COGNITIVE STRATEGIES EMPLOYED BY TRIATHLETES

By

HUGH MICHAEL MCDOUGALL

Bachelor of Science
University of Calgary
Calgary, Alberta, Canada
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Master of Science
Oklahoma State University
Stillwater, Oklahoma
1985

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Thesis Approved:

Larry T. Brown
Thesis Advisor

William W. Rambo

Robert J Weber

Rex T. Finnegan

Kenneth P. Sandvold

Norman N. Durham
Dean of the Graduate College

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NOMENCLATURE

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Abstract

The current study was designed to examine the cognitive strategies employed by triathletes, both as they trained and as they raced. Each subject carried a lightweight microcassette recorder during training rides and runs, while a constant-interval, audible cue prompted the athlete to verbalize his/her ongoing thought processes. This equipment was worn by 12 triathletes as they trained, with recordings being collected during competition from 7 of these athletes. Content analysis of the recordings revealed significant differences in the triathletes' cognitive approach to racing as compared to their approach during training. Subtle changes in strategy use were also noted over the course of a race within both the broad associative and dissociative strategy categories. Interview data indicated that the triathletes had given little thought to the cognitive aspects affecting performance. As such, practical implications of the current study for mental strategy training are considered. Implications for future research are also explored.

Cognitive Strategies Employed by Triathletes

While the effect of cognitive strategy upon performance in endurance-oriented athletic events has for some time enjoyed general recognition, the systematic, empirical examination of this effect remains a relatively novel challenge. Indeed, Morgan and Pollock's (1977) study of cognitive strategies engaged in by marathon runners represented the first critical examination of the thought processes employed during an endurance event. In fact, Morgan and Pollock's (1977) study continues to stand as a dominant work within this field (Schomer, 1986). The interest arising from Morgan and Pollock's (1977) work revolves largely around the finding that world-class, elite marathon runners employed a style of cognitive strategy quite different from the strategies employed by runners who were not of world-class caliber. Morgan and Pollock's (1977) study sparked a great deal of interest and controversy within the field of sport psychology and stands as the primary influencing factor for a great deal of research concerning the cognitive activities and strategies employed by athletes of all types and especially endurance athletes.

An account of Morgan and Pollock's (1977) findings will be presented, following by a review of the research which has arisen in an attempt to develop an understanding of the cognitive strategies employed by endurance athletes and the impact these strategies may exert upon performance.

Morgan and Pollock (1977)

Morgan and Pollock (1977) interviewed 27 middle long-distance and marathon runners, 19 of whom were considered to be world-class athletes. The remaining eight athletes were recognized to be outstanding college runners but were not of world-class caliber. Each athlete was asked to describe what he/she thought about during a long-distance run or marathon, outlining the thought processes which occurred during the course of the run. These interviews were otherwise unstructured, with no limit being placed upon the length of the athletes' responses.

Previous interviews conducted by Morgan (Morgan & Pollock, 1977) with 20 marathoners and long distance runners led the researchers to expect to find the runners in the 1977 study to employ a "dissociative" cognitive strategy. This approach requires that the athlete actively shun or ignore sensory input due to the discomfort associated with this feedback. Morgan and Pollock (1977) termed this strategy "dissociative cognitive rehearsal" (p. 390), reflecting the fact that these athletes reported themselves to be cognitively active during competition. However, these athletes reported that the focus of this cognitive activity rarely centered upon the act of running itself. Rather, they stated that they employed a variety of mental tasks specifically intended to shift the cognitive focus away from the act of running. Morgan and Pollock (1977) provide a variety of examples of this form of cognitive activity. For example, one runner reported that he

> always builds a house when he marathons; another writes letters to everyone he owes a letter to; another listens to a stack of Beethoven records; another participates in extremely complex mathematical exercises; another steps on the imaginary faces of two co-workers she detests throughout the marathon; another repeatedly sings the Star Spangled Banner in crescendo fashion; another age regresses and becomes a steam locomotive at the base of heartbreak hill; and so on (Morgan & Pollock, 1977, p. 390 - 391).

On the basis of this interview data, Morgan and Pollock (1977) had expected to find similar strategies to be reported by all 27 runners interviewed in the 1977 study. However, this hypothesis was not supported and this result represented a "major finding" in the words of the authors (Morgan & Pollock, 1977, p. 390). Indeed, it was this finding which first prompted controversy and guaranteed continued research into the cognitive strategies employed by endurance athletes.

Specifically, Morgan and Pollock (1977) found the dissociative strategy to be poorly representative of the cognitive activity reported by the world-class runners they had interviewed. Rather, these elite athletes were found to employ what has become known as an "associative" strategy, reporting that

> (1) they paid very close attention to bodily input such as feelings and sensations arising from their feet, calves, and thighs, as well as their respiration; (2) whereas they paid attention to time ("the clock"), pace was largely governed by "reading their bodies"; (3) they identified certain runners they would like to stay with during a given run if possible, but they did not typically employ a "leaching" strategy; (4) during any given marathon they constantly reminded or told themselves to "relax," "stay loose," and so forth; and (5) they typically did not encounter "pain zones" during the marathon, and most of these elite runners dismissed the phenomenon referred to as "the wall" as simply a myth - that is, they did not

> "come up against the wall" during the marathon run. (Morgan & Pollock, 1977, p. 390).

In this manner, the elite runners tended to focus upon the feedback received from their bodies and to modulate their pace accordingly. The contrast in cognitive strategies reported by Morgan and Pollock (1977), with elite runners employing primarily associative strategies and non-elite runners relying upon a dissociative coping strategy, remains controversial (Schomer, 1986).

Not only did Morgan and Pollock (1977) provide the first empirical examination of the various cognitive strategies employed by endurance athletes, the authors also speculated upon the function served by both the associative and dissociative cognitive styles which emerged from their work. In analyzing the basis for this difference in cognitive strategies, Morgan and Pollock (1977) draw an illustrative analogy between the runner and the household furnace:

> The furnace is driven by a thermostat, and by analogy we can think of the runner as being driven by his or her perceptostat. The perceptostat can be viewed as the center of a sensory system that integrates all other sensory systems along with information stores built from past environmental experiences. If one were to turn a thermostat

> completely on or off when temperature demands operated in opposing directions, there would be a system failure. Also, a thermostat that is not finely tuned will work, but it will be characterized by inefficiency (p. 401).

Morgan & Pollock (1977) go on to relate the dissociative cognitive strategy to this thermostat model:

> First, dissociation results in turning the perceptostat off, and it stays off until alerted by a cue to resume functioning. The cue might come in the form of dyspnea [a hungering for air resulting in labored or difficult breathing and often accompanied by pain] or parathesia [sic] [a numb, prickling, or tingling sensation], or it might be triggered by more serious stimuli such as the onset of heat exhaustion or a bone fracture. At any rate, such an approach would be quite inefficient, and, unlike the elite runner who incurs a deficit at the outset of a run and then achieves a relative steady state through association, the dissociative runner by contrast would incur deficits throughout a run, begin to associate following receipt of "alerting" cues, adjust the pace, repay the deficit, and then return to the dissociative state. The consequence of utilizing such a

> strategy would be the inefficient utilization of fuel, and the net result would be that such a runner would eventually 'come up against the wall,' perhaps discontinue the race, or, at best, simply perform at a level below his or her capability (p. 401).

Thus, the associative strategy was seen to serve a very adaptive purpose, maximizing the efficiency of the elite runner.

Mechanisms Underlying Cognitive Strategies' Effectiveness

Morgan and Pollock's (1977) work prompted other researchers to focus upon an examination of the mechanisms underlying the effectiveness of the two respective cognitive strategies, both strategy types being employed to facilitate endurance-oriented performance. Much of the work regarding the dissociative strategy builds upon the belief that attentional capacity is by its very nature finite and limited (Landers, 1980) and that the quantity of information which can be processed at any given time is limited (Navon & Gopher, 1979). This suggests that given a situation in which both internal and external sources of information are potentially available for processing, the processing afforded one stimulus or set of stimuli will limit the processing of any other (Pennebaker & Lightner, 1980).

The hypothesis that limited channel capacity underlies the effectiveness of a dissociative strategy has found support through the work of a number of researchers. For example, Pennebaker and Lightner (1980) found that subjects presented distracting sounds while exercising on a treadmill reported less fatigue and fewer symptoms of fatigue than did subjects attending to amplifications of their own respiration. The researchers also observed faster times when subjects ran a cross-country course than when the same subjects ran a lap course of equal length. Pennebaker and Lightner (1980) interpret these results as supportive of the limited channel capacity hypothesis. The demands placed upon the athlete to attend to the external environment as he/she ran the cross-country course were seen to diminish the attention afforded internal sources of information. As such, the subjects were apparently able to maintain a faster pace during the cross-country run while reportedly feeling equally fatigued upon completion of both lap course and cross-country runs.

Rejeski and Kenney (1987) found that subjects required to engage in a cognitive task (backward counting or arithmetic manipulation) exhibited greater endurance while maintaining an isometric contraction on a hand-held dynamometer when compared to the times posted by subjects who were not involved in a concomitant cognitive task. Once again, the attention allotted the dissociative cognitive task appears to occupy available "space" within the limited attentional channel, reducing the subject's ability to focus upon distress-related cues from sensory inputs. As a result, those subjects engaged in the "space occupying" cognitive task exhibited increased tolerance to fatigue. Interestingly, task complexity was not found to significantly affect the efficacy of the dissociative cognitive task (Rejeski & Kenney, 1987). Both simple and complex cognitive task involvement resulted in greater endurance being exhibited, subjects maintaining the isometric contraction for longer periods of time when engaged thusly.

Siegel, Johnson, and Kline (1984) also provided evidence supporting the hypothesis that limited channel capacity stands as the mechanism underlying the effectiveness of a dissociative coping strategy. Subjects were asked to ride a bicycle ergometer, pedaling for four minutes at 50 rpm against constant resistance, being provided no feedback regarding exercise load or time of trial. This initial introduction to the task was completed under either dissociative conditions (i.e., a continuous flow of arithmetic problems to be solved concomitantly) or control conditions (no dissociative stimuli present). Each subject was invited to return to the laboratory the following day and was asked to reproduce the amount of work generated the previous day. Resistance was maintained as a constant across both trials (days) while the subject was allowed to determine pedaling rate and time during the replication trial. Those individuals who were not provided any distracting (dissociational) task during the initial trial tended to produce significantly greater amounts of work during the reproduction trial. In interpreting this finding, Siegel, Johnson, and Kline (1984) suggest that the dissociative group, those provided the attention-demanding task, may have become "preoccupied" by the demands of the cognitive task i.e., the attention required to solve the arithmetic problems limited the processing of other internal and external feedback cues. In this fashion, the authors speculate, the subjects involved in the dissociative task avoided the tendency to focus inordinately upon the physical aspects of the aerobic exercise. This tendency to attend to the physical aspects of the task was evident among the control group subjects as reflected in their apparently inflated perception of exertion.

Relatively little expansion has followed Morgan and Pollock's (1977) hypothesis regarding the mechanisms underlying the effectiveness of the associative cognitive strategy. As these authors stated, by employing an associative strategy the elite athlete appears to achieve a relatively steady state throughout the course of an event, thereby performing in the most energy-efficient manner possible. As Siegel, Johnson, and Kline (1984) would later observe, "a strategy that emphasizes the processing of body sensations would seem optimal, since success at such activities is highly dependent on an accurate allocation of physical resources over an extended period of time" (p. 146).

Impact of Psychological Variables Upon Performance

Considered in a broader context, Morgan and Pollock's (1977) study provided the impetus for a great deal of subsequent research regarding the impact of psychological variables upon athletic performance. Much of the initial work to follow Morgan and Pollock (1977) consisted of examinations of differences in cognitive style between more and less successful athletes. For example, Mahoney and Avener (1977) found that successful American gymnasts tended to be more anxious prior to competition than their less successful teammates. As well, gymnasts who focused on internal mental images (i.e., kinesthetic feedback experienced during competition) performed better than those who employed external mental images (i.e., viewing themselves from the perspective of others)(Mahoney & Avener, 1977). Meyers, Cook, Cullen, and Liles (1979) found champion racquetball players to report more self-confidence, success in dreams, sport-related thoughts, self-instructional behavior, and more concentration on upcoming competition than less successful competitors. Celestino, Tapp, and Brumet (1979) found a significant correlation between locus of control and finish time for male marathon runners, with internal locus of control being associated with faster times.

