The influence of differences in cognitive style of selected swimming groups on ratings of perceived exertion.

Paul James Carpinter

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THE INFLUENCE OF DIFFERENCES IN COGNITIVE STYLE
OF SELECTED SWIMMING GROUPS ON
RATINGS OF PERCEIVED EXERTION

by

Paul James Carpinter

A Thesis
submitted to the Faculty of Graduate Studies
through the Faculty of Human Kinetics
in Partial Fulfilment of the requirements
for the Degree of Master of Human Kinetics at
The University of Windsor

Windsor, Ontario, Canada
1978
ABSTRACT

THE INFLUENCE OF DIFFERENCES IN COGNITIVE STYLE
OF SELECTED GROUPS ON RATINGS OF PERCEIVED EXERTION

by

Paul James Carpenter

The purpose of this study was to investigate the effects of swimming event preference and selected cognitive styles upon ratings of perceived exertion. Ratings of perceived exertion were assessed when subjects reached similar heart rate levels while pedalling a Monarch bicycle ergometer at 60 r.p.m. It was postulated that differences in the cognitive styles of internality-externality, field dependence-independence and reduction-augmentation would lead to sprint and distance swimmers systemically varying on ratings of perceived exertion.

Results indicated that swimming event preference did not influence ratings of perceived exertion and of those cognitive styles investigated only field dependence-independence produced significant interactions with other variables. These interactions were:

(a) A relationship between field dependence-independence and age. Junior swimmers (under 14 years of age) had a field-dependent cognitive style while senior swimmers (over 14 years of age) had a field independent cognitive style. This finding confirmed the results of previous researchers.
(b) Field dependence-independence predicted ratings of perceived exertion but in doing so only accounted for small amounts of the total variance.

(c) Field dependence-independence is the only cognitive style which discriminates on the basis of swimming event preference. Sprint swimmers tended to be field dependent and distance swimmers field independent. The difference was significant ($p < 0.03$). However, the multiple discriminant function generated using all the cognitive styles was not significant, classifying group membership only $57.89\%$ of the time.

Reduction - augmentation influenced ratings of perceived exertion at intermediate work rates to a small degree. Further investigation of the effect of this cognitive style on swimming event preference may possibly be noted at other tasks requiring maximum work output. Different techniques for measuring this cognitive style may also be necessary.

A relationship was noted between locus of control and ratings of perceived exertion. It appears that internals may rate perceived exertion more accurately than externals.

It was concluded that the cognitive style of field dependence-independence is related to competitive swimming. This result supports the work of several researchers who have reported that field dependence-independence is related to athletic involvement in team and individual sport activities.
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CHAPTER I

INTRODUCTION

Considerable research attention has been directed towards an examination of individuals participating in athletics and physical activity. Several authors have reported identifiable personality traits which characterize individuals selecting and participating in a particular sport (Kane, 1972; Ogilvie & Tutko, 1972; Alderman, 1974). In contrast, some authors have reported that personality is not a significant factor in athletic performance and that it is difficult to identify particular personality traits common to all athletes (Rushall, 1968; Kroll, 1970). Carron (1976) suggests that characteristics such as aggression, dominance, high self-concept, appear to be 'consistently' evidenced in individuals involved in athletic competition. However, the issue appears to be whether athletic behaviour can be attributed to some underlying causal mechanism or whether a summary label can be applied to specific observed behaviour in a specific context (Mischel, 1973). Many personality theorists have now adopted for this latter view; that is, individual differences in behaviour are attributable to behaviour patterns which are activated in specific response situations. In support of Mischel, Loy and Donnelly (1976) have postulated that an individual's response to an athletic situation is dependent upon an individual - environment interaction.

In reviewing the relationship between personality and behaviour, Neel (1977) suggests that various cognitive styles can be identified and that these refer to an individual's orientation to a
particular situation which correlates with certain larger behaviours (perceptual-cognitive-motivation-learned-motor-verbal), that is, behaviour styles. The use of term cognitive style derives from the measures used to identify specific behaviours, not the origin of the behaviour. It is possible that various cognitive styles may account for specific behaviour in an athletic situation. Differences in cognitive style may be reflected in a preference for a particular swimming event. If such a relationship exists it would provide evidence to support Morgan (1971) who postulated that some of the differences between athletic subgroups are due to athletes selecting events suited to their personal attributes rather than a consequence of athletic participation.

A number of cognitive styles have been identified and studied; levelling-sharpening, repression-sensitization, internality-externality, field dependence-independence. Witkin et. al (1971) state that the cognitive style concept approaches perceptual and intellectual activities from the perspective of the person engaged in them. Pursuit of this approach has demonstrated that an individual shows the same characteristic ways of functioning across these activities, suggesting that the classical division between the perceptual and intellectual can be relaxed. Gregory (1970) also notes a link between perceptual and intellectual activities, stating that the perception of a specific situation for the first time has a direct influence on later intellectual behaviour in similar situations. Therefore it is possible that perceptual styles may also reflect a particular cognitive style; for this study the perceptual style of reduction-augmentation will be considered as a cognitive style:

If differences in cognitive style can be demonstrated as basic to swimming event preference it is possible that cognitive
style will influence performance on more standard physiological tasks. A physiological task which has been reported to be influenced by the cognitive style of reduction-augmentation is a bicycle ergometer test to assess ratings of perceived exertion (RPE). Robertson et. al. (1977) have reported that cognitive style does influence ratings of perceived exertion for non-athletic males. If sprint and distance swimmers differ in cognitive styles it is possible that similar differences will be noted in ratings of perceived exertion on a bicycle ergometer.

This investigation will examine ratings of perceived exertion in groups of sprint and distance swimmers. Differences in field dependence-independence, reduction-augmentation and internality-externality (as measured by the Group Embedded Figure's Test, a Kinaesthetic After-effects Test and a revised version of Vando's R-A Scale, and the Nowicki-Strickland and the Rotter Internal-External Control Scales) found in these groups (sprint and distance swimmers) will be related to perceived exertion as revealed by a bicycle ergometer test with progressively increasing work loads to a self-imposed maximum.

DELIMITATIONS OF THE STUDY

This study is restricted to an investigation of swimmers from the Windsor Aquatic Club.

DEFINITION OF TERMS

Reducer: A reducer is tolerant of pain and tends to subjectively decrease what he perceives (reduces sensory stimulation).
Augmenter: An augmenter tends to be intolerant of pain and subjectively increases what he perceives (increases sensory stimulation).

Internal locus of control: Individuals with an internal locus of control perceive events as being a consequence of their own actions and thereby under personal control.

External locus of control: Individuals with an external locus of control perceive events as being unrelated to their own actions and thereby beyond their personal control.

Field dependent: In a field dependent cognitive style, perception is dominated by the overall organisation in the field and there is a relative inability to perceive parts of the field as discrete. Behaviour is determined by external environmental influences.

Field independent: In a field independent cognitive style, parts of the field are experienced as separate from the organized background and not linked with it. Behaviour is determined by events within the subject himself rather than external environmental influences.

Ratings of Perceived Exertion (RPE): RPE means the subject is asked to rate the total amount of exertion and physical fatigue, combining all sensations and feelings of physical stress, effort and fatigue.

Sprint Swimmer: Those who have a preference for an event which is less than 400 metres long.

