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Association and dissociation: Individual differences

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University of Hawaii, 1990
ASSOCIATION AND DISSOCIATION: INDIVIDUAL DIFFERENCES

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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ABSTRACT

This study attempts to integrate two independent research literatures which lie within the broad area of pain and cognitive aspects of pain: 1) research in pain and clinical pain treatment, and; 2) research in athletes' pain coping strategies. The study focused upon a specific question which cuts across both areas: When exposed to painful stimuli, do individuals tend to focus upon their pain (Association), or do they tend to distract themselves from the pain (Dissociation)? In addition to this central question, the study investigated differences between athletes and non-athletes on this dimension of association and dissociation, and it also investigated the relationship between three different pain experiences: minor pain experiences, worst pain experiences, and exercise induced pain, and explored levels of association and dissociation for each.

Prior to discussing the proposed study, the paper reviews relevant literature from two traditionally independent research areas. The review begins by considering problematical core questions in pain research and then takes an historical look at alternative approaches to conceptualizing pain. The prominent modern conceptualizations of pain are then discussed, with a specific focus upon recent behavioral and cognitive-behavioral models of pain and pain treatment. The efficacy of these psychological pain models in treating pain in clinical settings is briefly reviewed.

The last section of the review focuses upon the question of association and dissociation, with a review of relevant literature in two broad areas: work with athletes and studies performed in laboratory settings. This literature will then be used as a foundation for discussing the importance of both learning and individual differences in any pain model. As an introduction to the proposed study, a paradigmatic behavioral model of pain is introduced as a conceptual aid for integrating the separate
literatures reviewed. The review suggests that the work with athletes may prove itself as a useful alternative to traditional laboratory pain research.

The current study investigates and compares the psychological and behavioral approaches to pain of athletes and non-athletes, with a focus both upon individual differences and upon universal responses to pain. In addition, the commonalities between historical pain experiences and current exercise-induced pain, are explored. The primary findings of the study revealed: 1) that the pattern of increased associative pain strategies in situations of increased pain was found in subjects' self-report pain histories; 2) that these historical assessments of pain and responses to pain are correlated with current assessments of and responses to a laboratory based "sport" situation on a bicycle ergometer ride; 3) that the sample of non-elite athletes did not use significantly more associative pain strategies during the bicycle ergometer ride than non-athletes, and; 4) that, across all subjects in this non-elite athlete and non-athlete sample, self-reported levels of association for the bicycle ergometer task did not increase in response to increased effort and pain.

The results are compared with earlier studies using elite athlete populations and laboratory pain studies, and the findings are discussed in terms of a Paradigmatic-Behavioral model of pain proposed as one way to facilitate the integration of an otherwise disparate pain literature. The limits of the current study are discussed, and suggestions for future research to address these limitations are presented.
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I. WHAT IS PAIN?

This section will briefly describe the problematical area of defining pain. A following section of this paper reviews historical conceptions of pain and notes that for most of the last century, there was basic agreement about most pain phenomena. As described in more detail below, there have been sudden and dramatic changes in pain research since the 1960's. Unfortunately, the tremendous changes that have occurred in pain research in the past twenty years have resulted in increased confusion in basic pain issues. It appears that the field of pain is undergoing a process similar to what Kuhn (1962) labeled a paradigm shift. Thus defining pain is much more difficult now than it was thirty years ago, when one could describe pain as a simple sensory phenomenon without criticism (Melzak, 1986). While countless definitions of pain have been offered, the most parsimonious assessment of pain definitions is that a consensus has yet to be reached (Wolff, 1986).

Fordyce (1986), emphasizes that recent increased knowledge of the psychology of pain has demonstrated unequivocably that:

pain is not a simple sensory phenomena that, therefore, can be bound closely to peripheral stimuli alleged to produce it. Pain is a complex set of events involving peripheral stimulation from any of several possible modalities, the neural and cognitive processing of those stimuli, almost certainly emotional expression, and ensuing behavior. (p. 49, italics added).