Other researchers adopted a more direct and more specific approach. For example, 1978 saw the first examination of the effects of "psyching up strategies" on motor performance (Shelton & Mahoney, 1978). Olympic style weight lifters told to "psych up" evidenced significant and dramatic increases in grip strength when compared to a control group of lifters who were asked to count backwards. Hoffman (1983) provided further support for the effectiveness of appropriate cognitive strategies in the performance of tasks involving muscular strength. Specifically, preparatory arousal and imagery techniques were found to significantly enhance performance of bar-dips, sit-ups, and pull-ups.

More recently, a number of researchers have directed their attentions toward the impact of specific cognitive strategies on endurance performance, with both associative and dissociative strategies being found to facilitate such performance. For example, dissociative strategies have been found to result in increased performance times during strenuous exercise (Morgan, Horstman, Cyerman, & Stokes, 1983; Weinberg, Smith, Jackson, & Gould, 1984). As well, as noted previously, there is also evidence supporting the efficacy of dissociative cognitive coping strategies during endurance tasks (Pennebaker & Lightner, 1980; Siegel, Johnson, & Kline, 1984; Rejeski & Kenney, 1987). Morgan, Horstman, Cymerman, and Stokes (1983) found the use of dissociative strategies allowed for greater tolerance for exercise induced stress and discomfort and resulted in associated performance gains. Conversely, Schomer (1986) found a strong relationship between increased associative thought and training intensity while Masters and Lambert (1989) found the use of associative strategies to be related to faster times among marathon runners. Although both the associative and dissociative strategies have been shown to be effective in improving endurance performance, authors such as Schomer (1986) have argued strongly for the use of the associative strategies in order to maximize performance and minimize risk. This arguement is outlined below.

Schomer (1986)

Perhaps the most intriguing study to have developed as a direct result of Morgan and Pollock's (1977) original research is that of Schomer (1986). While Schomer (1986) accepted Morgan and Pollock's (1977) contention that there exist two divergent coping strategies, associative and dissociative, he disputed Morgan and Pollock's (1977) claim that the associative strategy is the exclusive purview of the elite endurance athlete. Schomer (1986) suggested that neither strategy is apt to be relied upon exclusively. Given this perspective, Schomer (1986) predicted an increase in the proportionate use of associative thought as a direct result of an increase in training intensity, based on his contention that "regardless of the marathoner's running status a high training effort can only be achieved and maintained safely and efficiently by adopting a predominantly associative mental strategy" (p. 52).

Schomer (1986) stands in agreement with Morgan and Pollock (1977) in recognizing the potential effectiveness of a dissociative cognitive strategy, affording the runner a means whereby he or she may cope with the painful sensory feedback associated with competitive endurance performance. As well, a dissociative mental approach may be relied upon to provide distraction from the monotony which can be associated with extended performance. However, Schomer (1986) contends that as an athlete gains experience he/she would tend to realize the fallacious nature of expressions such as "no pain, no gain" and/or "if it doesn't hurt, you can't be training hard enough" (Schomer, 1986, p. 42). Schomer states that the seasoned athlete would have come to respect the potential dangers which accompany endurance competition and high intensity training.

Schomer (1986) notes that, as well as allowing for the avoidance of injury, an associative strategy also places the athlete in a position whereby he/she more directly controls the process of running, suggesting the development of a sense of self-mastery. As well, the relative proportion of associative thought the athlete engages in may well be expected to increase as he/she increases the rigor or intensity of his/her training efforts (Schomer, 1986).

Schomer's (1986) research was also unique in that he recognized qualitative differences within the associative strategy employed by marathon runners of varying status. Specifically, superior runners were predicted to focus their attentions upon specific body parts while less experienced runners employed a more generalized focus. Having hypothesized the existence of this qualitative difference, one of Schomer's (1986) research goals involved the development of a functional mental strategy classification system.

In developing his methodology, Schomer (1986) reviewed previous research dealing with the mental strategies employed by long-distance runners. This review revealed that earlier studies, with a single exception (Sacks, Milvy, Perry, and Sherman, 1981), had not been designed to document the ongoing thought processes of endurance athletes. Rather, previous researchers had relied upon post-event interview data (Morgan & Pollock, 1977), anecdotal reports (Lumian, 1974), pre-race questionnaires (Freischlag, 1981), pre- and post-race questionnaires (Summers, Sargent, Levey, & Murray, 1982), or questionnaires administered during experimental manipulation of cognitive strategy (Okwamabua, Meyers, Schleser, & Cooke, 1983; Weinberg, Smith, Jackson, & Gould, 1984).

Schomer (1986) recognized the potential inherent in most of these designs for retrospective falsification and stressed the importance of recording the athlete's instantaneous thought processes throughout the full duration of his or her performance. In fact, only Sacks, Milvy, Perry, and Sherman (1981) had gathered data during the course of an actual endurance event, tape-recording answers to a structured questionnaire read out periodically by investigators bicycling alongside runners competing in a 100 mile road race.

Schomer (1986) recorded the thought flow of 31 marathon runners during training runs, each lasting a minimum of 30 minutes. Each subject was fitted with a microcassette recorder and a condenser microphone, the microphone enclosed in a cotton pouch which was pinned to the runners shirt at chest level. The subjects were instructed to say aloud whatever came to mind during the run and were assured that strict confidentiality would be maintained.

In order to determine the effect of the runner's status on mental strategy, Schomer (1986) selected subjects from three distinct groups of marathoners. Twelve had not participated in any regular physical activity for at least five years prior to the study and were involved an a seven-month training program geared toward their first marathon attempts. These twelve subjects constituted the "novice" group. Ten runners made up the "average group". These runners had completed a minimum of two marathons with race times falling between three and four hours for males and three and one half to four and one half hours for female subjects. The third, "superior group" was made up of nine highly competitive marathon runners, each of whom had posted race times below three hours for males and below three and one half hours for females. Six of these subjects (three males and three females) were considered to be elite South African marathon runners by virtue of their outstanding race times.

Texts of the recordings obtained from the runners were surveyed, with ten categories of mental strategy subclassifications emerging. The first four of these categories (A,B,C, and P) were seen to be task-related or associative in nature, with the balance (categories E,R,S,W,I, and T) constituting dissociative strategies. Schomer's (1986) categorization system is as follows (all references are to Schomer, 1986):

1. Feelings and Affects (A)

"Thoughts concentrating on general sensations of the whole body, like feelings of vitality or fatigue, overall tiredness, and stiffness without mention of specific body parts" (p. 5).

2. **Body Monitoring (B)**

"Thoughts of a here and now nature concerning specific anatomy, body parts, or body physiology like breathing rhythm, heart beat, or painful calf muscles" (p. 45).

3. **Command and Instruction (C)**

"Thoughts reflecting emphatic self-regulatory instructions to specific body parts or instructions to whole body functioning distinctly related to the activity and maintenance of running" (p. 46).

4. **Pace Monitoring (P)**

"Verbalized feedback on current performance with respect to time, distance, speed, or any other available form or method of pacing" (p. 46).

5. **Environmental Feedback (E)**

"Thoughts of a here and now nature on the weather condition, temperature, light conditions, smell, and noise level" (p. 46).

6. **Reflective Activity Thoughts (R)**

"Thoughts on past and future issues related to running like past racing experiences or training sessions and future race preparation and planning" (p. 46).

7. **Personal Problem Solving (S)**

"Thoughts revolving around issues of an intrapersonal and interpersonal nature including reflective introspection, belief system evaluation and modification" (p. 46).

8. **Work, Career and Management (W)**

"Thoughts spent on job, work, and career opportunities including thoughts centering around the execution, planning, and construction of work" (p. 46).

9. **Course Information (I)**

"Thoughts of a descriptive nature about scenery and general whereabouts that are of no consequence to pace" (p. 46).

10. **Talk and Conversational Chatter (T)**

"Direct speech when in communication with other runners and thoughts expressing follow-up chatter to initial exchanges, as well as unintelligible or inconsequential extraneous chitchat" (p. 47).

The runners' texts were then subjected to content analysis in order to examine the proportional occurrence of each strategy category, as well as to provide a means of comparing proportionate reliance upon associative versus dissociative strategies. As Schomer (1986) had predicted, the superior runners did not exhibit a preference for the associational strategies when compared to the novice and average marathoners. These results are significant in that they do not agree with Morgan and Pollock's (1977) assertions that the associative cognitive strategy is used almost exclusively by the elite marathon runner, non-world-class runners being reported to depend more commonly upon a dissociative coping strategy. Schomer's (1986) runners relied equally upon the associative strategies, regardless of their running status.

Schomer's (1986) examination of associative content also confirmed the existence of qualitative differences within the associative thought used by the various classes of runners involved in the study. This examination indicated that the Body Monitoring of the superior athletes was of a more exact and detailed nature than that employed by the other runners.

Questions Arising from Schomer's (1986) Work

Schomer's (1986) work must be applauded for the originality of its design and methodology and for the significance of the results generated. However, a critical examination of the study renders a number of questions. Schomer's (1986) method represented a clear improvement over that employed in previous mental strategy research, which relied heavily upon reflective, recall-based data. By recording continuously throughout the course of a given training run, Schomer (1986) hoped to document the "continuous," "unobscured" thought processes of his subjects. However, the nature of Schomer's (1986) method and subject instructions lead one to question whether the resulting record is in fact continuous and unobscured. The instructions provided each subject prior to a recording session (training run) requested only that the runner "say aloud whatever comes to mind during this run" (Schomer, 1986, p. 45). As a result, Schomer (1986) failed to control for frequency of report throughout the course of the training session.

Schomer (1986) states that the runners involved provided verbal reports at a mean verbalization rate of 5.946 "units" (or reports) per minute. Unfortunately, no variance measure accompanies this figure. As such, it is impossible to determine the consistency, either within or between subjects, with which Schomer's (1986) subjects reported their ongoing thoughts. Without controlling for or monitoring report frequency variances it is impossible to claim that the resultant data are either continuous or unobscured. Report frequency may, for example, have declined sharply through the course of the run simply as a result of fatigue. Had this been the case, the resulting data would tend to more accurately represent those cognitive strategies employed during the initial phases of the subject's run.

With no means of determining report consistency, it is also quite possible that the use of a given strategy, associative or dissociative, may have affected report frequency during the periods when that strategy was employed. For example, the athletes may have been reluctant to interrupt the dissociative "fantasy" engaged in in order to report upon it, thereby reducing the reported frequency of dissociative cognitions. Conversely, the runners may have been very willing to share their dissociative strategies, enjoying the richness of their distracting thoughts, while failing to report on their associative strategies, not wishing to be distracted and therefore jeopardize some of the control over the pacing which this strategy may provide. Any number of alternative hypotheses may be forwarded which would suggest differential reporting of the two classes of cognitive strategy. As no attempt was apparently made by Schomer (1986) to control or monitor report frequency, the "unobscured" nature or the resulting data stands in question.

The reasoning underlying the decision to rely upon data collected during training runs must also be considered. Schomer (1986) stated that experienced runners suggest that little potential exists for innovation and implementation of untried ideas during actual competition. The mental strategies recorded during training runs were therefore assumed to be an accurate approximation of those which would be observed during a real endurance event, e.g., a marathon, yet this assumption was apparently not empirically founded.

Statement of Problem

The work of Schomer (1986) and his predecessors represents an evolution of both theory and methodology regarding the study of cognitive strategies employed by endurance athletes. The present study was designed to further this evolution by examining the triathlon, a relatively recent phenomenon within the world of endurance athletics.

The triathlon has been called "the sport of the 80's" (Zimmer, 1984, p. 22). Simply defined, the term "triathlon" refers to a race which combines three endurance sports, each completed consecutively. Typically, the triathlete (the athlete competing in a triathlon) will encounter swimming, cycling, and running, in that order, during the course of a triathlon, with the transition period between events being included in the athlete's overall race time. While this combination of sports is by far the most common, a variety of combinations of endurance sports may be offered under the rubric "triathlon". In similar fashion, unlike the more familiar 26.2-mi marathon, there exists no true standard triathlon. The length of each race's component events is often designed to attract local or regional competitors and/or to accommodate an available course or facility.

The most well-known triathlon is the quintessential "Ironman," involving 4 km (2.4 mi) of swimming, a 180-km (112 mi) bicycle ride, and a marathon run of 42 km (26.2 mi). There are also a few ultratriathlons which involve greater distances. Most triathlons, however, involve more modest distances e.g., a 1-km (0.6 mi) swim, a 20- to 40-km (12.4- to 24.8-mi) bicycle ride, and a 10- to 16-km (6.2- to 10-mi) run.