Distance Swimmer: Those who have a preference for events which are more than 400 metres long.
CHAPTER II

REVIEW OF THE LITERATURE

Theoretical Background

The term cognitive style seems to be a comparatively recent addition to psychological theory (Vernon, 1973). Vernon indicates that a person's cognitive style, which relates to their personality type, is closely related to the idea of 'type' which flourished in German psychology in the 1900's to 1930's. As the term has not appeared consistently in the literature until recent years it is not surprising that several different definitions of cognitive style are advanced.

Wallach (1962) states that the word 'style' has entered psychology's technical vocabulary to signify certain kinds of generality. Specifically, Wallach reports, that an individual who reacts in one manner in one situation will react in a particular characteristic way in another. Witkin et al. (1962) defines cognitive style in a way similar to Wallach's definition of 'style'. That is, cognitive style is the consistent modes of functioning which characterize an individual throughout his perceptual and intellectual activities. Messick (1969) regards styles as typical modes of perceiving, remembering, thinking and problem solving, which are "inferred from consistencies in the manner and form of cognition, as distinct from the content of cognition or the level of skill displayed". Such definitions seem to support the 'trait' approach to personality typing and would not support Mischel (1973) who claims that individual differences in behaviour are attributed to behaviour patterns which are activated in specific situations.
Further to the above definitions, Conklin (1969) suggests that cognitive style is conceived as a superordinate construct which is involved in many cognitive operations and which accounts for individual differences in a variety of cognitive, perceptual and personality variables. This definition is also supported by Vernon (1973) and appears to involve the effect of the situation on the behavioural response. Such a definition would be closely associated with the postulates of Mischel (1973) and Loy and Donnelly (1976) who infer that an individual-environment interaction may well influence the cognitive style portrayed by the individual.

Field dependence-independence

Vernon (1973) reports that few cognitive styles have so far been firmly established as stable and consistent syndromes but the cognitive style of field dependence-independence is the most successful and replicable style so far investigated. The field dependence-independence dimension is best described by one of the basic measures which was utilized during the researching of this style (Witkin, 1949; 1950). In the initial experiments Witkin placed subjects one at a time in a special chair in a dark room. In front of the subject was a luminous rod inside a luminous square frame. The task for the subject was to turn a knob that would rotate the luminous line until the line was perpendicular. The frame around the line was tilted somewhat. If the subjects straightened the line by reference to the frame he would set it at a different position from the one it would be set at if he used his own body as a reference point for the perpendicularity of the line. Subjects who used their own kinaesthetic senses as the reference point for the line were found to behave differently from those subjects who used the external frame as the reference point on other measures which
were made. In general, Witkin et al. (1954, 1962) have concluded that those subjects who used themselves as reference points were more independent, self-directed, thoughtful and introspective than those who used the external frame of reference. The former group was called field independent, in the sense that their behaviour was determined by events within themselves rather than by external environmental influences, and the latter group field dependent.

Subsequent to Witkin postulating this style, considerable research attention has been directed towards investigating the differences between field dependence and field independence. The following findings provide insight into the nature of these differences.

In many intellectual tasks and some measures of personal function, the field independent person excels, but Fitzgibbons et al. (1965) found that the field dependent person came into his own in social situations, showing greater recall and recognition of social stimuli. This finding is of little surprise as Witkin et al. (1962) report that field dependents are group dependent. Further, Eagle et al. (1969) report that field dependent persons are more likely to attend to and therefore learn more about the social aspects of their environment, stimulated by their reliance on external sources of information for self definition.

The superiority of field independents on intellectual tasks which was noted by Fitzgibbons et al. (1965) may be partly attributed to the findings of Spotts and Mackler (1967). They report that field independent individuals are consistently more creative than comparable groups of field independent peers. The relationship of creativity to intelligence had been reported previously by Getzels and Jackson (1955). Field dependents are
also claimed to have slower decision making times than do field independents (Loo and Townsend, 1977) while Stuart and Bronzaft (1970) indicate that there is a tendency for field dependents to decline in performance in anxiety-provoking situations.

It appears that field independence-field dependence may also be affected by age and sex. Pande (1970) used the Embedded Figures Test to measure field dependence-independence and found that women were relatively more field dependent than men. Witkin et al. (1962) report that field independence increases with age until age 17 years, then a plateau appeared. Male/female differences were maintained, however.

As indicated by the above, considerable differences exist between field dependents and field independents and these differences have been reported by those investigating athletic behaviour. The results of Pargman, Schreiber and Stein (1974) support the postulate that field dependents are likely to be more responsive to other people in a social situation. They concluded that field dependency plays a role in athletic involvement and indicated that team sport athletes are likely to be more field dependent than individual sport athletes. Bard (1972) reported a similar result but also suggested that field independent subjects would perform at a superior level in individual sports.

Williams (1975) and Svinicki et al. (1974) suggest that field dependence and field independence also seems to be an important influence on sport preference. Adding to his earlier work and supporting Bard, Pargman (1975) reports that among males, team sport athletes tend to be field dependent and individual sport athletes field independent. No relationship was noted for female
subjects however.

Whiting and Hendry (1969) report that international table tennis players tended to be field independent and a similar result was reported by Jones (1973) for a men's international field hockey squad. Jones suggests that one might speculate a general tendency for athletic participants to have a field independent mode of perception.

Lefcourt and Siegel (1970) report that field independent subjects had shorter reaction times (greater attention) with self as opposed to experimenter controlled stimulus onset during the reaction time procedure. Haslam (1972) reports a significant positive correlation between the amount by which a subject's pain threshold was lowered and field dependence while Loo and Townsend (1977) suggest that field dependence is associated with slow decision time. These findings are not specifically related to athletics but decision time, pain threshold and reaction time may well be behaviours that would correlate with successful athletic performance and a specific cognitive style.

If successful athletic performance is partly attributable to cognitive style, field dependence-independence may well be related to swimming event preference. Differences in perceived exertion may therefore be related to a systematic relationship between cognitive style and swimming event preference if this can be demonstrated to occur.

**Internality-Externality**

Neel (1977) states that internality-externality is also one of a number of cognitive styles that have been identified and
studied. A considerable amount of research has investigated the nature of internality-externality and the following studies indicate the nature of this relationship.

Rotter (1966, 1972) reports that people learn differently in situations where rewards depend on luck, chance or the subject's belief in his own skill or characteristics determining whether reinforcement will occur. These two differing conditions suggest that the amount of learning will differ accordingly. Gore and Rotter (1963) postulated that people who have a greater belief that their behaviour determines what happens to them would be more likely to take part in social action for change when dissatisfied with present conditions. They concluded that persons who were internal are more likely than externals to take part in activities to change the environment when they consider it noxious. This finding was supported by Strickland (1965).

Gore (1962) studied the question of how internal and external subjects reacted to the control of their behaviour by others by subtle or overt suggestion. Her results suggest that when given a conscious choice, the internal individual is not resistive to suggestion. However, when internals become aware that an attempt is being made to subtly manipulate them, they prove resistive.

Phares (1955) attempted to resolve the issue whether or not internals are more likely to make efforts to change the environment in a favourable direction for themselves and whether they are more likely to be more effective than externals in such a situation. He reported that internals were generally more successful in changing the environment to suit themselves than were the externals.
Several studies investigated the relationship between internality-externality and intelligence. Bialer (1961) and Crandall, Katkovsky and Preston (1962) report that intelligence is positively related to perceived internal control. Lefcourt (1966) in discussing these findings states that in studies where the range of intelligence is not as extensive as in the above mentioned investigations, little relationship has been found between intelligence and internality-externality. Deever (1968) and Lefcourt and Telegji (1971) have found a relationship between internality and field-independence for subjects predicting measures reflecting cognitive activity.

