Disc - Self-reported rating of discomfort

Pain - Did the subject feel her discomfort was painful for that trial?

Slp - Did the subject get enough sleep the night before the trial?

Food - Did the subject eat too much or too little before the trial?

OF - Were there any other factors preventing the subject from performing her best?

PE - Did the subject expect to do better than on her previous trial?

PA - After the trial, did the subject feel that she did do better than on her previous trial?