1978 saw the first triathlon, an "Ironman," which combined the sports and distances of what were then the Hawaiian Island's three premier endurance races. Fifteen men entered the competition, with twelve completing the race. The following year the event drew 100 entrants. By 1983 approximately 1000 triathlons were held in the United States, involving an estimated 250,000 athletes, one fifth of which were women, with the entrants ranging in age from 15 to 60 (Zimmer, 1984). In 1984 some 1800 scheduled races were held in the US with an estimated draw of over 600,000 participants (Zimmer, 1984). In 1988 over 2000 triathlon events were staged in the United States drawing some one million participants (Serrani, 1989). Only four officially sanctioned "Ironman" triathlons were held in 1987, these being run in Hawaii, New Zealand, Japan, and Canada (Southam, 1987). However, the geographical range represented by these four races is indicative of the widespread popularity the sport has generated in its brief history. In fact, the calendar of upcoming triathlons provided in one of the popular triathlon magazines (Triathlete, 1990) reflects the international popularity this sport currently enjoys, with triathlons being held in the United States, Canada, Australia, New Zealand, Japan, Tahiti, the Netherlands, Mexico, France, Malaysia, Sweden, Ireland, Spain, and even the U.S.S.R. The triathlon was included as a demonstration sport in the 1990 Commonwealth Games in Auckland, New Zealand (Newkirk, 1990) and consideration has also been afforded the proposal that some standardized triathlon become an Olympic event (Rochlin, 1984). Indeed, the triathlon may be featured as a demonstration sport in the 1992 Olympics in Spain (Serrani, 1989).

As one would expect, the increase in interest in triathlon participation has sparked a demand for information regarding training and racing technique, diet, equipment, and so on. Interestingly, while the physical aspects of the sport have received extensive attention, the impact of psychological factors upon a triathlete's performance has not yet been addressed. To paraphrase one athlete, many triathletes have "peaked out" physically, having trained to the point where any additional physical gains will be minimal. As a result, there exists a great deal of interest in any research which will aid the triathlete in developing a greater understanding of the psychological aspects of his or her performance.

The current study was proposed with two primary goals. The first was the examination of the cognitive strategies employed by the triathlete. Specifically, this research was designed to address the question of which cognitive strategies triathletes typically rely upon, associative or dissociative, and the nature of these strategies.

The second primary focus of this investigation addressed a critical assumption which has previously gone unchallenged. While Schomer's (1986) method provided a means of recording the cognitive strategies relied upon by endurance athletes as they participated in their sporting activities, Schomer's (1986) results and subsequent conclusions were based solely upon data gathered during training runs. The practical validity and utility of these results are therefore dependent upon the validity of the assumption which underlies this method of data collection, namely, the assumption that those mental strategies recorded during training accurately reflect those strategies relied upon during an actual racing situation. In fact, much of the research within this field becomes merely an academic exercise if the practical generalizability of the results generated is not assumed.

The present study was designed to allow for comparison of the thought processes engaged in by triathletes as they trained for the triathlon and as they competed in actual, sanctioned triathlons. It was hoped that this comparison would allow for a determination of the validity of the practice of relying upon training data in the study of cognitive strategies employed by endurance athletes. These results were also expected to have significance with respect to the training regimens of triathletes and other endurance athletes. One of the aims of psychology's involvement in the realm of sport is to assist the athlete in realizing his or her fullest potential (Brown & Mahoney, 1984; Geron, 1983; Nediffer, DuFresne, Nesvig, & Selder, 1980). To this end, it was hoped that the results of the current study would serve to guide the athlete interested in structuring training so as to include the cognitive aspects of his or her sport and allowing him or her to maximize the results of this cognitive-strategy training.

Method

Subjects

Twelve individuals, eleven male and one female, acted as voluntary participants in the current study and were not compensated for their participation. Each had competed in at least one triathlon during the ongoing triathlon season and each was actively involved in training for participation in future triathlon races. Subjects were recruited largely following their completion of local triathlons, the author soliciting their participation directly. Recruited subjects were also asked to provide the names and phone numbers of other potential subjects whose participation was subsequently solicited by phone. Subjects were also recruited from lists of athletes competing in previous triathlons and from applications submitted for participation in upcoming races.

Subjects ranged in age from 22 years, 4 months to

36 years, 1 month ($\underline{\bar{X}}$=28 years, 3 months. SD=4 years, 5 months). Each was a seasoned competitive triathlete, with involvement in the sport ranging from three to five years. Each of these subjects competed in sanctioned triathlon races on a regular basis and each was highly dedicated and involved in the sport, training from between one to four hours on a daily basis. As a reflection of their commitment to the sport, two of the subjects were reportedly considering competing in the sport on a professional level.

Apparatus

An Olympus Pearlcorder S911 microcassette recorder was carried by each subject in order to record in-vivo data. The microcassette recorder was carried in a specially adapted, commercially available belt pack originally designed to carry a personal stereo. The microcassette was positioned in the small of the subject's back, this being the least distracting position in which the equipment may be carried (Schomer, 1986). The subject also wore a small condenser microphone clipped to his/her shirt at chest level. The wire connecting the microphone to the microcassette recorder ran under the subject's arm to the waist belt containing the recording equipment.

The subjects also carried a small electronic audio-cueing device designed and constructed specifically for the current study. The cueing mechanism itself was situated within the belt pack, accompanying the microcassette recorder. In total, the recording equipment (including belt pack and cueing device) weighed approximately 408 g. The cueing device's small speaker accompanied the recording microphone, clipped to the subject's shirt at chest level, the speaker wires being intertwined with the microphone's wire. The cueing device served to prompt the subject to report upon his/her ongoing cognitive activity by producing an audible tone of approximately 0.5 sec duration at regular 3-min intervals. This interval was established during pilot research conducted with endurance athletes not directly involved in the study. Employing this interval, the audio cues and subsequent reports were not considered excessive or overly intrusive and the pilot subjects did not reportedly become familiar with the interval, thereby allowing for accurate anticipation of the cue. The cueing device also served to electrically activate the microcassette recorder to initiate a 15-sec recording period concurrent with the presentation of the audible cue, the cueing device controlling the duration of this period.

Each of the subject's recordings was subsequently transcribed using an Olympus Microcassette Transcriber, Model TC 1000. Each recording and corresponding text was identified using only a numerical code in order to ensure subject anonymity.

Procedure

Each subject was asked to carry the recording equipment during one training run and one training ride on his/her bicycle. Subjects were familiarized with the recording equipment and were provided the following instructions, both written and verbal, prior to wearing the recording equipment for the first time:

> I am interested in what triathletes think about as they train and as they race. Each time you hear the tone, I would like you to say aloud whatever you are thinking at the moment. These tapes will be treated in the strictest confidence. Please report whatever you are thinking as accurately as possible no matter how simple or irrelevant it may seem to you. I am interested in whatever you are thinking. There are no taboo issues or limits. You may speak in whatever fashion you like. You do not need to talk in complete sentences. You may say whatever you are thinking in sentences, phrases, or words.

Subjects were also informed of the duration of the recording period following each cue (15 sec) but were not informed as to the interval between cues (3 min). Any questions posed by the subject regarding the task demands were addressed; however, no additional information was provided regarding the focus of the study i.e., associative vs. dissociative cognitive strategies, etc. A brief review of these instructions was provided prior to the subject's second recording session.

Prior to their first recording session, the subjects were informed of their right to discontinue their participation at any time during the course of the study and their anonymity was guaranteed. These provisions were outlined in writing and the subjects' signatures were secured verifying their understanding and acceptance of these conditions (see Appendix A for example of informed consent form). Three subjects (all male) were subsequently asked permission to allow photographs to be taken as they participated in the research. Each signed statements verifying his permission to use these photographs in future presentations of the research, verbal and/or written. Each of these subjects was assured that his name would not be employed in any such presentation, this stipulation being included in the statement each of these subjects signed (see Appendix B for example of statement).

In order to minimize the impact that participation in the study had upon the triathletes' behavior and cognitive processes, no attempt was made to influence the nature or duration of the athletes' training sessions. As a result, eight of the subjects completed the cycling-training recording session first, followed by the running-training session, while the data collection was completed in the reverse order in the case of the remaining four subjects. No attempt was made to control for this order. Four subjects completed the cycling-training and running-training recordings consecutively without interruption. In the case of the remaining triathletes, data collection for the two sports was interrupted by an interval of between 1 and 13 days.

Upon completion of both training-session recordings, arrangements were made to allow for in-vivo recording during a sanctioned race in which the triathlete was entered. While 11 of the 12 subjects agreed to wear the recording equipment both in training and during a race, logistics prevented two of these athletes from participating in the racing component of the study. Failure of the cueing equipment due to water leakage rendered two of the remaining nine race-generated recordings non-usable. As a result, training data were collected from all 12 subjects, with 7 subjects (all male) completing both the training and racing phases of the study.

Data were collected during four triathlons, each race being held in a different location. Each triathlon consisted of a 1-km swim (open water, mass start), a 40-km ride, and a 10-km run, in this order. In each case, the race in which a given triathlete wore the recording equipment occurred within 4 to 16 days of his or her final training-recording session.

During that triathlon race in which a subject was participating the recording equipment was donned by the subject, with the author's assistance, during the first transition (between the swimming and cycling portions of the race). All precautions were taken to ensure that the donning of the equipment did not significantly lengthen the athlete's transition time. The triathlete then completed the cycling and running portions of the race wearing the recording equipment, providing an audible report when cued to do so by the equipment (every 3 min). The subjects were relieved of the equipment immediately upon completion of the race.

Shortly thereafter the triathlete was interviewed by the author using a loosely structured interview in which the triathlete was asked to outline the strategy(ies) employed during the swim and those employed during each of the four recording conditions (Cycling-Training, Running-Training, Cycling-Racing, Running-Racing). The triathletes were also questioned as to the degree to which they had considered the psychological aspects of their performance prior to their involvement in the current study.

Results

Each of the triathlete's recordings was transcribed using an Olympus Microcassette Transcriber, Model TC 1000. Each recording was divided into thirds, with any recordings generated during the second transition (between the cycling and running portions of the race) being discarded. Division into thirds was employed as a result of preliminary discussions with a number of endurance athletes who indicated that this division roughly mirrored the manner in which they conceived of an endurance event, either training or racing. These athletes reported that when considering an endurance event they typically divided the event into three stages (beginning, middle, and finish), with each of these stages being qualitatively different and unique.

Mental Strategy Classification System Development

In order that the content of each text could be categorized (to allow for statistical analysis), Schomer's (1986) ten mental strategy categories were revised following an initial review of a subset of the data. This revision involved an elaboration of the definitions of each of Schomer's 10 categories in order to clarify these definitions and more clearly specify their use. As well, one of Schomer's (1986) categories was renamed, the new name more clearly reflecting the spirit of the category following refinement of the category definition (Schomer's "Personal Problem Solving" being renamed "Introspection"). Ten additional categories, seven associative and three dissociative were developed to augment the ten revised categories. The resulting mental strategy classification system was comprised of 20 categories, categories 1 through 10 making up the associative mental strategy spectrum, categories 11 through 20 defining dissociative mental strategies. Schomer's (1986) original classification system was developed solely upon data collected during the training runs of marathon runners and was not comprehensive enough to account for the cycling and/or racing data involved in the current study. The author's revisions produced a classification system which was appropriate for use with data collected during both cycling and running and across both training and racing conditions. The following mental strategy classification system emerged:

Associative Categories

1. Feelings and Affects

Thoughts concentrating on general sensations of the whole body, like feelings of vitality or fatigue, overall tiredness, and stiffness without mention of specific body parts. Included references to "good form" without specific body parts being mentioned. References to the athlete's affective state also fell under this category, e.g., "I feel great," etc.

2. Body Monitoring

Thoughts of a here and now nature concerning specific anatomy, body parts, or body physiology like breathing rhythm, heart beat, or painful calf muscles. Also included references to stride.

3. Command and Instruction

Thoughts reflecting emphatic self-regulatory instructions to specific body parts or instructions to whole body functioning distinctly related to the activity and maintenance of running or cycling. Included self-motivating statements, e.g., "gotta keep going," "go, go, go," "push, push," etc.

4. Pace Monitoring

Verbalized feedback on current performance with respect to time, distance, speed, or any other available form or method of pacing. Included references to position relative to start, finish, transition area, turn-around point, etc. during a race, and also included statements regarding location during training runs/rides, e.g., "almost to the highway."

5. Other Participants

Thoughts concerning position and/or performance relative to other participants. Included references to other racers as well as references to training partners or imagined runners/riders used during training to simulate competition.