Lefcourt (1966) reports that research is scanty on how internal or external control expectancies become generalized across differing situations. Watson and Baumel (1967) report that internal locus of control subjects made more errors when they anticipated not having control over the situation, while external locus of control subjects made more errors when they anticipated possessing control over the situation. Similarly, Julian, Lichtman and Ryckman (1968) found that internals preferred circumstances under which they could exert greater control over their outcomes. Scrull and Karabenik (1975) report a significant Personality x Situation locus of control interaction when cheating behaviour was more prevalent in congruent personality-situation combinations (internal-skill and external-chance) than in incongruent combinations (internal-chance and external-skill). Phares (1976) summarizes these findings and states that learning, performance and behaviour in specific situations are different when subjects perceive that they can control the contingency behaviour and reinforcement and when they perceive they lack such control.
Several studies have investigated the relationship between locus of control and performance under skill and chance conditions. For example, Rotter and Mulry (1965) report that internals devote more attention to decisions about skill related tasks than do externals while Phares (1972) suggests that there appears to be a direct relationship between the extent of coping behaviour and the expectancy that one's skill or ability is the crucial variable in achieving reinforcement. Phares mentions that this was especially so for subjects who had an internal locus of control.

Lefcourt and Wine (1969) concluded that internal subjects were more likely to attend to cues which help to resolve uncertainties and hence internals were able to make decisions more quickly. Julian and Katz (1966) however, reported that internals required more time to make decisions as the difficulty of the decision making increased. Lefcourt, Gronnerud and McDonald (1973) state their results support the contention that internals would be quicker at noting changes in the conditions about them and would be quicker to respond to their perceptions. Decision time may be one factor that influences certain forms of athletic performance but the exact nature of this relationship has yet to be investigated. However, it is possible that differences between externals and internals could be noted in athletic performance.

Burke and Straub (1976) investigated the relationship between psycho-social parameters, locus of control and successful age group swimmers. They report that internality is linked to success and that there is a possible difference in locus of control for sprint and distance swimmers. They suggest that distance swimmers may require to endure pain over long periods of time and accept delays of gratification and reveal therefore a greater
tendency toward internality. Burke, Straub and Bonney (1975) report that young female distance runners were high in internality, independent and possessed superior academic achievement. Therefore, it appears that there may be some basis for linking athletic event preference to locus of control. The findings of Seeman (1963, 1966, 1967) would indicate this in that he reports that internals are more knowledgeable at least in terms of personally relevant information suggesting that internally orientated athletes will be more knowledgeable about the athletic situation and therefore possibly more successful.

Lynn, Phelan and Kiker (1969) report that team sport athletes are more internally orientated. As mentioned, field dependency is a characteristic of those participating in team sports. Whether or not some athletes are attracted to a particular athletic activity on the basis of tendencies toward internality and field dependency has not yet been resolved.

Lefcourt et al. (1973) report that their results support the conditions about them and would be quicker to respond to their perceptions. Wolk and DuCette (1974) found that internals on both intentional and incidental learning tasks perform better than externals. Athletes are constantly required to adjust their performance on the basis of quick decisions. The findings above also suggest that success in athletics may be linked to locus of control.

Craig and Best (1977) state that internals manifested greater pain tolerance than externals. However, instruction on the nature of the situation as contrasted with personal control over the induction of pain did not influence pain tolerance. Pain
tolerance has been investigated as being a factor in athletic performance but has yet to be linked to cognitive style and athletic performance.

Several of the behavioural responses mentioned investigate behaviours that are related to athletic performance and this author cited only one study which focused on the relationship between internality-externality and swimming. Therefore, based on these findings, it is possible to conclude that the nature of sprint and distance events is such that internality-externality may influence performance. That is, sprint and distance races may be perceived as being sufficiently different by athletes so as to differentiate between internals and externals with respect to event preference. A difference in perceived exertion based on the relationship between internality-externality and swimming event preference could therefore quite reasonably be expected.

Reduction-Augmentation

As mentioned in the previous chapter the traditional dichotomy between perceptual and intellectual activities may not be realistic and individuals may act characteristically in both intellectual and perceptual activities. There is therefore an obvious relationship between cognitive style, perceptual augmentation and reduction. The possibility of such a perceptual style reflecting differences in cognitive style has been noted.

Petrie (1960) reported that some individuals will consistently reduce the intensity of their perceptions and others will tend to augment the intensity, and has identified three perceptual modes, i.e., reducer, augmenter, and moderate. 'Reducers'
describe themselves as alert, cautious, clear thinking, conscientious, dependable, determined, efficient, and enthusiastic (Jones, 1972). In contrast, Jones states that augmenters tend to be bossy, careless, unimaginative, logical, loud, sensitive and serious. Although little attention has been given to investigating how reducers and augmenters describe themselves, perceptual reduction and augmentation has been considered by other researchers. Sales (1972) noted that augmenters typically magnified the intensity of stimulation. In contrast, reducers attenuated the intensity of sensation and compensated by seeking stimulation.

Several behavioural responses have been identified for those categorized as reducers and augmenters. Perceptual reducers have been found to be more tolerant of pain and noxious stimulation (Petrie, 1967). Petrie, Collins and Solomon (1960) report that reducers are less tolerant of sensory deprivation while Sales (1972) indicates that perceptual reducers are sensation seekers. In addition reducers have been reported to be extraverted (Vando, 1969) and likely to judge time as passing more slowly (Petrie, Collins and Solomon, 1960; Ryan and Foster, 1967).

Authors have reported research investigating the nature of the relationship between reduction/augmentation and athletics. Ryan and Kovacic (1966) felt that the ability to tolerate pain might be related to the type of activity in which a person took part. Their experimental work was taken to indicate that:

(a) contact athletes tolerated most pain
(b) non athletes tolerated least pain
(c) non-contact athletes were located between these 2 extremes
Further, Ryan and Foster (1967) reported that athletes with the pain tolerance were also 'reducer' perceptual types.

The ability of athletes to tolerate more pain than non-athletes has also been reported by Phillips (1972) and Ellison and Freischlag (1975). This finding is also supported by Walker (1971) who found female athletes to vary in pain tolerance according to their level of performance, i.e., superior versus inferior. Pain tolerance and perceptual augmentation-reduction has been noted but few studies have been reported linking reduction-augmentation to athletic event preference.

The above findings indicate that reduction-augmentation may influence athletic performance. Therefore it is reasonable to suggest that swimming event preference may be linked to this cognitive style and that differences between sprint and distance swimmers manifest themselves on a bicycle ergometer test to rate perceived exertion.

Ratings of Perceived Exertion (RPE)

Borg (1962) has stated that perceived exertion is a resultant phenomenon which depends directly on the state of various physiological functions, e.g., heart rate, blood lactate, oxygen uptake. Borg attaches importance to this phenomenon because often the continuation of work as well as the intensity at which one chooses to work is dependent upon the analysis of the rate of exertion perceived by the individual. Borg developed the most accepted scale for the rating of perceived exertion using a 14 point numerical scale. Subjects pick a number that best describe their feelings of exertion in relation to perceptions of their own exertion.
level. Although Borg mentions that perceived exertion is dependent on the state of various physiological functions, Morgan (1972) reports that perceived exertion does not appear to be influenced so much by factors such as maximal aerobic power, intensity of training, body composition, etc., but suggests that RPE may be dependent upon other factors of a psychometric nature. He mentions that various psychological states and traits seem to play a role in the perceptual processing of information relating to muscular work. On the basis of Morgan's suggestion, it may well be possible to predict differences in RPE based on cognitive style.