As Melzak (1973), noted, one essential problem in defining pain is the implicit difficulty in defining anything which falls only within the "unique multidimensional space of an individual." While solutions to this dilemma have been achieved, chiefly by operationalizing pain and focusing upon directly observable behaviors (Fordyce, 1988), the fact remains that much of what is
commonly called pain is private. It may be this quality that leads to miscommunication and disagreement over pain definitions. One recent review of the question of defining pain notes that:

Pain has the attributes of a sensation, yet its usual capacity to make us uncomfortable or to suffer distinguishes it from other sensations. This uncertainty about the exact nature of pain is reflected in our language. We use the term pain for the feeling produced when we are physically injured and also for our emotional reaction when we suffer as a consequence of unkind words or the loss of a loved one (National Science Foundation, Research Briefing on Pain and Pain Management, 1985, p.19)

This recognition of the complexity of the phenomenon of pain has tended to result in the utilization of non-standardized definitions in much research, causing difficulties in interpreting data involving varying definitions. The field has been aptly described as "multidisciplinary, but not interdisciplinary, in the sense that medical, psychological, and social perspectives are seldom genuinely integrated." (Karoly & Jensen, 1987, p.1) This disunity of the pain literature can be seen as a specific example of the "pre-paradigmatic" nature of psychological research described by Staats (1983), who argues that the process of psychological research would be facilitated with active attempts at synthesizing disparate literatures.

A Consensual Definition of Pain

Recognition of the diverse and fractured quality of the field, however, has led towards attempts at integration in the study of pain. One important start has been a concerted effort towards interdisciplinary research established by the International Association for the Study of Pain (IASP) (1979). This interdisciplinary organization has quickly become an important forum for pain research. Recognizing the problems of non-
standard nomenclature, the IASP's task force on the taxonomy of pain produced a number of basic definitions for pain researchers.

Rather than attempting to produce another definition of pain, this paper will utilize the IASP definitions. A review of the IASP's definition of pain demonstrates how far the field has moved from a simple sensory view of pain. The IASP defines pain as: "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." (IASP Subcommittee on Taxonomy, 1979, p.250)

While the subjective and multidimensional quality of pain suggested by the IASP definition might surprise individuals unfamiliar with recent developments in the pain field, it reflects contemporary research in laboratory and clinic settings and the changing views of neurologists and physiologists as well as psychologists. In the current view, emotions and cognitions are seen as just as important as sensations in the nature of pain. The interdisciplinary recognition of a need for definitions and theories that unify the field is encouraging. In addition, the widespread influence and acceptance of the IASP definition makes the task of defining pain more uniform for current researchers. Thus, while following parts of this paper will occasionally refer to various conceptualizations of pain proposed by different sources, the IASP definition of pain will be a basic reference point. A proposed paradigmatic behavioral model of pain will be shown to incorporate the IASP definition of pain as well.

In addition, this paper will also refer to two commonly used subcategories or subdefinitions of pain: Acute pain and Chronic pain. While there are subtle wording differences in various authors' operationalizing of these terms, acute pain generally refers to pain provoked by injury or acute trauma, while chronic pain is that pain which persists beyond the usual course of an acute trauma or beyond the time typically required for healing (Bonica, 1985). It is conventional for researchers and clinicians to use six months as a temporal criterion for the label of chronic pain.
II. PHILOSOPHIES OF PAIN

How did philosophers ever come to think that man is an animal which seeks pleasure and avoids pain?" - Reik, Masochism in Modern Man

While recent dramatic expansions in pain clinics, anti-pain medications, and dollar amounts paid on pain problems might suggest otherwise (Bonica, 1980), confronting pain is not a novel problem. Much as pain may be present from birth (Beecher, 1951), concerns about pain and descriptions of treatments are found in the earliest writings of Western and Eastern civilizations (Bonica, 1953). Philosophers and even whole societies have struggled with some basic questions concerning pain. Is pain necessary? How is pain related to pleasure? The most basic question has been, of course, what is pain?