6. Consequential Research/Equipment Concerns

Thoughts concerning research or research equipment when research or equipment had an effect upon comfort and/or performance.

7. Consequential Equipment and Clothing Monitoring

Thoughts concerning non-research equipment or items of clothing when the equipment or items of clothing were of consequence to comfort and/or performance. Given the importance of water intake, references of a here and now nature concerning water or need for water were considered as "consequential equipment."

8. Consequential Course Information

Thoughts concerning terrain and other geographical features when these features were of consequence to pace and/or performance. Included references to hills, flat areas, etc.

9. Consequential Environmental Feedback

Thoughts concerning weather condition, temperature, light conditions, smells, and/or noise level when such feedback was of consequence to comfort and/or performance, e.g., wind, heat, etc.

10. General Associative Category

Employed when report was clearly associative (of here and now nature, focused upon activity athlete was involved in, etc.), but did not fall within one of the categories defined above.

Dissociative Categories

11. Inconsequential Environmental Feedback

Thoughts of a here and now nature concerning the weather condition, temperature, light conditions, smells, and/or noise level which were of no direct consequence to pace and/or performance, e.g., "The light coming down through the trees is sure pretty."

12. Reflective/Anticipatory Activity Thoughts

Thoughts concerning past and future issues related to running and/or cycling including past racing experiences or training sessions and future race preparation and planning. Included reports indicating reflection or anticipation concerning ongoing training run/ride or race, e.g., consideration of pacing on upcoming section of run, thoughts reflecting on beginning of ride while midway through the ride, review of mental checklist of activities during upcoming transition or reflection on these activities once through transition, etc.

13. Introspection

Thoughts revolving around issues of an intrapersonal and interpersonal nature including reflective introspection, belief system evaluation and modification. Included references to other individuals such as the athlete's spouse, children, etc. but not those references focused upon training partners or race participants (which would be coded either "5" or "19").

14. Work, Career, and Management

Thoughts concerning job, work, and career opportunities including those centered around the execution, planning, and construction of work. Included references to homework and other academically-oriented issues in the case of students.

15. Inconsequential Course Information

Thoughts of a descriptive nature concerning immediate scenery and general whereabouts that were of no consequence to pace and/or performance. Included references made to traffic, traffic lights, etc.

16. Talk and Conversational Chatter

Direct speech when in communication with other runners/riders and thoughts expressing follow-up chatter to initial exchanges, as well as unintelligible or inconsequential extraneous chit-chat.

17. Inconsequential Research/Equipment Concerns

Thoughts concerning research or research equipment when research or equipment had no effect upon comfort and/or performance.

18. Inconsequential Equipment and Clothing Monitoring

Thoughts concerning non-research equipment or items of clothing when the equipment or clothing were of no consequence to comfort and/or performance.

19. Inconsequential Thoughts Concerning Other Participants

Thoughts concerning other participants which had no bearing upon pace or performance and/or which were not concerned with position or performance relative to these other participants, e.g., "Jack is riding his new bike today," "tremendous number of people here this morning," etc.

20 General Dissociative Category

Employed when report was clearly dissociative (not of here and now nature, not focussed upon activity athlete was involved in, etc.) but did not fall within one of the categories defined above.

Classification of Subjects' Reports

The content of each subject's recordings, collected under both training and racing conditions, was categorized using this modified classification system. As outlined previously, each subject had been instructed to report aloud his or her thoughts when cued, these cues occurring at 3-min intervals. The subjects' reports were automatically recorded for 15 sec. While some recordings revealed the use of a single cognitive strategy throughout the 15-sec period, many recordings involved the use of a variety of themes or strategies. In these cases, the recording was subdivided, with each unique strategy being isolated for individual classification. For example, the following 15-sec report:

"Couple of dogs up there on the top of the hill. Lets go legs, come on!" would be subdivided as follows:

"Couple of dogs up there on the top of the hill."\
"Lets go legs, come on!"

Each 15-sec recording was subdivided, where necessary, according to the above criteria, subdivisions within a given 15-sec recording representing the use of a unique strategy. Each of these subdivisions were then classified using the revised mental strategy classification system, subcategories being identified numerically. For example: "Couple of dogs up there on the top of the hill." was classified as "15" -- Inconsequential Course Information. "Lets go legs, come on!" was classified as "3" -- Command and Instruction.

Individual categories were scored repeatedly within a report in those instances in which subdivisions of the report involved unique, novel uses of a category which did not reflect the repeated or continued use of a single strategy. For example, the report, "I feel real good now. Looking down at my shadow and I can see my form looks good too." would be classified as including two instances of category 1 -- Feelings and Affects. The statement "I feel real good now" focuses upon a general, overall feeling of vitality and clearly falls within this category. The subject's concern regarding form also falls within this same category; however, as this does not represent a recapitulation or continuation of the same strategy, this statement would be afforded a second category 1 scoring (i.e., Feelings and Affect).

Inter-Rater Reliability

A subset of 72 recordings was developed from the recordings collected from the 12 subjects. This subset included one randomly selected 15-sec recording from each third of each subject's training data, both cycling and running. Each 15-sec recording was independently classified by the author and a trained research assistant using the revised twenty-category mental strategy classification system. Concordance ratings were calculated for each third of each sport comparing the author's ratings to those of the research assistant, both on the basis of subcategory classification and mental strategy type (associative vs. dissociative). The resulting concordance ratings indicated moderately high inter-rater reliability when subclassification ratings were considered. The raters achieved 87.4% concordance across the cycling-training data and 85.7% concordance across the running-training data. High inter-rater reliability was evidenced when mental strategy type (associative vs. dissociative) was considered, the independent raters achieving 97.7% concordance across the cycling data and 90.5% concordance across the running data (see Appendix C for specific concordance rates, both within and across thirds).

Evaluation of Mental Strategy Type (Associative vs. Dissociative)

Frequency tables were compiled indicating the report frequency for each of the twenty subcategories for each third of each triathlete's recordings, collected during both training and racing (where available). Summation of these frequencies for each third of an event (Cycling-Training, Cycling-Racing, Running-Training, Running-Racing) resulted in frequency counts for each event. In order that comparison of training and racing conditions could be made, frequency tables were also produced considering only the data recorded by those seven triathletes who completed both training and racing portions of the study. Each of the above frequency counts were then transformed onto percentages of occurrence.

The categorizations were then collapsed across mental strategy type (associative vs. dissociative) and the associative strategy frequencies were transformed into percentages of occurrence. The dissociative percentage was indicated by the remainder, given the mutually exclusive nature of the two strategy types.

In order to address the question of whether the triathletes relied more heavily upon either associative or dissociative mental strategies during one or more of the recording conditions (CT,CR,RT,RR) or thirds within each condition, z tests were performed (α = .05), testing the hypothesis that P (the proportion of associative responses) = .50. Z tests were carried out on the observed associative percentage for each of the 12 combinations of stage (beginning, middle, end), recording context (training vs. racing), and sport (cycling vs. running). Each of these calculations employed only data collected from the seven triathletes who provided both training and racing recordings in order to allow for comparison of these conditions (see Appendix D for associative percentage scores, z-values). The use of the z test assumes that the sampling distribution is normal in form. By convention, if the product of NxP is equal to or greater than 10, deviations from normality are considered to be negligible (Glass & Hopkins, 1984). This criterion was readily satisfied.

The results of the z tests indicated that the associative percentage was significantly greater than 50% during racing conditions, while training revealed no significant divergence from a 50/50 associative/dissociative balance. This finding was consistent across both cycling and running. When specific thirds were considered within these training and racing recordings, the racing condition revealed significant reliance upon an associative strategy during each third, regardless of sport. Similar analysis of the training data revealed a consistent balance between associative and dissociative strategy, neither strategy being employed in significantly more or less than 50% of the triathletes' individual reports. These results held consistently across thirds for both cycling and running training data.

<u>Analysis of Variance</u>

Two analyses of variance (ANOVA) were carried out, with the proportionate degree of associative thought serving as the dependent measure. The first of these was a 3 X 2 ANOVA involving stage (beginning, middle, end) and sport (cycling vs. running) with training data from all 12 subjects being included in this analysis. The results of this ANOVA revealed no significant main effects or interactions.

A 2 X 3 X 2 ANOVA was then completed with recording context (training vs. racing), stage (beginning, middle, end), and sport (cycling vs. running) constituting the matrix. Once again the proportionate degree of associative thought constituted the dependent measure. In this instance, only the seven subjects providing complete training and racing data were included in the analysis. The results of this analysis revealed a single significant main effect for context (training vs. racing), ($F(1, 12) = 24.35$, $p < .0025$), with no other main effects or significant interactions being evidenced.

Report Frequency and Rank Order

In order to assess the relative reliance upon individual subclass category types, absolute frequency of report of each of the twenty subdivisions within the mental strategy classification system was calculated. Totals were calculated and rank ordered for each of the four combinations of recording context (training vs. racing) and sport (cycling vs. running). Each of the frequency scores was also transformed to a percentage score i.e., absolute subcategory frequency / total number of reports considered. Such calculations were undertaken using the training data gathered from all 12 subjects. However, for comparison purposes with racing data, these calculations were duplicated using only that data gathered from the seven subjects providing both training and racing data. (See Appendixes E through L for report frequency rank orders).

Discussion

While there exists a foundation of investigation into the mental strategies employed by endurance athletes, the bulk of this research and certainly the most influential studies within the field have focused upon the marathon runner's cognitive coping styles. Although the triathlon has become a tremendously popular sport during the 1980s, to date there has been no formal examination of the cognitive strategies that underlie a triathlete's performance. The current study was therefore designed and undertaken in an effort to examine the triathlete's mental approach to his/her sport, to answer the question "What cognitive strategies do triathletes bring to bear upon their performance?" or, more simply put, "What do triathletes think about?" The scope of this question was further expanded to allow for comparison of those cognitive strategies employed during training to those relied upon during competition. Thus the question became not only "What do triathletes think about?", but "What do triathletes think about when they train and is this similar to what they think about during a race?" The results of this investigation are of practical importance because of their potential to improve the effectiveness of a triathlete's training in preparation for competition.

The methodology and results arising from this study also carry significant implications for continued research into the cognitive strategies employed by endurance athletes.

Training Vs. Racing

Examination of the cognitive strategies employed by the triathletes in the current study can best proceed through the comparison of strategies recorded during training and racing. During training, the triathletes employed both associative and dissociative strategies, showing an even balance between the two, approximately 50% of the training reports being of an associative nature, 50% being dissociative. This may be considered a general statement regarding training as this associative/dissociate balance was exhibited both during training rides (cycling) and runs. Further, no change was noted in this even balance through the course of either a training ride or run.

By comparison, the data collected during actual competitive triathlons revealed significant reliance upon the associative cognitive strategies, with 69.4% to 80.0% of the athletes' race-generated reports being of an associative nature. As was the case with the training data, general statements may be made in reference to the athletes' cognitive approach to racing because this overwhelming reliance upon the associative cognitive strategies was evident in both the riding and ensuing running portions of the race and was consistent throughout the entire race. Thus, when stage (beginning, middle, end), sport (cycling, running), and recording context (training vs. racing) were considered, only recording context was found to significantly affect the degree to which the triathletes employed associative (and conversely, dissociative) cognitive strategies.

This finding lends support to Morgan and Pollock's (1977) contention that the associative strategies have the potential for maximizing the endurance athlete's efficiency. As was the case for the elite runners in Morgan and Pollock's study (1977), the triathletes appear to have recognized the advantages to be gained by relying upon the associative strategies. This point is reflected by the overwhelmingly skewed reliance upon these associative strategies during actual competition, the triathlete's ultimate goal being the maximization of efficiency during competition, thereby resulting in the athlete's best potential performance (i.e., fastest race time).

Direct observation and informal discussion with many triathletes (research subjects and others) suggested that, regardless of the intensity with which the triathlete trained, these efforts paled in comparison to those extended during competition. The dramatic increase in intensity of the racing situation compared to training was found to be accompanied by an equally dramatic increase in reliance upon associative strategy types. This finding is consistent with Schomer's (1986) contention that the relative proportion of associative thought employed by an endurance athlete would increase as he/she increased the intensity or rigor of his/her training regimen. Given the potential dangers accompanying competitive endurance training, Schomer (1986) believes that this intensity may be achieved and maintained safely and efficiently only through the use of primarily associative strategies.