Discussion

The issue of cognitive style and athletic event preference has received little attention by researchers. If a swimmer has a particular cognitive style he may be able to more accurately relate to personally relevant information during the competitive performance, e.g., achieving a particular time interval by matching output with performance, whether they are in a suitable position to execute a turn or take over from a colleague in a relay. A swimmer may similarly be able to tell how fast or how slow he is going regardless of the physiological cues that may distort his perception of the situation. Identification of whether a swimmer is field dependent or field independent, internally or externally orientated or a reducer or augmenter and how they relate to perceived exertion may provide swimming coaches with information about their charges indicating the type of event to which they may be best suited. Consistently poor performance may be related to a swimmer's cognitive style being incompatible with a particular event and account for the early drop out rate in swimming.
Differences in perceived exertion between sprint and distance swimmers may, therefore, be systematically related to the cognitive styles of field dependence-independence, internality-externality and reduction-augmentation. Sprint swimmers, for instance, are likely to be field dependent as it is important to them to have a global perception of their athletic situation. It is not advantageous for them to focus on any one cue but it is necessary for them to be aware of all cues pertaining to the athletic situation. Failure to be aware of all cues may result in a substandard performance. In contrast, a distance swimmer should primarily be aware of his own performance; as an inability to perceive how he is performing in this athletic situation could result in the swimmer not performing to expectations, i.e., knowledge of the process. For instance, if the swimmer does not accurately judge his pace at an early stage of the race (field independent) it is possible that he will cover the early portions of the race too quickly and consequently have no energy left to complete the last stages of the race at a pace which will allow for a successful performance.

Similar differences between sprint and distance swimmers for reduction-augmentation could be expected. For instance, sprint swimmers could be expected to continually reduce stimuli, i.e., show greater pain tolerance, as an inability to continually reduce will mean that the swimmer will fall behind the leading swimmers. As the sprint event is too short in total time span it is unlikely that the swimmer who is in the back of the field can achieve sufficient speed in the latter stages of the race in order to achieve success. In contrast a distance swimmer cannot afford to race too quickly during the initial stages of the event, i.e., continually reduce stimuli. If he were to do so it is possible that the swimmer would
have insufficient reserves or energy to complete the race at a pace which may enable him to achieve success.

As the nature of sprint and distance swim events is sufficiently different, internals and externals may well indicate a preference for one or other of these events. Internals may well be sprinters as the reviewed literature indicates that internals and not externals may be best suited to sprinting. For example, sprinters should have the ability to make quick decisions, have sensitivity and alertness to perceptual cues, should be very knowledgeable about a relatively unstable situation and perceive the nature of the task sooner and therefore react sooner when defeat threatens. Internals are reported to excel over externals at these tasks so internals may well be sprint swimmers and not distance swimmers as the nature of the sprint event requires the behaviour described above.

**HYPOTHESES**

**Hypothesis 1:** Sprint swimmers will differ from distance swimmers in the cognitive style of reduction-augmentation and will therefore rate perceived exertion differently.

**Hypothesis 2:** Sprint swimmers will differ from distance swimmers in the cognitive style of internality-externality and will therefore rate perceived exertion differently.

**Hypothesis 3:** Sprint swimmers will differ from distance swimmers in the cognitive style of field dependence-independence and will therefore rate perceived exertion differently.
CHAPTER III

METHODOLOGY

Subjects

The subjects for this study were all members of the Windsor Aquatic Club. The sample consisted of 16 boys aged 12-21 years and 23 girls aged 11-23 years. All subjects were participating in a competitive swimming programme and regularly attended competitive meets.

Procedures

1. Reduction-Augmentation.

The subjects were measured by two different techniques.

(a) Each subject was administered the kinaesthetic after-effects (KAE) measuring procedure. This measurement was obtained by utilizing the procedure described by Sales (1973):

"S was blind folded and then was presented with (a) a 30" long wedge-shaped block which increased from ½" wide at its narrowest end to 4" at its widest end and (b) a 1½" wide rectangular block. S was asked to grasp the rectangular block with his preferred hand and then to run his other hand forward along the wedge shaped block (an ascending judgement) until he found where the width of the wedge seemed to be the same as the width of the rectangle. S was given two practice trials, and then he was asked to make four ascending judgements of the rectangular block. The average of these four judgements served as the S's pretest score for the KAE task.

Following these judgements, S was asked to rub, handle and feel a 2½" rectangular block..."
with his preferred hand for one minute. Thereafter he was asked to make four additional ascending judgements of the size of the 1 ½" rectangular block. A S's score on the KAE task was his average assigned change from the first four judgements to the last four judgements. This measure is continuous, and S's tend to exhibit positive scores because of the contrast effects. Thus, small or negative numbers imply relative KAE reduction and large positive numbers imply relative KAE augmentation.

(Sales, 1972, p57)

(b) The subjects were also presented with a revised version of Vando's (1969) R-A Scale. Subjects were ranked on both measures for reduction-augmentation and their rank on each measure was totalled. The sample was then divided at its median into 2 groups and classified as either reducers or augmenters. Analysis was performed utilizing the combined score and each of the individual scores. A factor analysis was also performed on the revised Vando scale.

2. Internality-Externality

Because of the variance in age of the sample, subjects were presented with either the Nowicki-Strickland or the Rotter Internal-External Control Scales. Subjects under 13 years of age responded to the Nowicki-Strickland Scale and the remainder responded to the Rotter Scale. In order to compare the two scales the raw scores were converted to standard scores for analysis.

3. Field Dependence-Independence

All subjects responded to the Group Embedded Figures Test (Witkin et al., 1971).
4. **Ratings of Perceived Exertion**

Each subject ran on a Quintin treadmill in order to ascertain their maximum heart rate. Subjects were instructed to run for as long as they could until the gradient and speed of the treadmill prevented them from continuing. Subjects were instructed that they would be expected to continue running for 4-6 minutes. Immediately upon completion of the treadmill run each subject's heart rate was recorded on a Beckman Type RP Cardiotachometer. Subjects were then given a short rest (1-2 minutes) and were then instructed to repeat the treadmill run under the same conditions. Heart rate was again recorded upon completion to ascertain whether or not the initial reading was approaching a maximum value. The greater reading of the two was recorded as **maximum heart rate**.

On a subsequent visit to the laboratory, subjects performed an exercise test on a mechanically braked Manarch bicycle ergometer. Subjects exercised at 60 r.p.m. and work loads were manipulated so as all subjects were at a similar heart rate prior to asking them to rate perceived exertion. The rating was solicited at that time when the subject's heart rate steadied at each of the following predetermined rates:

- 120 b.p.m. (beats per minute) - light work
- 150 b.p.m. - moderate work
- 180 b.p.m. - heavy work
- greater than 180 b.p.m. - maximum work

Subjects exercised for 2-4 minutes at the manipulated work load in order to reach the predetermined heart rate. Subjects were instructed to continue exercising until they were no longer able to continue. Instructions given to the subjects prior to the commencement of the tests are included in Appendix A.
As with all tests of the format, all indicators of the work load the subject was working at were shielded from the subject's view.