While the number of television commercials designed to sell various chemical pain agents gives a clear indication that some Americans view pain as unnecessary, historically there have been a number of contrasting opinions on this point. Religious philosophers have spent an inordinate amount of time on this question, perhaps due to the frequent prominence of pain and suffering in the history of various churches and religious rituals. While Christ's suffering on the cross was not the first example of religious martyrdom, it is worth noting that it was this act, more than any other, that is used as evidence of Christ's humanity. C.S. Lewis (1965), writing on the philosophical "problem of pain" (if there is a God, why is there pain?), presents a quote which sums up one view:

"The Son of God suffered unto the death, not that men might not suffer, but that their sufferings might be like his"- George Macdonald, Unspoken Sermons, p. vi.'
Religious leaders and philosophers are not alone in stressing the essential nature of pain. Many societies have created tremendously painful rites of initiation which must be completed before acceptance as a full member (Kerr, 1981; Mead, 1956; Steward, 1946). Modern psychopathologists, as well, have noted that the loss of pain reactions is an early indication that a schizophrenic is moving into catatonia and losing contact with reality. Some have gone as far as to say that pain "is necessary for self-awareness" (Zborowski, 1969, p. 26). Interestingly, the preschizophrenic's loss of the ability to experience pleasure, or anhedonia, has also been noted as a pathonomic sign (Chapman & Chapman, 1979; Meehl, 1952; Rado, 1956).

The relationship between pleasure and pain has been another central and controversial question. One point of view is that pleasure and pain are extremes on a continuum, and that individuals are motivated to pursue pleasure and avoid pain. This view has been the basis of philosophical schools such as the British philosophical movement of Locke and Hume, as well as the basis of the behavioral and motivational theories of psychology (e.g. McLelland, 1953). This view was given a satirical rebuttal by the German philosopher Nietzsche, reacting to the British philosophical schools, when he said "Man does not pursue pleasure, only the Englishman does!" (Nietzsche, 1975).

While the esoteric debates of philosophers and theorists may seem remote from clinical research, the importance of understanding the pain and pleasure relationship is critical to success in treating a number of problems. Researchers in the areas of depression, addictions, and the recently resurrected "masochistic" or "self-defeating personality disorder" in the DSM III-R (American Psychiatric Association, 1986) all have a stake in more clearly delineating the pain/pleasure relationship. One concrete example of the relevance for pain research and treatment is a study by Anderson and Pennebaker (1980), which looked at...
the effect of "labelling" upon perceptions of pain and pleasure. In this simple study, one group of subjects was told that the study was interested in responses to painful stimuli, while another group was told that the study was interested in responses to pleasurable stimuli. Both subject groups were then exposed to identical stimuli: pressing their fingertip onto a piece of vibrating sandpaper. When the subjects were then asked to rate the stimuli on a continuum from painful to pleasurable, the pain group labeled the stimuli as painful while the pleasurable group rated the stimuli as pleasurable. Following the experiment, subjects from both groups insisted that the stimuli could only be perceived as painful (or pleasurable).

The Anderson & Penebaker (1980) study highlights two facts becoming more obvious to researchers in the area of pain. One fact is that a simple sensory view of pain is inadequate. A second fact is that laboratory pain research may highlight aspects of pain unnoticed in clinical studies. Despite this, laboratory research, which often emphasizes the subjectivity of pain, has often been ignored or criticized by clinical pain researchers (Beecher, 1952). In addition, non-research oriented clinicians have traditionally held the view that "real" pain would not be subject to the subtle factors found in the laboratory. This response reflects two beliefs which have grown out of the medical model of pain that dominates both our culture and a large body of traditional pain research. One belief is that pain is a tangible and relatively simple physical phenomenon. A second common belief is that pain that is not caused by a localizable physical trauma is less real than pain that makes physical sense. Both of these suppositions have been challenged in the last twenty-five years by research and theories which have found pain to be a tremendously subtle and complex phenomenon.
III. HISTORICAL CONCEPTUALIZATIONS OF PAIN