Schomer (1986) provides only a scattergram representation of the range of proportions of associative mental strategy employed during training by the three groups of marathoners involved in his study (novice, average, and superior). Estimates of the range and average associative thought proportion for these three groups are as follows: the "novice" runners averaged 37% associative thought, their records ranging from 8% to 66% associative content; the "average" runners averaged 29.5% associative thought, ranging from 0% to 59% associative content; and the "superior" runners averaged 44.5% associative thought, their reports ranging from 14% to 75% associative content. Each of the triathletes involved in the current study was an experienced, highly competitive, and successful endurance athlete. In order to remain competitive and successful, each was dedicated to a daily regimen of high intensity training. Therefore, it comes as no surprise that the triathlete's balanced use of associative and dissociative strategies during this training most closely mirrors the cognitive approach employed by superior marathon runners during their training runs. Specifically, during their training rides the triathletes' reports averaged 50.7% associative thought content. The average proportion of associative thought during the triathletes' training runs was found to be 56.4%.

These results also lend support to to Schomer's (1986) contention that endurance athletes engage in both associative and dissociative cognitive strategies, relying on neither the associative nor the dissociative strategy type exclusively as had been suggested by Morgan and Pollock (1977). While the reports recorded during competition show a marked increase in the percentage of associative thought as compared to these training figures, a small proportion of the racing triathletes' thoughts continued to be of a dissociative type.

While the analysis of the triathletes' cognitive strategies at an associative vs. dissociative level is important in answering some of the basic questions regarding these athletes' mental approach to their sport, questions arising out of the previous work done with other endurance athletes (e.g., Morgan & Pollock, 1977; Schomer, 1986) called for a more detailed level of analysis. As a result of the methodology employed in the current study this more detailed analysis of the triathletes' training and racing strategies was possible, both in terms of examining strategy use through the course of an event and at the level of specific strategy type (subcategory).

Comparison of Event Stages

Preliminary discussions with a number of endurance athletes (triathletes, marathon and medium distance runners, and cyclists) indicated that these individuals conceived of a training session or race as being divided into three qualitatively different stages or thirds: beginning, middle, and end. These athletes reported that the focus of their thoughts varied between stages, their mental strategy changing through the course of the event. As the current study employed a consistent sampling interval in recording the triathletes' reports during both training sessions and races, the resulting data could easily be divided into thirds in order to analyze for changes in cognitive strategy through the course of a training session or during a race.

With respect to broad strategy type (associative vs. dissociative), the ANOVA results indicated that stage (beginning, middle, end) did not significantly affect the relative percentage of associative to dissociative strategies employed either in training or during a race. The triathletes used both associative and dissociative strategies consistently throughout a training run or ride, the relative percentage of each never varying significantly from 50% during the course of the training session. Similar consistency was apparent during competition; however, the triathletes relied much more heavily upon associative strategies. Thus, in contrast to the anecdotal reports of a wide number of endurance athletes, the broad strategy types (associative, dissociative strategies) showed no evidence of change during the course of either a training session or an actual race.

Subcategory Analysis of Event Stages

The associative and dissociative classifications represent rather broad strategy types, each of these categories comprising ten subcategories. Unlike the case when these more general associative and dissociative categorizations were considered, the triathletes' use of the subcategories within each of these broader strategy types did not in all cases show strong consistency across each stage of training and racing or across sports.

While cycling, the triathletes were found to employ both the associative and dissociative subcategory strategies in a very consistent manner across stages of an event, be it a training session or the cycling portion of a race. The data collected as the triathletes ran showed less consistent use of the subcategories. While engaged in a training run, the athletes' use of the associative subcategories was consistent throughout the training session but their dissociative subcategory use remained consistent only through the first two thirds of their workouts (the beginning and middle portions). During the final stage of a training run the triathletes tended to concern themselves relatively frequently with Equipment and Clothing, these thoughts being inconsequential to their immediate comfort or performance. Such concerns were only rarely reported during the initial two stages of a training run.

The running portion of a competitive race also involved subtle changes in the triathletes' mental strategies. The triathletes exhibited a shift in their use of the associative strategies following the first stage of the run, that portion of the race immediately following the transition from cycling to running. This shift was due in large part to the triathletes' use of Body Monitoring strategies. As the triathletes began the run their reports frequently included Body Monitoring, reports of this nature representing 21.2% of the associative reports recorded during this initial stage of the run. However, this emphasis upon Body Monitoring was short-lived, as during the middle and final stages of the run the report frequency of this subcategory dropped dramatically, representing only 2.4% of the associative reports recorded during the middle stage and 2.1% of those reported during the final stage of the run. This emphasis upon Body Monitoring following the transition is understandable: the athletes were attempting to become accustomed to the kinesthetic feedback associated with the act of running, having just completed a 40 km ride. Reflecting this, in the majority of these reports the triathletes alluded to feelings in their legs.

With respect to the dissociative subcategories, the triathletes' mental approach to the running portion of the race was similar during the first and third stages of the run, but differed during the middle stage. Specifically, the triathletes tended to rely heavily upon various General Dissociative strategies (responses of a dissociative nature which did not fall within one of the specific dissociative subcategories) during the first and third stages, this subcategory being the most frequently reported of the dissociative subcategories during both of these stages and accounting for 35.7% and 33.3% of the dissociative reports during these stages, respectively. In contrast, throughout the second, middle stage of the run, General Dissociative Thoughts represented only 8.3% of the dissociative reports.

Close examination of the data revealed that much of the variation in report frequency rank orders between stages could be attributed to the strategy changes noted above and/or to variations in the relative degree to which the triathletes employed those subcategories which were used only infrequently. Comparing the report totals for each of the ten subcategories within a strategy type (associative, dissociative) for the four recording conditions (Cycling-Training, Cycling-Racing, Riding-Training, and Riding-Racing) indicated that the triathletes tended to rely very heavily upon certain of the subcategories. This is reflected in the fact that three associative and three dissociative subcategories in each recording condition rank order (across stages) accounted for between 50.6% and 78.4% of the total reports recorded during that recording condition combination (CT,CR,RT,RR).

These results indicate that the triathletes tended to rely upon a small number of subcategories as their primary mental approach throughout the course of a given event. The qualitative difference in cognitive strategy reported during preliminary discussions with a number of endurance athletes may be due largely to variations in the relative degree to which the secondary, infrequently employed subcategories are called upon. As such, the triathletes' use of the associative and dissociative subcategory strategies was more closely examined in order that a complete understanding of the athletes' mental approach to their sport could be developed.

Dissociative Subcategories

Examination of the use of the ten dissociative strategies was important as fully 50% of the triathletes' training reports involved strategies of this nature. When totaled across all four recording conditions (CT,CR,RT,RR), the three most frequently employed dissociative subcategories represent fully

67.6% of all dissociative reports recorded (see Appendix M for report frequency rank order of dissociative subcategories across all recording conditions). This finding indicates that the triathletes tended to rely very heavily upon a select few types of dissociative mental strategies, specifically, in rank order: subcategory 12, Reflective/Projective Activity Thoughts; subcategory 15, Inconsequential Course Information; and subcategory 20, General Dissociative Thoughts.

The high rank-order correlation between the report frequency of dissociative subcategories recorded during Cycling-Training and Running-Training, $r_s(9) = .93$, $p < .005$, indicated similar usage of these strategies during both of these phases of the triathletes' preparations for competition. Given this finding, the individual dissociative subcategory report frequencies were totalled across the two training conditions and a rank order was developed (see Appendix N for report frequency rank order of dissociative subcategories across training). When totaled across both cycling and running training conditions, these same three subcategories, Reflective/Projective Activity Thoughts, Inconsequential Course Information, and General Dissociative Thoughts were found to hold the first three rank-order positions. As was the case when all recording conditions were considered, these three subcategories accounted for the bulk (70.8%) of the dissociative reports recorded during training sessions.

High rank-order correlations between racing conditions (CR, RR), $\underline{r_s}(9) = .85$, $\underline{p} < .005$, also allowed for the combining of these data, resulting in general dissociative subcategory report frequency totals and associated rank ordering for racing (see Appendix O for report frequency rank order for dissociative subcategories across racing). In the case of racing, both subcategory 12, Reflective/Projective Thoughts, and subcategory 20, General Dissociative Thoughts, were found to be relied upon heavily, these two subcategories accounting for 54.1% of the total dissociative reports recorded during racing. Thus, in both training and racing situations, the triathletes relied very heavily upon Reflective/Projective Thoughts and General Dissociative Thoughts.

Consideration of subcategory 15, Inconsequential Course Information, involved examination of the two recording contexts, training vs. racing, as this subcategory was found to drop markedly in proportionate frequency of report when training was compared to racing. While accounting for 27.2% of total dissociative reports during training sessions (cycling and running combined), Inconsequential Course Information was the focus of only 7.4% of the reports recorded during competition. This drop may be understood by considering the nature of the two recording contexts and that of the subcategory itself.

Inconsequential Course Description was defined as "thoughts of a descriptive nature about scenery and general whereabouts that are of no consequence to pace and/or performance." The definition was also interpreted in a broader sense to account for references to traffic and other similar, unavoidable hazards faced by the triathletes, these being considered as part of the "scenery and general whereabouts." Indeed, many of the reports falling under this subcategory involved comments regarding traffic, road signs, etc. This was especially true of those reports recorded during training, these concerns being of significant importance in ensuring a safe training ride or run. As the actual triathlon races were conducted over closed, protected courses there existed little opportunity for concern or comment upon traffic or road signs. As a result, the few reports in this category recorded during the races typically involved more general descriptions of the triathletes' surroundings.

Three other significant changes in the nature of the triathletes' dissociative strategies became apparent when the training data were compared to those recorded during races. First, subcategory 19, Inconsequential Thoughts Regarding Other Participants, was employed much more frequently during racing situations than in training. This category was ranked seventh and accounted for only 3.1% of the dissociative reports during training but was the second most frequently reported dissociative category during racing situations, accounting for fully 20% of these reports. This dramatic increase is understandable as 19 of the 24 training sessions were completed by triathletes running or riding alone, with little opportunity for concerns regarding other participants, except in the case of imagined competitors. As a contrast, the racing situation provided ample opportunity for this type of dissociative thought.

Subcategory 16, Talk and Conversational Chatter, also showed a considerable increase in report frequency from training to racing situations, increasing from the least frequently reported subcategory during training, accounting for only 1.1% of the dissociative training reports, to the fifth ranked subcategory during racing, garnishing 7.4% of the dissociative reports recorded during competition. This increase once again reflects the largely solitary nature of training as compared to the potentially interactive nature of the racing situating.

The remaining dissociative subcategory which was found to vary markedly when the training and racing data were compared was subcategory 13, Introspection. While maintaining the fourth rank among the dissociative subcategories in terms of training report frequency and accounting for 9.7% of the total dissociative training reports, Reflective Introspection and Personal Problem Solving was employed relatively infrequently during competition, dropping to eighth rank with only 2.2% of the dissociative racing reports being of this nature. Thus, while the triathletes may view their training sessions as an opportunity to engage in "growth oriented" introspection, such thoughts are only very infrequently indulged in during competition.

Associative Subcategories

The triathletes were found to engage in both associative and dissociative strategies with equal frequency during training; however, they relied primarily upon associative strategies when involved in competition. Given the relative importance placed upon these associative strategies, a detailed analysis of the use of the associative subcategories was clearly warranted. When considered across all four recording conditions (CT,CR, RT,RR), subcategories 1, Feelings and Affect, and 4, Pace Monitoring, emerged as the two top-ranked associative strategies, accounting for 39.0% of all associative reports (see Appendix P for report frequency rank order of associative subcategories across all recording conditions). Highly significant rank-order correlations of report frequency of associative subcategories were found between Cycling-Training and Running-Training, $r_s(9) = .65$, $p < .025$, and between Cycling-Racing and Running-Racing, $r_s(9) = .75$, $p < .01$, and thus these data were collapsed across sports. This resulted in the development of general racing and training associative subcategory report frequency totals and rank orders (see Appendixes Q and R for report frequency rank orders of associative subcategories across training and racing). The reader will recognize that this procedure mirrors that used in the examination of the dissociative subcategory data.

As was the case when the results were totaled across all four recording conditions, when training was compared to racing, subcategories 1 and 4, Feelings and Affect and Pace Monitoring were found to be the most heavily relied upon of the associative subcategories, accounting for remarkably consistent proportions of the athletes' associative reports. Specifically, 39.8% of the associative reports recorded during training fell into either the Feelings and Affect or Pace Monitoring subcategories, while 38.4% of the racing associative reports were of this type.

The only subcategory which evidenced a notable change in relative use when training was compared to racing was subcategory 5, Other Participants, ranking eighth and accounting for only 3.9% of the associative reports during training and ranking fourth, accounting for 14.4% of the associative reports recorded during competition. This change may have been predicted given the solitary nature of most of the triathletes' training sessions, affording little opportunity to gauge one's performance or position against others. Ample opportunity existed for such comparison during competition and this is reflected in the increase in the use this strategy during the races.