Statistical Procedures

The following data were acquired for each subject:

a) swimming event preference  
b) age  
c) sex  
d) maximum heart rate  
e) a measure of field dependency/independency  
f) a measure of locus of control  
g) two measures of perceptual reduction-augmentation  
h) four ratings of perceived exertion

The variables were analyzed by Statistical Analysis Systems (S. A. S) and Statistical Package for the Social Sciences (S. P. S. S.) computer programmes calculated on the University of Windsor's IBM s/360 Mod 65 Computer. The following analyses were computed:

a) Stepwise multiple regression analysis  
b) Multivariate Analysis of Variance  
c) Contingency analysis  
d) Factor Analysis and Split-half reliability of the revised Vando Scale  
e) Discriminant Function Analysis

**Stepwise Multiple Regression Analysis**

This technique selects variables in order of the suitability to predict a criterion measure. Based on the hypotheses for this investigation, perceived exertion will be predicted by group membership, cognitive style and age.
Multivariate Analysis of Variance

This statistical procedure investigated the effects of a particular cognitive style on ratings of perceived exertion.

Discriminant Function Analysis

This statistical procedure utilized several measures to predict another measure. The procedure differs from stepwise regression analysis in that the predictor variables utilized determined an individual's group membership (sprint or distance swimmers). Perceived exertion ratings were used as predictors in this analysis.

Contingency Analysis

This analysis utilized Chi-square to ascertain whether there was a significant difference between the different cognitive styles identified. Subjects were categorized according to their preference for sprint or distance swimming events and were also assigned 3 different cognitive styles to see if there was a combination of cognitive styles which distinguished the groups being investigated in this study (sprint and distance swimmers).

Factor Analysis

The revised Vando Scale scores were factor analyzed utilizing principal components analysis to investigate the nature of the underlying variables and to see if there was a relationship to the other measure of reduction-augmentation utilized (Rinaesthetic aftereffects). The original instrument purported to differentiate between reducers and augmenters (Vando, 1969). A split-half
reliability coefficient was also calculated for the revised scale.
CHAPTER IV

RESULTS

Stepwise Regression Analysis

The hypotheses stated that differences in ratings of perceived exertion between sprint and distance swimmers were expected. That is, sprint swimmers would rate perceived exertion differently than distance swimmers regardless of cognitive style. Stepwise regression analysis, however, indicated that swimming event preference is not a good predictor of ratings of perceived exertion whereas cognitive style is better. The stepwise regression analysis was computed utilizing event preference, results on the kinaesthetic aftereffects, locus of control and the Group Embedded Figures tests as predictors of perceived exertion (dependent variable). The computation indicated that perceived exertion is best predicted by the cognitive styles of field dependence-independence and reduction-augmentation. The results of the stepwise regression for the dependent variables (ratings of perceived exertion) are detailed in Tables 1-4.
### TABLE 1

PREDICTORS FOR RATINGS OF PERCEIVED EXERTION
FOR LIGHT WORK

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>Sum of Square</th>
<th>Mean Square</th>
<th>F</th>
<th>Prob&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>1</td>
<td>26.31</td>
<td>26.31</td>
<td>7.84</td>
<td>0.005</td>
</tr>
<tr>
<td>Error</td>
<td>33</td>
<td>110.66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>136.97</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B Value</th>
<th>Std Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>11.15</td>
</tr>
<tr>
<td>Field Independence dependence</td>
<td>-0.16</td>
</tr>
</tbody>
</table>

R Square = 0.192

No other variables met the 0.5000 criterion for entry into the model.

### TABLE 2

PREDICTORS OF RATINGS OF PERCEIVED EXERTION
FOR MODERATE WORK

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>Sum of Square</th>
<th>Mean Square</th>
<th>F</th>
<th>Prob&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>2</td>
<td>28.13</td>
<td>14.07</td>
<td>2.30</td>
<td>0.10</td>
</tr>
<tr>
<td>Error</td>
<td>32</td>
<td>189.01</td>
<td></td>
<td>5.91</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>217.14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B Value</th>
<th>Std Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>15.39</td>
</tr>
<tr>
<td>Reduction-Augmentation (KAE)</td>
<td>-0.13</td>
</tr>
<tr>
<td>Field Independence-dependence</td>
<td>-0.16</td>
</tr>
</tbody>
</table>

R Square = 0.013

No other variables met the 0.5000 criterion for entry into the model.
### TABLE 3

**PREDICTORS OF RATINGS OF PERCEIVED EXERTION FOR HEAVY WORK**

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>Sum of Square</th>
<th>Mean Square</th>
<th>F</th>
<th>Prob&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>2</td>
<td>11.56</td>
<td>5.79</td>
<td>2.21</td>
<td>0.13</td>
</tr>
<tr>
<td>Error</td>
<td>32</td>
<td>3.95</td>
<td>2.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>95.54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B Value  Std Error

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td>Reduction -</td>
<td>-0.00</td>
<td>0.07</td>
</tr>
<tr>
<td>Augmentation (KAE)</td>
<td></td>
<td>1.46</td>
</tr>
<tr>
<td>Field Independence-</td>
<td>-0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>Dependence</td>
<td></td>
<td>3.75</td>
</tr>
<tr>
<td>R Square = 0.12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No other variables met the 0.5000 criterion for entry into the model

### TABLE 4

**PREDICTORS OF RATINGS OF PERCEIVED EXERTION FOR MAXIMUM WORK**

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>Sum of Square</th>
<th>Mean Square</th>
<th>F</th>
<th>Prob&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>2</td>
<td>2.96</td>
<td>1.48</td>
<td>0.9</td>
<td>0.39</td>
</tr>
<tr>
<td>Error</td>
<td>33</td>
<td>4.18</td>
<td>1.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>51.14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B Value  Std Error

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>19.25</td>
<td></td>
</tr>
<tr>
<td>Field Independence-</td>
<td>-0.004</td>
<td>0.03</td>
</tr>
<tr>
<td>Dependence</td>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td>Reduction -</td>
<td>-0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>Augmentation (KAE)</td>
<td></td>
<td>1.42</td>
</tr>
<tr>
<td>R Square = 0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No other variables met the 0.5000 criterion for entry into the model
Although the predictors utilized provide a significant F ratio at each of the work rates measured, the total variance accounted for by the selected predictors at any of the work loads is not very large. Table 5 summarizes these values at each of the work loads.

<table>
<thead>
<tr>
<th>Work Rate</th>
<th>R Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Work</td>
<td>0.19</td>
</tr>
<tr>
<td>Moderate Work</td>
<td>0.13</td>
</tr>
<tr>
<td>Heavy Work</td>
<td>0.12</td>
</tr>
<tr>
<td>Maximum Work</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Table 5 indicates that a considerable amount of unexplained (error) variance is present in this analysis. Even though two of the cognitive styles measured have significant F values, the magnitude of unexplained variance is such that the predictors selected in the stepwise regression analysis are of little practical value.