"Pain is perfect miserie, the worst
Of evils, and excessive, overturnes
All patience." - Milton, Paradise Lost (Book VI, 11, 462)

Evidence that pain is an enormously complex phenomenon can be found in the fact that it supports so many distinct theoretical and conceptual views. Holders of a number of viewpoints have been able to find support for their particular view in the domain of pain. There really is no consensual model of pain. Thus, to discuss and evaluate various individual pain models requires an organizing structure or means for categorizing models. Unfortunately, however, there is not even a consensual structure for organizing the literature! The controversy on nearly every aspect of pain has led to a situation in which, as one prominent theorist notes, "it is impossible to discuss pain without taking a theoretical point of view" (Melzak, 1986, p.1).

Literature reviews in the area of pain tend to be as narrow and selective as the individual approaches themselves, with the organizing structure reflecting a theoretical bias. The reviews tend to serve an author's own theoretical viewpoint by creating strawmen models of competing viewpoints and organizing the review in a way which highlights the strength of one view to the detriment of another. This competitive rather than synthetic approach to literature reviews is said to be common in a disunified science, due to professional reinforcers for presenting ideas as new and unique (Staats, 1981). The current study hopes to avoid this pitfall by presenting two traditional means of describing the history of the field and then contrasting the most prominent current pain models. The two histories of pain are organized chronologically, and with specific emphasis upon the development
of the "sensory versus psychological" approaches to conceptualizing pain.

Chronological View of Pain Models.

Perhaps the greatest strength of the historical review of pain models is that it forces recognition of two important points: 1) there is a tendency to recycle the ideas first offered hundreds of generations before, and; 2) pain is a resilient phenomenon, and the excitement which has accompanied nearly every new approach to the treatment of pain has been relatively short-lived.

Although writings about pain go back as far as Babylon (Bonica, 1953), most reviewers recognize the beginnings of modern viewpoints in the writings of the great Greek philosophers. Plato and Aristotle considered pain to be an emotion, and most Greeks believed pain was a punishment by the gods for some offense (Raj, 1985). Interestingly, the English word, pain, based upon the Greek word poine which meant penalty, reflects this early view (Funk and Wagnalls, 1977). In addition, the Greek age saw the development of the competing philosophical schools of stoicism, cynicism, and hedonism, all of which, were very concerned with pain and pleasure. While hedonism has developed a perjorative and primarily sexual connotation in modern usage, the early Hedonists saw a pleasurable life as one which was peaceful, simple and free from pain (Edwards, 1979). The stoics, however, felt that pain could be overcome rationally, by using logic and reasoning (Turk & Rudy, 1986), while the cynics actively avoided pleasure.

Despite the philisophical debates, however, most individuals subscribed to the heavenly punishment model. With the growing influence of Christianity, and the advent of the dark ages, there was a millenium in which pain relief and pain treatment was actively discouraged by the church (Raj, 1985). While the changes of the Renaissance saw a generally heightened interest in pain, most pain historians see Descarte's dualistic model as the beginning of the modern approaches to pain (Bonica, 1983). The beginning of the Nineteenth century saw the Western rediscovery
of opium's use as an analgesic, the introduction of medically used anaesthesia, and the search for the specific physiological sources of pain (Raj, 1983). Refinements followed, but it was not until quite recently, in the "psychological revolution" of the 1960's, that actual changes in views of pain occurred (Melzak & Wall, 1980). While the recency of a number of changes has produced a great deal of excitement, it has also produced confusion and a directionless quality in the field. Some authors believe that this confusion is also the result of a challenge to the allopathic view of the body typified by the medical model (Lyddon, 1987).

The terms allopathic and homeopathic refer to two contrasting schools of medicine which existed in the early 19th century. Allopathy was a descendent of the Rational view of medicine, which saw symptoms as harmful phenomena representing a breakdown of the Cartesian human machine (Engel, 1977). During the 19th century, allopathic medicine, aided by advances in anatomy and by the discovery of specific disease processes, grew in prominence and eventually took steps to eliminate homeopathic medicine. Today's Western medicine is virtually all allopathic and homeopathy is simply not taken seriously. Homeopathy, grew out of an Empirical view of medicine, and believed that symptoms were indicative of a body's own curative effort (Lyddon, 1987). Given this viewpoint, symptoms are not aggressively "countered" as is done in the allopathic approach (Coulter, 1977).