Strategy Changes During Race: Cycling-Racing Vs. Running-Racing Comparison

As was outlined in the introduction, the triathlon involves the combination of three endurance sports. Typically, as was the case in the current study, these sports include swimming, cycling, and running, in that order. A comparison of the cognitive strategies employed by the triathletes during the cycling portion of a race to those relied upon during the running phase of the same race was undertaken to examine the changes in cognitive strategy which occurred through the course of the race. While ANOVA analysis at the level of the broad associative vs. dissociative categorizations indicated no significant change in strategy as the race wore on, analysis at the finer, subcategory level revealed subtle strategy changes.

High rank-order correlations were found between subcategory report frequency for cycling and running during racing situations for both associative and dissociative strategies, CR vs. RR, associative subcategories, $\underline{r_s}(9) = .75$, $\underline{p} < .01$; CR vs. RR, dissociative subcategories, $\underline{r_s}(9) = .85$, $\underline{p} < .005$. These high correlations indicated a great deal of similarity in the triathletes relative dependence upon the various cognitive strategies available. However, this correlation was not perfect, indicating some discrepancies in subcategory use across sports during competition. While the majority of these discrepancies were relatively minor and do not bear closer examination, a select few of the changes were significant enough to be noteworthy. Changes occurring within both the associative and dissociative subcategories were considered.

Dissociative Subcategories: Cycling-Racing Vs. Running-Racing Comparison

The triathletes' use of the dissociative subcategories remained remarkably stable during the course of the entire race, with only two of these subcategories showing differential use as the race progressed through the cycling phase and into the running phase (see Appendix K for cycling-racing dissociative subcategory report frequency, Appendix L for running-racing dissociative subcategory report frequency). The most evident change occurred in the triathletes' use of subcategory 19, Inconsequential Thoughts Concerning Other Participants. This subcategory accounted for 24.7% of the total dissociative reports recorded during the cycling portions of the triathlons, this being the second most frequently reported subcategory during this phase of racing. Following the transition from cycling to running, the triathletes' concern over other participants -- when such concern did not relate to their own pace or relative position -- dropped markedly, this subcategory accounting for only 7.9% of the total dissociative responses during the running portion of the race and ranking sixth among the dissociative subcategories in terms of frequency during this, the final phase of the competition. Thus, as the triathletes progressed through the race they tended to concern themselves less and less with inconsequential thoughts regarding other racers, thoughts which did not directly affect their own performance.

The second noteworthy change in dissociative strategy use reflected in the cycling vs. running comparison of the racing data involved subcategory 20, General Dissociative Thoughts. While affecting little change in report frequency rank order, the transition from cycling to running was found to produce a considerable increase in the relative degree to which the General Dissociative subcategory was reported. Specifically, this subcategory accounted for 14.4% of the Cycling-Racing reports. The running phase saw this subcategory relied upon much more heavily, accounting for 26.3% of the dissociative reports recorded as the triathletes ran to complete the race.

Associative Subcategories: Cycling-Racing Vs. Running-Racing Comparison

As was the case with the dissociative subcategories, the associative strategies were found to be employed in a relatively consistent manner throughout the course of the cycling and running portions of a race. However, four changes in the use of specific subcategories were apparent when the cycling and running data were compared (see Appendix G for cycling-racing associative subcategory report frequency, Appendix H for running-racing associative subcategory report frequency). In reviewing the changes in strategy which occurred as the triathletes progressed through the course of a race there became evident a tendency to focus upon the highly performance-oriented of the associative subcategories, those most closely tied to feedback and instruction regarding the athlete's own performance.

Subcategory 4, Pace Monitoring was apparently of paramount importance in both the cycling and running phases of the race, this subcategory being tied for the most frequently reported subcategory as the athletes were cycling, and being the single most frequently reported subcategory as they ran. What is not reflected in the rank order of report frequency is a marked increase in relative reliance upon this subcategory as the race progressed. While 18.2% of the triathletes' associative Cycling-Racing reports involved Pace Monitoring, they increased their reliance upon this subcategory to 28.4% during the running phase of the race.

A similar increase was evident in the triathletes' reliance upon subcategory 1, Feelings and Affect. This subcategory accounted for 13.4% of the associative reports recorded as the triathletes completed the cycling phase of a race. During the running phase of the race, the triathletes relied more heavily upon thoughts concerning Feelings and Affect, these thoughts representing 22.0% of all associative reports recorded as the racing triathletes ran.

The remaining noteworthy changes in the triathletes' use of the associative strategies during the course of a race involved subcategory 2, Body Monitoring, and subcategory 5, Other Participants. Body Monitoring was found to increase in report frequency (accounting for 9.2% of the total associative running reports as compared to 5.7% of the cycling reports), becoming the fourth most popularly reported associative strategy during the running phase of competition, as opposed to the eighth during cycling. In keeping with the increasingly narrow focus upon those subcategories most closely tied to feedback and instruction regarding the athlete's own performance, the comparison of the cycling and running data also indicated a sharp decrease in concern regarding the subjects' position and performance relative to other competitors as the race progressed (subcategory 5, Other Participants). Thoughts of this nature accounted for 18.2% of all associative reports recorded during the cycling phase of the triathlons. Following the transition to running, the triathletes showed much less concern regarding other competitors' performances as a means of gauging their own, with only 7.8% of the associative reports involving this type of comparison. As was the case with Pace Monitoring and Feelings and Affect, these changes in the use of Body Monitoring and concerns regarding Other Participants reflect a narrowing of the athletes' attentional focus, their thoughts becoming increasingly centered upon those strategies which most directly affected performance by providing immediate feedback regarding ongoing activity. The data indicate that as the race progresses toward its termination the triathletes became so self-focused that they concerned themselves very little with other competitors or their relative positions. Parenthetically, this may serve to explain why many of the triathletes spoke informally of racing against personal goals and of enjoying the fact that they felt the sport revolved less around beating one's competition than simply realizing one's greatest potential.

Practical Implications

In outlining social learning theory, Bandura (1977) observed that an individual's behavior represents the reciprocal, interactive effects of three influencing factors: physical abilities, behavioral skills, and cognitive processes. Similarly, an athlete's performance may be understood to result from the reciprocal, interactive effects of his or her physical abilities, the mastery of sport-specific behavioral skills, and the influence which psychological factors play upon his or her performance. The competitive triathlete's training regimen is typically well designed to develop the physical abilities and skills necessary to produce optimal competitive performance. For example, those triathletes participating in the current study trained at high-intensity levels for between one and four hours daily. Most were keenly aware of the various recommended training techniques and regimens and each had developed a routine which he or she felt would serve as the best preparation for competition. Many also reported that they had modified their diets in order to facilitate their performance in the sport. The triathletes' commitment to realizing the greatest benefit from their preparatory efforts was also evident in the equipment they employed. Specifically designed, this equipment was purchased, often at considerable cost, as a means of best exploiting the skill development and physical gains realized through the athlete's training efforts.

In contrast to the emphasis placed upon the development of their physical abilities and sport specific skills, these athletes were found to have given little, if any, attention to the psychological factors which influence performance. As became apparent during the post-race interviews, the majority of these highly dedicated, highly motivated athletes had given this aspect of their training and racing performance no consideration whatsoever, although many reportedly recognized the importance of psychological factors in determining their performance and the performance of others. Those few triathletes who reported that they had attended to their thoughts during training and/or racing spoke of the the development of a generally positive, self-motivating attitude e.g., "I can do this," or dealt with the mental approach employed in a specific situation, for example, invoking the image of a hungry preying mantis when attempting to overtake another cyclist. None of the triathletes in the current study had incorporated any form of mental strategy training or conscious mental preparation as a component of his/her training program. Thus, one of the most fundamental insights arising from the present study was a recognition of the disproportionate emphasis placed in training upon the development of the physical abilities and skills necessary for these triathletes to race at a competitive level.

Given the unbalanced attention presently payed to the somatic aspects of their performance, the psychological factors that influence a triathlete's efforts may hold the greatest potential for improved race-day performance. Many of the triathletes participating in the current study reported that the time spent in training represented virtually the maximal commitment that they could afford given the other demands upon their time and energies. The incorporation of mental strategy training into these triathletes' established training regimens would require little or no additional time commitment.

For the competitive triathlete thusly interested, the results of the current study may serve a number of purposes. Most fundamentally, the study's focus may bring the cognitive aspects of the sport to the awareness of the triathlete who had not considered this previously. Such was the case for many of the triathletes who participated in the study. As one triathlete stated "I never thought it was something to think about ... until now." The study's results may also be used to facilitate the triathlete's development of a greater understanding of his/her own mental strategy use by providing a means of classifying and categorizing his/her own thoughts while training and racing and by prompting comparison of these two contexts. The results also allow for comparison between the triathlete's own pattern of mental strategy use and the patterns employed by the triathletes involved in the current study.

The findings suggest that, with respect to specific strategy type (i.e., subcategory strategies) within both the associative and dissociative categories, those strategy types relied upon most heavily during competition tended to be those which were reported most frequently during training. In both the training and racing situations, the triathletes relied primarily upon a limited number of both associative and dissociative strategies. Given this awareness, the triathlete may focus his/her training attentions more strictly upon those strategies employed in competition.

The consistency in strategy use found when cycling was compared to running, both during training and in competition, also indicates that the triathletes relied upon a relatively standardized and consistent mental approach to both of these elements of the triathlon rather than developing sport-specific strategies. This suggests that, just as the physical benefits derived from running may also facilitate cycling performance and vice versa, similar "cross-training" may be possible in terms of mental strategy use.

The triathlete's use of specific associative and dissociative subcategory strategies during training was found to closely approximate the approach they would rely upon during competition. Such was not the case when their strategy use was examined at the broader level of associative vs. dissociative classification. The content of the triathletes' race-generated reports was fully 65% - 80% associative in nature. In contrast, during training the triathletes' thoughts were evenly split between the two categories. At this level, the triathletes' training did not approximate their competitive mental approach. This may be of considerable significance to the triathlete interested in structuring his or her mental strategy training.

Given that the triathlete will be relying primarily upon the associative strategies during competition, he/she may facilitate the use of these strategies by placing similar emphasis upon these strategies during training. During training the triathlete may develop a sense of the effect that his/her cognition has upon performance and recognize those strategies that most influence this performance. Strategy use may then be matched to specific situations and goals. For example, the triathlete may recognize and develop specific strategies that result in faster times as he/she runs up hill or cycles in pursuit of others. By determining the relative effectiveness of particular strategies during training, the triathlete may then employ these same strategies during competition. By providing for greater consistency between the training and racing situations in terms of mental approach, the triathlete may facilitate the efficient use of these strategies.

While providing for greater consistency between the training and racing situations, structured mental strategy training which emphasizes the associative strategies may also hold a number of associated benefits for the triathlete. Schomer (1987) has stated that the marathon runner must be taught to employ associative strategies in order to optimize the athlete's physical skill. In support of this, Masters and Lambert (1989) found the use of associative strategies to be negatively correlated with race time among marathon runners. The use of primarily associative strategies during training may also allow the triathlete to gain greater physiological benefits from his/her workouts. Schomer (1986) has shown a strong direct relationship between the increased use of associative strategies and training intensity. By allowing for training efforts of higher intensity, Schomer (1987) suggests that the increased use of associative strategies during training may result in greater aerobic conditioning.

Indeed, the competitive triathlete may be ill-advised to focus his or her training efforts upon the dissociative strategies. As Morgan and Pollock (1977) have stated, the use of dissociation may increase the risk of overuse injuries such as fractures, etc. as well as the risk of heat stroke and/or heat exhaustion. By training him/herself to rely primarily upon the dissociative strategies, serious injury may occur during the high intensity training undertaken by the committed triathlete. Furthermore, by training to become highly reliant upon dissociative strategies, the triathlete may also significantly increase the risk of injury during competition, given the increased incentive to dissociate from painful sensory feedback signalling a serious injury or condition. In fact, the risks associated with the use of dissociative thought during high effort training have led Schomer (1987) to characterize such an approach as "precarious" and "irresponsible."

The dissociative strategies may also prevent triathletes from fully capitalizing upon their aerobic conditioning. Morgan and Pollock's (1977) thermostat analogy, outlined in the introduction of this work, illustrates the advantage derived by the endurance athletes who employ the associative strategies, closely monitoring the feedback received from their bodies and adjusting their pace accordingly. Parenthetically, one of the subjects in the current study reported that he had come to recognize and employ this approach during competition, attending to the biophysiological feedback he received in order to remain at the very limit of his aerobic tolerance without overextending himself.