Multivariate Analysis of Variance

This technique was utilized to investigate possible differences and ratings of perceived exertion as determined by swimming event preference and cognitive style. Multivariate analysis of variance (MANOVA) determines the overall effect of an independent variable upon more than one dependent variable. The dependent variables in this instance were ratings of perceived exertion.
TABLE 6

MULTIVARIATE ANALYSIS OF VARIANCE - EFFECT OF COGNITIVE STYLE AND SWIMMING EVENT PREFERENCE ON RPE

<table>
<thead>
<tr>
<th>Wilks' Criterion</th>
<th>Df</th>
<th>Prob &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event preference</td>
<td>0.961</td>
<td>(4, 28)</td>
</tr>
<tr>
<td>Field dependence-</td>
<td>0.876</td>
<td>(4, 28)</td>
</tr>
<tr>
<td>independence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locus of control</td>
<td>0.842</td>
<td>(4, 28)</td>
</tr>
<tr>
<td>Reduction-Augmentation</td>
<td>0.883</td>
<td>(4, 28)</td>
</tr>
</tbody>
</table>

Of those independent variables investigated, Table 6 indicates that one which most significantly influenced ratings of perceived exertion at all work rates. Wilks' Criterion is stated as Lambda (L) and is an inverse measure of the discriminating power in the original variables which has not yet been removed by the discriminant functions. For locus of control, L is smaller than the L values for the other parameters investigated and therefore locus of control can be suggested as having some influence upon ratings of perceived exertion by swimmers.

If the ratings of perceived exertion are considered individually (i.e. at light, moderate, heavy and maximum work) the independent variables (cognitive styles and swimming event preference) influence each of the perceived exertion ratings to a minor extent. This result confirms the result obtained by the stepwise regression analysis and is reported in Table 7, except that no effect of any kind is noted for a rating of perceived exertion at the light work load (120 beats per minute) with multivariate analysis of variance.
TABLE 7

EFFECT OF COGNITIVE STYLE OF RATINGS OF PERCEIVED EXERTION

<table>
<thead>
<tr>
<th>Effort</th>
<th>F</th>
<th>Prob F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate Work (150 b.p.m)</td>
<td>3.12</td>
<td>0.08</td>
</tr>
<tr>
<td>Heavy Work (180 b.p.m)</td>
<td>3.34</td>
<td>0.07</td>
</tr>
<tr>
<td>Maximum Work (&gt;180 b.p.m)</td>
<td>3.47</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Contingency Analysis

To assess whether relationships existed between the variables utilized the following 2 way contingency tables were computed:

Event * (Reduction-Augmentation/Field dependence-independence/Locus of Control/Age/Sex)

Reduction-Augmentation * (Field dependence-independence/Locus of Control/Age/Sex)

Field Dependence/Independence * (Locus of Control/Age/Sex)

Locus of Control * (Age/Sex)

For each of these tables a Chi statistic was computed. The one table with a significant Chi value is recorded below.
TABLE 8

TABLE OF FIELD DEPENDENCE-INDEPENDENCE BY AGE

<table>
<thead>
<tr>
<th>FREQUENCY EXPECTED</th>
<th>Junior</th>
<th>Senior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Dependent</td>
<td>9.0</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>15.5</td>
</tr>
<tr>
<td>Field-Independent</td>
<td>1.0</td>
<td>16.0</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Chi-Square = 6.624  DF = 1  Prob = 0.0101

When Chi-Square is based on 1 Df, or if any of the expected cell frequencies are less than 10 the true probability estimate can be determined by Yates' correction for continuity (Hardyck and Petrinovich, 1976). For the data in Table 7 Chi-Square is 6.31 which is significant at the 0.02 level (p < .02). Junior and Senior age levels were set as over 14 years and under 14 years. This age level distinguishes Junior and Senior swimmers in the Windsor Aquatic Club.

Discriminant Function Analysis

This statistical procedure attempts to distinguish between two or more groups of cases. By taking a predictor and mathematically combining the scores the procedure locates a dimension on which sprint and distance swimmers are located at different ends of a continuum. The analysis only selected field dependence-independence as that predictor which discriminates between sprint and distance swimmers. A further step in the analysis determines
a multiple discriminate function for each of the variables measured (i.e. field dependence-independence, reduction-augmentation and locus of control.) The multiple discriminant function generated by combining all the discriminant functions obtained was not significant, however Table 9 summarizes the statistics computed in this analysis.

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Wilks' Lambda</th>
<th>Chi-Square</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00106</td>
<td>0.99</td>
<td>0.37</td>
<td>0.847</td>
</tr>
<tr>
<td>Field dependence-independence</td>
<td>0.88</td>
<td></td>
<td>0.030</td>
</tr>
</tbody>
</table>

For the computed multiple discriminant function to be significant a large increase in the eigenvalue would be necessary. The eigenvalue is a measure of the importance of the multiple discriminant function. Based on the predictors utilized the procedure calculates the percentage of 'grouped' cases correctly classified (Table 10).
TABLE 10

PREDICTION RESULTS

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>N</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Group 1</td>
</tr>
<tr>
<td>Group 1 Sprint</td>
<td>26</td>
<td>14.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>53.8%</td>
</tr>
<tr>
<td>Group 2 Distance</td>
<td>12</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33.3%</td>
</tr>
</tbody>
</table>

Number of uses correctly classified 57.89%

Factor Analysis and Split-half Reliability

The results of the principal components analysis indicate that the two instruments utilized to measure reduction-augmentation are independent of one another ($r_{KAE/Vando} = 0.107$). However, as predictors of that factor retained by the principal components analysis the two tests are equally useful, both measuring 0.7739 of the one factor retained as indicated in Table 11.
Prior to utilizing the revised Vando Scale in the analyses that have been reported in this chapter a split-half reliability coefficient was computed for the revised scale. The coefficient of reliability for the scale was $R = 0.509$. This statistic compares unfavourably with a split-half reliability coefficient of 0.89 which Vando (1968) obtained on the original instrument. Vando also reported a test-retest correlation of 0.74 and suggests that on this initial evidence the scale is internally consistent. Because the reliability for the revised scale was rather low the previous analyses were performed utilizing the kinaesthetic after-effects score. This measure has been used by other researchers (Barnes, 1976) as a measure of reduction-augmentation while the Vando scale has not yet been extensively utilized and remains untested for this purpose.
Discussion

Although the hypotheses that sprint and distance swimmers would differ on ratings of perceived exertion because of the influence of a particular cognitive style were not supported, other findings are in the predicted direction.

Witkin et al. (1954, 1962) have reported that field dependence-independence is a developmental construct with field independence increasing until age 18. This finding was confirmed with this sample, significant differences ($\chi^2 = 5.73, p < 0.02$) being noted between junior and senior swimmers. The previously reported differences between field dependents and field independents on the basis of sex was not confirmed, however. Witkin et al. (1962) reported that women are more field dependent than men and this difference is maintained through all age levels.

Field dependence-independence appears to be the only cognitive style which accounts for differences between sprint and distance swimmers. (The stepwise multiple regression procedure and the discriminant function analysis procedure both select that variable which accounts for the major portion of the variance in the first instance.) In each case the cognitive style of field dependence-independence was selected as that variable accounting for the most variance. Discriminant function analysis computed a significant difference between dependents and independents ($p < 0.03$). Coupled with a significant relationship between age and field dependence-independence it would appear that this cognitive style may be one factor in influencing the 'drop out' rate amongst competitive swimmers as well as influencing swimming event preference. It is also possible that the continued competitive
swimming experience may also account for the seniors being more field independent.