In order for the triathlete's pattern of cognitive strategy use during training sessions to parallel that relied upon during competition, the proportion of associative thought engaged in during these sessions would have to be increased substantially, with the athlete continuing to focus upon those specific strategies relied upon most heavily during competition. Schomer (1987) has outlined a mental training program for marathon runners which emphasizes the reinforcement of selected associational thoughts and reports a significant increase in the proportion of associative strategy use during training runs as well as an increase in perceived training effort. Similar results may be expected for the competitive triathlete.

Equipment Use in Training

In describing the shaping process involved in the mental strategy training program described above, Schomer (1987) suggests the involvement of another runner, a coach, or a sport psychologist in order to monitor, adjust, and reinforce the desired associative strategies lest the athlete become overwhelmed by the task to which he/she is attempting to attend. In those instances in which a marathoner is forced to embark upon a mental strategy training program without such assistance, Schomer (1987) suggests the use of a log book to record and monitor strategy use. As most of the triathletes participating in the current study trained individually and did not have available the services of either a coach or sport psychologist, it is fair to assume that most triathletes interested in modifying their cognitive strategies would be forced to do so through their own efforts. The recording equipment and categorizing system developed during the course of the present study might serve the triathlete in these efforts much more adequately than would a conventional log book. This equipment provides ongoing, in-vivo recordings of the athlete's reported thoughts throughout the course of a training session, these recordings being available for review and analysis immediately following completion of the run or ride. This review, while providing samples of the triathlete's strategy use over the entire course of the training session, would require little more time than would the completion of a comprehensive written record based upon recall of strategy use. For example, employing 15-sec recordings cued at 3-min intervals over a 1-hr run, complete record review would require a total of only five minutes of the triathlete's time. By relieving the triathlete from dependance upon his or her recollection of the strategies employed, this system would also allow the triathlete to focus attention completely upon monitoring and evaluating the effectiveness of the various strategies he or she employed.

Research Implications

The results of the current study hold a number of research implications, both in generating specific questions which must be addressed empirically, and in terms of future research efforts regarding the psychological factors affecting endurance-oriented athletics. The most pressing and practically important question arising from this research revolves around a determination of the effectiveness of a mental strategy program in affecting both the cognitive strategies relied upon during competition and, ultimately, the triathlete's performance. While a training program emphasizing the associative strategies would appear to hold great promise for improved competitive performance, such claims must remain speculative until the practical effectiveness of such a mental strategy training program has been determined empirically. Similarly, the effect that specific mental strategy training may have upon the incidence of sport-related injuries also remains to be examined.

In a more general sense, the results of the current study may influence the nature of research concerning the psychological aspects of endurance athletics. One of the primary goals underlying this study was to examine the assumption that those mental strategies recorded during training accurately reflect those strategies relied upon during competition. The results indicate that the mental strategy use reported by triathletes during training may be, in many respects, poorly representative of the approach these athletes employ during competition. This finding holds significant implications for continued research in this field. Only by collecting data during competition can a complete, rounded understanding of the role of mental strategy upon endurance-oriented athletic performance be developed. The study of both training and racing components will be necessary in order that the effectiveness of various mental strategy training programs can be accurately assessed. Through such efforts, continued research in this area will render results and information which will be considered practically valid and useful to the competitive endurance athlete.

Consideration of the nature of the two recording contexts, training vs. racing, allows for an understanding of the impetus to assume that training-generated data accurately represents that generated during competition. The training situation affords the researcher tremendous flexibility in terms of data collection. With most competitive endurance athletes training on a daily basis, data collection may be relatively easily scheduled and rescheduled if necessary. In contrast, the flexibility enjoyed by the researcher when collecting training data is lost when data are collected during competition, because the event's location and time are out of the control of either the experimenter or the subject(s). Nor does the competitive event allow for reclamation of lost or unusable data (e.g., due to mechanical malfunction).

Researchers may also harbor concerns regarding their subjects' willingness to participate in research ventures which require their participation during actual competition. When approached, most triathletes readily agreed to participate in the current study. Some expressed concern regarding the racing phase of the study and reserved their final commitment to this phase of the study until they had worn the recording equipment during training. In only one case did a triathlete decline to participate during competition following the training trials. The balance of the triathletes were enthusiastic about wearing the equipment during a race. It is hoped that the author's experience may help to assuage those researchers' fears that data collection during competition may adversely affect subject recruitment or participation.

When asked to outline their thoughts during training and when racing, the reports provided by the triathletes during the post-race interviews involved significant condensation of the strategies employed over the course of these events. As a result, the fine nuances of the athletes' mental strategy use were lost in the recall-generated verbal reports. This abbreviation was considered to be largely a function of the nature of the recall task. Each subject was provided unlimited time to make a report and the interviews occurred shortly after completion of the race. Thus, the triathletes' tendency to condense strategy use can probably not be attributed either to restricted opportunity for more complete report or to forgetting in the case of the race-oriented reports.

More alarmingly, the triathletes' post-race reports were found to be somewhat inaccurate when compared to their in-vivo recordings. While the triathletes' recollections of their race strategies accurately reflected the extensive use of the associative strategies, the reports regarding training strategies did not suggest the balanced use of associative and dissociative strategies evident in the in-vivo recordings collected during trained. Rather, the triathletes' recall of their training strategies incorrectly suggested an overwhelming reliance upon the associative strategies, specifically Pace Monitoring, Command and Instruction, and Feelings and Affect. This recall may have been due to an attempt on the triathletes' part to impress the author or it may have been due to the interval between the training sessions and the post-race interview. The inaccuracy may also have reflected a genuine ignorance on the triathletes' part as to the amount of dissociative thought engaged in during training. Regardless of the reason, the inaccuracy of these reports suggests that the continued use of post-hoc, recall-based data must be critically considered. This is especially true given the advantages offered by in-vivo recording. As compared to recall-based methods, in-vivo recording allows for much greater accuracy, the immediate nature of the subject's reports eliminating the effects of memory, confabulation, condensation of report, etc. which may significantly color an athlete's post-hoc report. The use of a consistent interval between reports in conjunction with the use of a specifically developed categorization system also allows for more accurate determination of mental strategy use throughout all phases of training and racing as well as allowing for accurate comparison both within and between these events.

The use of in-vivo recording might be criticized for its "obtrusive" nature. While a number of triathletes forwarded similar concerns when their involvement in the current study was initially solicited, experience wearing the equipment during training apparently dispelled these concerns. Many spontaneously reported that they very quickly forgot that they were wearing the equipment once a training session was underway and, as noted previously, all but one readily agreed to wear the equipment in a sanctioned triathlon race. The unobtrusive nature of the equipment is also reflected in the minimal number of triathletes' reports that made direct reference to the experimental equipment as affecting the athlete's pace or performance, reports of this type having been assigned to a unique category within the classification system. Of the triathletes' 1379 individually classified reports (totalled across recording contexts), only eight involved comments regarding the recording equipment as being in any fashion disruptive to the athlete's performance, this being the least frequently reported type of comment recorded. As a result, the author is confident in suggesting that in-vivo audio recording employing report prompting with a fixed interval represents the most accurate yet unobtrusive method of mental strategy data collection currently available, allowing for consistent, representative sampling of the athlete's mental strategies over the entire recording period.

While in-vivo audio recording was employed as an unobtrusive means of recording the triathletes' ongoing thought processes during cycling and running, no such method could be developed for use during the swimming portions of the triathlon. The subjects completing both the training and racing portions of the study were asked, as part of the post-race interview, to describe what they thought of during the swimming portion of the race. Each of those triathletes who indicated the use of specific strategy types described associative strategies such as focusing upon stroke technique and swimming in a straight line. Many also reported that they concentrated on completing the swim solely as a means of progressing to the cycling and running portions of the race, focusing much of their attention upon making up time and race positions during these events. Interestingly, a large number of the triathletes reported that they also concentrated upon simply surviving the swim, staying away from other competitors, and avoiding being hit and kicked. The mass start of the open water swim appears to foster such concerns regarding "survival." Closer examination of the cognitive aspects of the aquatic component of the triathlon is certainly warranted; however, such an examination will require the development of specialized methods and equipment for recording in-vivo data.

The results of the current study point to the need for continued research regarding the impact of mental strategy upon the performance of the triathlete. The sport has gained wide spread popularity in a relatively brief time since its conception in 1978 and is vying for recognition as an Olympic sport. Extensive study has allowed for significant advances in both the means by which the triathlete may prepare physically for competition and in the equipment he or she has available to best exploit conditioning and skills. The psychological factors which influence a triathlete's performance, however, have been overlooked. As a result, the triathletes in the current study were found to have focused their training attentions and efforts completely upon the somatic aspects of their performances. Given the dedication that these athletes exhibited, it is difficult to imagine any one of them making a conscious decision to ignore any aspect of their training. Their failure to incorporate mental strategy evaluation and training appeared to reflect a genuine ignorance concerning the potential effects of cognition upon performance. This ignorance is easily understood given the fact that this aspect to the triathlete's performance has been ignored by researchers and hence by the authors of the popular books and magazine articles upon which these athletes depend upon in developing and modifying their training regimens. It is hoped that the current study will serve to prompt a greater recognition and examination of the psychological factors underlying a triathlete's performance, both among competitive triathletes and within the research community.

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Appendix A

<u>Informed Consent Form</u>

My signature below signifies that I am participating in Hugh McDougall's research voluntarily. I understand that I am free to discontinue this participation at any time. I also understand that my anonymity will be closely guarded and that my name will not appear in any presentation to result from this research, regardless of presentation format.

Participant's Signature ______________________________

Date __________

Appendix B

Photography Permission Form

I hereby give my permission for photographs to be taken of me while I participate in the research project being conducted by Hugh McDougall. I also give my permission for the use of these photographs in future presentations arising from this research. I understand that my name will be held in strict confidence and that I will not be referred to by name in any such presentation (visual or written).

Participant's Signature ______________________________

Date __________

Appendix C

Inter-Rater Concordance Rates

Concordance at Level of Specific Subcategory Classification

	Third 1st	2nd	3rd	Across Thirds
Cycling-Training Data	92.6	83.3	86.2	87.4
Running-Training Data	92.3	82.8	82.1	85.7

Concordance at Level of Mental Strategy Type
(i.e., Associative vs. Dissociative Strategy)

	Third 1st	2nd	3rd	Across Thirds
Cycling-Training Data	96.3	96.7	100.0	97.7
Running-Training Data	92.3	86.2	92.9	90.5

Note. Figures within tables represent percentage concordance between independent raters' ratings of subset of 72 recordings collected from 12 subjects, i.e., one randomly selected 15-sec recording from each third of each subject's cycling and running training data.

Appendix D

Associative Percentage Scores, z-values

Training Data

	Cycling (Thirds)				Running (Thirds)			
	1st	2nd	3rd	Across	1st	2nd	3rd	Across
Associative Percentage	53.13	53.49	44.64	50.68	59.32	59.62	50.82	56.40
z-value	0.71	0.80	-0.99	0.26	1.46	1.42	0.13	1.69

Racing Data

	Cycling (Thirds)				Running (Thirds)			
	1st	2nd	3rd	Across	1st	2nd	3rd	Across
Associative Percentage	69.40	79.65	72.18	73.42	78.79	77.36	80.00	78.77
z-value	4.88	7.82	5.70	10.32	5.73	4.76	5.82	9.40

Note. Calculations employed only data collected from triathletes providing both training and racing recordings.

Z-values for all training data indicate no significant divergence from 50/50 associative/dissociative balance. Z-values for all racing data indicate reliance upon associative strategies significantly greater than 50% ($\alpha = 0.05$).

Appendix E

Report Frequency Rank Order

Cycling-Training

Associative Subcategories

Category -	7	1	4	9	8	2	3	5	10	6
Report Frequency -	37	34	33	22	18	16	14	9	3	1
% of Total	19.8	18.2	17.6	11.8	9.6	8.6	7.5	4.8	1.6	0.5

Total Reports = 187

Note. Frequencies totaled across thirds of training ride. Data (above) restricted to those subjects completing both training and racing components of study to allow for comparison with racing data.