Although the sample was divided at its median for the cognitive style of internality-externality a relationship was noted between locus of control and ratings of perceived exertion. The mean for the senior group on the Rotter Internal-External Scale was 9.14 on the 24-point scale with \( s = 0.80 \). This indicates that the senior group tended towards an internal locus of control and the multivariate analysis of variance data presented in Table 6 could be interpreted as follows: ratings of perceived exertion are best predicted by swimmers with an internal locus of control and these swimmers differ on their ratings of perceived exertion from those swimmers with an external locus of control. In contrast the junior group tended towards an external locus of control (\( \bar{X} = 25 \) on the 40-point Nowicki-Strickland Scale, \( s = 6.86 \)). However significant differences between juniors and seniors on ratings of perceived exertion, event preference and locus of control were not obtained. The trend noted for internals to have lower ratings of perceived exertion may be explained by findings presented in the literature review. Internals were reported to have the ability to make quick decisions, have sensitivity and alertness to perceptual cues and are knowledgeable about relatively unstable situations. These findings suggest that internals may rate perceived exertion more accurately than externals. The basis for this possible relationship was not indicated by the results of this study as event preference and age did not influence ratings of perceived exertion.

Morgan (1972) also reported that psychological states and traits play a role in the perceptual processing of information
relating to muscular work and perceived exertion. The results of this investigation are in agreement with Morgan, in that, locus of control appears to be one such psychological variable that influences perceived exertion.

The results of this study indicated that reduction-augmentation only influence ratings of perceived exertion at work rates when the subject's heart rate is greater than 150 b.p.m but less than 180 b.p.m (Tables 1-4). This result is possible support for the several authors who have linked reduction and augmentation to athletics (Ryan & Kovacic, 1966; Ryan & Foster, 1967; Phillips, 1972; Ellison & Freischlag, 1975). However, a significant reduction-augmentation effect was not noted at maximum work rates (heart rates in excess of 180 b.p.m) and it is probable that this cognitive style does not influence perceived exertion ratings at maximum effort. The amount of variance accounted for by reduction-augmentation was not significant (Table 4). If there is a link of this cognitive style with athletics as reported by the above authors, the failure to substantiate their results could possibly be due to the instruments used to measure reduction-augmentation in this study. The Vando Scale was originally constructed by using the results of several pilot studies with subjects aged between 20 and 23 years. The scale was revised to counter two obvious problems: (a) culturally decayed items. The scale was originally constructed in 1969, and (b) rewording of some of the choices so as the option presented would be readily understood by subjects in this investigation.

As reported, the revised scale had a split-half reliability of 0.509 and correlated poorly with the Kinaesthetics
Aftereffects Test ($r_{KAE/Vando} = 0.107$). These two results suggest that the revised scale was not measuring the cognitive style of reduction-augmentation and therefore, all results in this study were computed by using the kinaesthetic aftereffects measures as reflecting the cognitive style of reduction-augmentation. However, Barnes' (1976) in a summary of the Kinaesthetic Aftereffects Test reports several shortcomings of this technique and these are advanced as possible reasons why the cognitive style of reduction-augmentation was not successful in discriminating between sprint and distance swimmers or predicting measures of perceived exertion. The problems with the Kinaesthetic Aftereffects Test are as follows:

(a) Repeated application of the KAE task tend to produce less of an aftereffect. This means that the test-retest reliability is very difficult to determine.

(b) A problem with the wedge instrument is that subjects may be able to use the position of their arm with respect to their body, as they move their fingers along the wedge, to act as a cue in helping them make more accurate judgements.

(c) Utilization of change scores (as was done in this study) is another problem. Change scores are not independent baseline measurements. Subjects with high scores on baseline (the initial series of measures) measures are more likely to show lower scores subsequently (and hence be classified as reducers). This effect may well be due to statistical regression. That is, on repeated applications extreme judgements are likely to be fewer. Chance factors are more likely to contribute to extreme scores than to average scores, and such chance factors are unlikely to reappear on subsequent trials.
The median split to identify reducers' and augmenters has been used by other researchers (Craig & Best, 1977). However, because the standard deviation for each group (Seniors, \( s = 0.08 \); Juniors, \( s = 8.18 \), but with 3 extreme measures removed the standard deviation for Juniors was considerably lower, \( s = 4.9 \)) on the Kinaesthetic Aftereffects Test was rather small, it is probable that the classification of some individuals is incorrect and hence the classification of subjects obtained by the median split method may be inaccurate.

The same problem occurs when using this method on the locus of control scores. Had the scores on both the Rotter and the Nowicki-Strickland Scales produced larger standard deviations suggesting a greater dispersion of scores, a median split would possibly have identified internals and externals more accurately. The results of the multivariate analysis of variance indicate that there is a tendency toward significance for an overall effect of locus of control on ratings of perceived exertion (Table 6). A more suitable method for classifying internals and externals may have produced an increased level of significance.

Of those cognitive styles investigated it appears as if field dependence-independence was the most useful in determining ratings of perceived exertion and swimming group membership. Table 12 gives a review of the effect of field dependence-independence to the various analyses.
TABLE 12

INFLUENCE OF FIELD DEPENDENCE-INDEPENDENCE ON SELECTED PARAMETERS

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<td>Discriminant Function</td>
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</table>

The data in Table 11 and the discriminant function analysis indicates that field dependence-independence not only categorized swimmers into group membership better than the other cognitive styles used but also accounts for the largest portion of the total variance in 3 of the perceived exertion measures.

The computations revealed that subjects studied in this investigation were correctly classified by the multiple discriminant function into the sprint or distance group 57.89% of the time. The data presented in Table 12 and also the selection of variables in the discriminant function analysis (field dependence-independence was the only cognitive style which significantly differentiated between the two groups, \( F = 5.12, p < 0.03 \)) suggests that field dependence-independence is an important parameter in selecting group membership and assessing ratings of perceived exertion. Although the field dependence-independence was selected as the best
predictor of group membership, the multiple discriminant function generated utilizing all the cognitive styles was not significant. (Table 9).
CHAPTER V

CONCLUSIONS, RECOMMENDATIONS & SUMMARY

Conclusions

Overall, the results of this investigation suggest that cognitive style is related to event preference in competitive swimmers and to a lesser extent perceived exertion. Field dependence was the only significant cognitive style shown by the discriminant function analysis to relate to sprint or distance group membership and was also selected in stepwise regression analysis as that factor which best predicted ratings of perceived exertion. However, the importance of field dependence-independence to the total variance in each of the above analyses was not very great. Of the other cognitive styles investigated, multivariate analysis of variance results indicated a slight, but non significant influence of locus of control on ratings of perceived exertion while reduction-augmentation was selected by stepwise regression analysis as being a factor that contributed to the total variance in ratings of perceived exertion for moderate and heavy work rates. However the contribution of reduction-augmentation to the total variance in each of these cases was not significant.

Several authors have reported that field dependence-independence plays a role in athletic involvement (Bard, 1972; Pargman, Schreiber and Stein, 1974). Of the three cognitive styles investigated in this study, field dependence-independence is best related to competitive swimming involvement. The discriminant
function analysis computed for this cognitive style indicated that the sprint group tended to be more field dependent than did the distance group and this difference was significant (p<0.03). This would suggest that sprint swimmers are more group dependent, attend to all cues in the peripheral field of vision and be aware of the combination of all cues that may effect the performance while distance swimmers are more field independent.