Category
1 - Feelings and Affects
2 - Body Monitoring
3 - Command and Instruction
4 - Pace Monitoring
5 - Other Participants
6 - Consequential Research/Equipment Concerns
7 - Consequential Course Information
8 - Consequential Equipment and Clothing Monitoring
9 - Consequentioal Environmental Feedback
10 - General Associative Category

Appendix F

Report Frequency Rank Order

Running-Training

Associative Subcategories

Category -	4	1	2	3	9	7	8	10	5	6
Report Frequency -	25	21	20	13	5	4	4	2	2	1
% of Total	25.8	21.7	20.6	13.4	5.2	4.1	4.1	2.1	2.1	0.1

Total Reports = 97

Note. Frequencies totaled across thirds of training run. Data (above) restricted to those subjects completing both training and racing components of study to allow for comparison with racing data.

Category
1 - Feelings and Affects
2 - Body Monitoring
3 - Command and Instruction
4 - Pace Monitoring
5 - Other Participants
6 - Consequential Research/Equipment Concerns
7 - Consequential Course Information
8 - Consequential Equipment and Clothing Monitoring
9 - Consequentioal Environmental Feedback
10 - General Associative Category

Appendix G

Report Frequency Rank Order

Cycling-Racing

Associative Subcategories

Category -	4	5	3	1	8	7	9	2	10	6
Report Frequency -	45	45	35	33	33	22	15	14	4	1
% of Total	18.2	18.2	14.2	13.4	13.4	8.9	6.1	5.7	1.7	0.4

Total Reports = 247

Note. Frequencies totaled across thirds of cycling portion of race.

Category
1 - Feelings and Affects
2 - Body Monitoring
3 - Command and Instruction
4 - Pace Monitoring
5 - Other Participants
6 - Consequential Research/Equipment Concerns
7 - Consequential Course Information
8 - Consequential Equipment and Clothing Monitoring
9 - Consequentioal Environmental Feedback
10 - General Associative Category

Appendix H

Report Frequency Rank Order

Running-Racing

Associative Subcategories

Category -	4	1	3	2	5	8	7	9	10	6
Report Frequency -	40	31	21	13	11	8	7	5	4	1
% of Total	28.4	22.0	14.9	9.2	7.8	5.7	5.0	3.5	2.8	0.7

Total Reports = 141

Note. Frequencies totaled across thirds of running portion of race.

Category
1 - Feelings and Affects
2 - Body Monitoring
3 - Command and Instruction
4 - Pace Monitoring
5 - Other Participants
6 - Consequential Research/Equipment Concerns
7 - Consequential Course Information
8 - Consequential Equipment and Clothing Monitoring
9 - Consequentioal Environmental Feedback
10 - General Associative Category

Appendix I

Report Frequency Rank Order

Cycling-Training

Dissociative Subcategories

Category -	15	12	20	13	18	11	19	17	14	16
Report Frequency -	61	35	31	19	14	7	5	4	3	3
% of Total	33.5	19.2	17.0	10.4	7.7	3.8	2.7	2.2	1.6	1.6

Total Reports = 182

Note. Frequencies totaled across thirds of training ride. Data (above) restricted to those subjects completing both training and racing components of study to allow for comparison with racing data.

Category
11 - Inconsequential Environmental Feedback
12 - Reflective/Anticipatory Activity Thoughts
13 - Introspection
14 - Work, Career, and Management
15 - Inconsequential Course Information
16 - Talk and Conversational Chatter
17 - Inconsequential Research/Equipment Concerns
18 - Inconsequential Equipment and Clothing Monitoring
19 - Inconsequential Thoughts Concerning Other Participants
20 - General Dissociative Category

Appendix J

Report Frequency Rank Order

Running-Training

Dissociative Subcategories

Category -	12	20	15	13	17	18	19	11	14	16
Report Frequency -	23	23	9	6	3	3	3	3	2	0
% of Total	30.7	30.7	12.0	8.0	4.0	4.0	4.0	4.0	2.7	0.0

Total Reports = 75

Note. Frequencies totaled across thirds of training run. Data (above) restricted to those subjects completing both training and racing components of study to allow for comparison with racing data.

Category
11 - Inconsequential Environmental Feedback
12 - Reflective/Anticipatory Activity Thoughts
13 - Introspection
14 - Work, Career, and Management
15 - Inconsequential Course Information
16 - Talk and Conversational Chatter
17 - Inconsequential Research/Equipment Concerns
18 - Inconsequential Equipment and Clothing Monitoring
19 - Inconsequential Thoughts Concerning Other Participants
20 - General Dissociative Category

Appendix K

Report Frequency Rank Order

Cycling-Racing

Dissociative Subcategories

Category -	12	19	20	15	16	18	17	13	14	11
Report Frequency -	38	24	14	7	5	3	2	2	1	1
% of Total	39.2	24.7	14.4	7.2	5.2	3.1	2.1	2.1	1.0	1.0

Total Reports = 97

Note. Frequencies totaled across thirds of cycling portion of race.

Category
11 - Inconsequential Environmental Feedback
12 - Reflective/Anticipatory Activity Thoughts
13 - Introspection
14 - Work, Career, and Management
15 - Inconsequential Course Information
16 - Talk and Conversational Chatter
17 - Inconsequential Research/Equipment Concerns
18 - Inconsequential Equipment and Clothing Monitoring
19 - Inconsequential Thoughts Concerning Other Participants
20 - General Dissociative Category

Appendix L

Report Frequency Rank Order

Running-Racing

Dissociative Subcategories

Category -	12	20	16	15	17	19	11	18	13	14
Report Frequency -	11	10	5	3	3	3	1	1	1	0
% of Total	28.9	26.3	13.2	7.9	7.9	7.9	2.6	2.6	2.6	0.0

Total Reports = 38

Note. Frequencies totaled across thirds of running portion of race.

Category
11 - Inconsequential Environmental Feedback
12 - Reflective/Anticipatory Activity Thoughts
13 - Introspection
14 - Work, Career, and Management
15 - Inconsequential Course Information
16 - Talk and Conversational Chatter
17 - Inconsequential Research/Equipment Concerns
18 - Inconsequential Equipment and Clothing Monitoring
19 - Inconsequential Thoughts Concerning Other Participants
20 - General Dissociative Category

Appendix M

Report Frequency Rank Order

Across All Recording Conditions

(CT, RT, CR, RR)

Dissociative Subcategories

Category -	12	15	20	19	13	18	16	11	17	14
Report Frequency -	107	80	78	35	28	21	13	12	12	6
% of Total	27.3	20.4	19.9	8.9	7.1	5.4	3.3	3.0	3.0	1.5

Total Reports = 392

Note. Data (above) restricted to those subjects completing both training and racing components of study.

Category
11 - Inconsequential Environmental Feedback
12 - Reflective/Anticipatory Activity Thoughts
13 - Introspection
14 - Work, Career, and Management
15 - Inconsequential Course Information
16 - Talk and Conversational Chatter
17 - Inconsequential Research/Equipment Concerns
18 - Inconsequential Equipment and Clothing Monitoring
19 - Inconsequential Thoughts Concerning Other Participants
20 - General Dissociative Category

Appendix N

Report Frequency Rank Order

Across Training

(CT, RT)

Dissociative Subcategories

Category -	15	12	20	13	18	11	19	18	14	16
Report Frequency -	70	58	54	25	17	10	8	7	5	3
% of Total	27.2	22.6	21.0	9.7	6.6	3.9	3.1	2.7	1.9	1.1

Total Reports = 257

Note. Data (above) restricted to those subjects completing both training and racing components of study.

Category
11 - Inconsequential Environmental Feedback
12 - Reflective/Anticipatory Activity Thoughts
13 - Introspection
14 - Work, Career, and Management
15 - Inconsequential Course Information
16 - Talk and Conversational Chatter
17 - Inconsequential Research/Equipment Concerns
18 - Inconsequential Equipment and Clothing Monitoring
19 - Inconsequential Thoughts Concerning Other Participants
20 - General Dissociative Category

Appendix O

Report Frequency Rank Order

Across Racing

(CR, RR)

Dissociative Subcategories

Category -	12	19	20	15	16	17	18	13	11	14
Report Frequency -	49	27	24	10	10	5	4	3	2	1
% of Total	36.3	20.0	17.8	7.4	7.4	3.7	3.0	2.2	1.5	0.7

Total Reports = 135

Note. Data (above) restricted to those subjects completing both training and racing components of study.

Category
11 - Inconsequential Environmental Feedback
12 - Reflective/Anticipatory Activity Thoughts
13 - Introspection
14 - Work, Career, and Management
15 - Inconsequential Course Information
16 - Talk and Conversational Chatter
17 - Inconsequential Research/Equipment Concerns
18 - Inconsequential Equipment and Clothing Monitoring
19 - Inconsequential Thoughts Concerning Other Participants
20 - General Dissociative Category

Appendix P

Report Frequency Rank Order

Across All Recording Conditions

(CT, RT, CR, RR)

Associative Subcategories

Category -	4	1	3	7	5	2	8	9	10	6
Report Frequency -	143	119	83	81	67	63	52	47	13	4
% of Total	21.3	17.7	12.4	12.1	10.0	9.4	7.7	7.0	1.9	0.6

Total Reports = 672

Note. Data (above) restricted to those subjects completing both training and racing components of study.

Category
1 - Feelings and Affects
2 - Body Monitoring
3 - Command and Instruction
4 - Pace Monitoring
5 - Other Participants
6 - Consequential Research/Equipment Concerns
7 - Consequential Course Information
8 - Consequential Equipment and Clothing Monitoring
9 - Consequentioal Environmental Feedback
10 - General Associative Category

Appendix Q

Report Frequency Rank Order

Across Training

(CT, RT)

Associative Subcategories

Category -	4	1	7	2	9	3	8	5	10	6
Report Frequency -	58	55	41	36	27	27	22	11	5	2
% of Total	20.4	19.4	14.4	12.7	9.5	9.5	7.7	3.9	1.8	0.7

Total Reports = 284

Note. Data (above) restricted to those subjects completing both training and racing components of study.

Category
1 - Feelings and Affects
2 - Body Monitoring
3 - Command and Instruction
4 - Pace Monitoring
5 - Other Participants
6 - Consequential Research/Equipment Concerns
7 - Consequential Course Information
8 - Consequential Equipment and Clothing Monitoring
9 - Consequentioal Environmental Feedback
10 - General Associative Category

Appendix R

Report Frequency Rank Order

Across Racing

(CR, RR)

Associative Subcategories

Category -	4	1	3	5	7	8	2	9	10	6
Report Frequency -	85	64	56	56	40	30	27	20	8	2
% of Total	21.9	16.5	14.4	14.4	10.3	7.7	7.0	5.2	2.1	0.5

Total Reports = 388

Note. Data (above) restricted to those subjects completing both training and racing components of study.

Category
1 - Feelings and Affects
2 - Body Monitoring
3 - Command and Instruction
4 - Pace Monitoring
5 - Other Participants
6 - Consequential Research/Equipment Concerns
7 - Consequential Course Information
8 - Consequential Equipment and Clothing Monitoring
9 - Consequentioal Environmental Feedback
10 - General Associative Category

VITA

Hugh M. McDougall

Candidate for the Degree of

Doctor of Philosophy

Thesis: COGNITIVE STRATEGIES EMPLOYED BY TRIATHLETES

Major Field: Psychology

Biographical:

Personal Data: Born in Berwyn, Alberta, Canada, May 10, 1959.

Education: Received Bachelor of Science Degree with Honors in Psychology from University of Calgary in 1982; Received Master of Science Degree in Psychology (Clinical) from Oklahoma State University in 1985; completed A.P.A. approved pre-doctoral internship at Essex County Hospital Center in Cedar Grove, New Jersey in 1989; completed requirements for Doctor of Philosophy in Psychology (Clinical) degree at Oklahoma State University in July, 1990.

Clinical Experience: clinician within private practice, Colonial Clinic, Orlando, Florida, November, 1989 to July, 1990; clinical psychology intern, A.P.A. approved pre-doctoral internship, Essex County Hospital Center, Cedar Grove, New Jersey, September, 1988 - September, 1989; practicum experience, Red Rock Comprehensive mental Health Center, Oklahoma City, Oklahoma, 1987 to 1988; marriage and family therapist, Oklahoma State University Marriage and Family Clinic, Stillwater, Oklahoma, 1986 to 1988; practicum experience, Stillwater Community Mental Health Clinic, Stillwater, Oklahoma, 1986 - 1987; practicum experience, Psychological Services Center, Oklahoma State University, Stillwater, Oklahoma, 1984 - 1985.

Professional Experience: Tutor, Graduate Statistics and Experimental Design Courses, Oklahoma State University, 1986 to 1987; Teaching Assistant, Undergraduate Statistics and Experimental Design Course, Oklahoma State University, 1984 to 1986.