Alternatively sprint swimmers may become more field dependent because of continued exposure to a particular competitive swimming programme. The sprint swimmers programme is such that during their event it is imperative that they have a global perception of their athletic situation. It is not advantageous for them to focus on any one cue but it is necessary for them to be aware of all cues pertaining to the athletic situation. In contrast the distance swimmer is primarily aware of his own performance as an inability to perceive how he is performing in his athletic situation could result in the swimmer not performing to expectations. (A distance swimmer must accurately judge time and pace himself throughout his event to ensure a successful performance). Therefore continued exposure to a distance swimming programme may result in the swimmer developing a field independent cognitive style rather than being attracted to that programme in the first instance because of his field independent tendencies.

The relationship between field dependence-independence and age has been noted by several authors (Witkin et. al., 1962; Pande, 1970). This relationship was confirmed by the results of this study with junior swimmers being significantly more field dependent than the field independent senior swimmer's (p<0.02). Male and female differences in field dependence were not, however,
The Vando Scale has been utilized in a modified version by Loy * with groups of young children and the results of his work have been inconclusive. The revised Vando Scale used in this study did not discriminate between reducers and augmenters. This could be attributed to the construct validity of the instrument. That is, it was not possible to have confidence in the revised scale as it did not relate a measure reduction-augmentation with ratings of perceived exertion which it was hypothesized to do. Vando (1969), however, indicated that his scale required further validation to establish whether reduction-augmentation can be determined by use of a questionnaire. Vando stated that the findings of his study offer good evidence that there is a reducing-augmenting personality dimension. The low reliability of the revised scale and the low correlation between measures on the Kinaesthetic Aftereffects Test and the revised scale suggest that Vando's findings can be challenged. The techniques for measuring reduction-augmentation in the sample used for this investigation do not appear to be suitable. As indicated, the KAE instrument has several shortcomings (Barnes, 1976) and hence it is quite possible that an accurate measure of reduction-augmentation was not obtained.

Although the sample investigated can be considered as highly trained athletes, the nature of the perceived exertion task was such that several subjects reported that they felt uncomfortable during the execution of the perceived exertion test. Verbal reports at the conclusion of the treadmill run and the bicycle ergometer

* Personal Communication
test indicated that most subjects stopped because of local muscle soreness and stiffness rather than cardiovascular discomfort. The nature of the subjects' athletic activity is such that their conditioning of leg muscle groups receives minimal attention and this could be advanced as a possible reason for subjects completing the two tests at a time prior to maximum effort. The selection of a physiological task which would produce a maximum work output based on cardiovascular efficiency as well as muscle fatigue may have resulted in sprint and distance swimmers differing in ratings of perceived exertion. Perceived exertion ratings are required to be made on the basis of all sensations of fatigue, not any one sensation (See Appendix A).

Recommendations

The findings of this study indicate that field dependence-independence warrants further investigation. Assessment of field dependence-independence by other techniques which are not as heavily reliant upon cognitive ability would possibly discriminate between swimmers and other athletic subgroups as well as between swimming subgroups (sprint and distance swimmers).

The finding that a difference in field dependence-independence significantly differentiates between senior and junior swimmers may also be a basis for further investigation. This cognitive style may be a factor in accounting for the high 'drop out' which has occurred within the Windsor Aquatic Club of swimmers approximately aged 14. Assessment of the cognitive style of those who have ceased to be involved in competitive swimming would indicate whether field dependence-independence is related to athletic involvement as suggested by Bard (1972) and Pargman (1975).
A further investigation of this relationship between cognitive-style and 'drop out' may give insight into the relationship between athletic involvement and changes in personality disposition. This is the type of relationship that is postulated by Mischel (1973) and Loy & Donnelly (1976). Competitive swimming involvement after 14 years of age may well mean that swimmers who remain in a competitive programme become more field independent because of their athletic involvement and continued exposure to a specific environment.

The cognitive style of reduction-augmentation did not discriminate between sprint and distance swimmers on ratings of perceived exertion. A slight effect was noted when subjects were exercising at intermediate work rates but this cognitive style contributed minimally to the total variance as determined in the stepwise regression analysis. Although problems with the assessment of reduction-augmentation were noted further investigation considering the effect of this cognitive style may further differentiate sprint and distance swimmers on the basis of cognitive style. As subjects used in this study are continually performing at maximum work rates the nature of other investigations could possibly focus on the relationship of reduction-augmentation and swimmers working maximally.

Summary.

The purpose of this study was to investigate the effects of swimming event preference and selective cognitive styles upon ratings of perceived exertion using members of the Windsor Aquatic Club as subjects. Ratings of perceived exertion were assessed when subjects reached similar heart rate levels while
pedalling a Monarch bicycle ergometer at 60 r.p.m. It was postulated that differences in the cognitive styles of internality-externality, field dependence-independence and reduction-augmentation (as assessed by the Rotter and Nowicki-Strickland Internal-External Control Scales, the group Embedded Figures Test and the Kinaesthetic Aftereffects Test and a revised Vando Scale) would lead to sprint and distance swimmers systematically varying on ratings of perceived exertion.

The data was analysed using Statistical Analysis Systems and Statistical Packages for the Social Sciences computer programmes. The following analyses were computed: stepwise regression analysis, multivariate analysis of variance, contingency analysis, discriminant function analysis and factor analysis (principal components analysis).

Results indicated that swimming event preference did not influence ratings of perceived exertion and of those cognitive styles investigated only field dependence-independence produced significant interactions with other variables. These interactions were:

(a) A relationship between field dependence-independence and age. Junior swimmers (under 14 years of age) had a field dependent cognitive style while senior swimmers (over 14 years of age) had a field independent cognitive style. This finding confirmed the results of previous researchers.

(b) Field dependence-independence predicted ratings of perceived exertion but in doing so only accounted for small amounts of the total variance.
(c) Field dependence-independence is the only cognitive style which discriminates on the basis of swimming event preference. Sprint swimmers tended to be field dependent and distance swimmers field independent. The difference was significant \( (p<0.03) \). However, the multiple discriminant function generated using all the cognitive styles was not significant, classifying group membership only 57.89% of the time.

The revised Vando Scale did not discriminate between reducers and augmenters in this sample and possible reasons are advanced as to why this instrument failed. Results on the Kinaesthetic Aftereffects Test did not discriminate between reducers and augmenters and nor did the results of this test correlate with the revised Vando Scale. Problems with the Kinaesthetic after-effects measuring technique outlined by Barnes (1976) are reported.

Reduction-augmentation influenced ratings of perceived exertion at intermediate work rates only. Further investigation of the effect of this cognitive style on swimming event preference may possibly be noted at other tasks requiring maximum work output. Different techniques for measuring this cognitive style may also be necessary.

It was concluded that the cognitive style of field dependence-independence is related to competitive swimming. This result supports the work of several researchers who have reported that field dependence-independence is related to athletic involvement in team and individual sport activities.
APPENDIX A

Perceived Exertion Test Instructions

You are now going to take part in a work test. You will by cycling on the ergometer while I am measuring various physiological functions. I also want to try to estimate how hard you feel the work is; that is, I want you to rate the degree of perceived exertion you feel. By perceived exertion we mean the total amount of exertion and physical fatigue, combining all sensations and feelings of physical stress, effort and fatigue. Don't concern yourself with any one factor such as leg pain, shortness of breath or the work intensity, but try to concentrate on your total, inner feeling of exertion. Try to estimate as honestly and objectively as possible. Don't underestimate the degree of exertion you feel, but don't overestimate it either. Just try to estimate as accurately as possible.
## APPENDIX B

Test Results and Personal Data on Subjects

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REFERENCES CITED


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