While researchers in pain have not traditionally focused upon the allopathic-homeopathic conflict, there have been recent attempts to integrate the fields of health psychology and behavioral medicine within the two domains (Schwartz, 1982; Lyddon, 1987). These reviews have pointed out that some approaches to health psychology (eg. operant conditioning), have been commandeered by the prevailing allopathic approach as another technique, like surgery and pharmacology, to aggressively counter sickness and symptoms.
Recognition of the contrasting schools is also useful for understanding the contextual origins and applications of various pain approaches. For example, it is worthwhile noting that the often maligned "medical model" is not the only medical model. It is also helpful to recognize that modern pain conceptualizations have not developed in an intellectual or sociopolitical vacuum. The consensus that symptoms such as pain are signalling mechanical breakdown and should be aggressively countered has resulted in the booming marketplace of analgesic medications. Despite the new ideas of recent pain approaches, the milieu of pain treatment remains the same: it is an allopathic rational environment in which pain is seen as evidence of some physical damage and as a phenomenon to be eliminated.

**Sensory Versus Psychological Models.**

Dividing theories of pain into sensory and psychological pain models remains a common means for organizing the field, primarily due to the lingering effects of outdated theories of pain. As will be discussed in greater detail, current pain researchers recognize that pain is a multidimensional phenomenon with both sensory and psychological components. For the purposes of review, however, it is important to understand how pain researchers and clinicians have traditionally viewed pain (and how much of medicine still views pain, as evidenced by categories in DSM III-R). Roughly stated, "sensory" theories are concerned with the neurophysiological and neurohormonal changes that are associated with tissue damage, while "psychological" theories are concerned primarily with pain that has not been found to result from tissue damage or other observable organic pathology. Partly due to the belief systems created by the dominance of the biomedical model, most people are quite comfortable with the division of sensory versus psychological pain, and tend to refer to this division as "real" pain versus "head" pain (Sternbach, 1986).
Before the 1960's, there really was only one sensory theory, now referred to as Specificity Theory, and its roots are traceable to Descartes, who described it in 1644. Descartes used a church bell analogy to describe pain, in which tissue damage and a resulting pain stimulus was like pulling the rope at the bottom of the bell-tower, and the bell ringing in the belfry was like the resulting pain reaction (Melzak, 1972). The paradigm of the specificity theory led to centuries of searching for the specific nerve fibers responsible for specific pains, and a surgical approach to ending pain.

Psychological models of pain developed before the 1960's were relegated to focusing upon individuals whose pain frustrated physicians looking for "real" pain. Thus, the early psychological theories were attempting to explain what the medical community saw as abnormal behavior: pain not associated with diagnostically apparent tissue damage. Freud took an interest in "psychological" pain, which he saw as a symbolic representation of an underlying intrapsychic conflict. Freud argued that an individual with "non-medical" pain would choose a symbolically "appropriate" pain as a substitute for the underlying sexual or aggressive conflict (Pilowsky, 1986). This psychodynamic model of hypochondriasis, as well as the psychodynamic model of masochism, or the linking of sexual and other pleasure with pain (Reik, 1941), led to half a century of mental health professionals looking for the "meaning" of pain to a patient.

One other outgrowth of the hypochondriacal view of pain patients whose pain could not be medically identified was an attempt to find pain "personalities," or those individuals whose personality leads to pain complaints. While this focus created a tremendous amount of research into pain correlates such as personality scale scores, anxiety disorders, and depression, it also solidified the role of psychologists and psychiatrists in pain treatment as the experts in working with individuals with
personality problems rather than pain problems (Kellner, 1986).

Treatment failures and a lack of anatomical and physiological support for the specificity theory opened the way for Melzak & Wall's Gate-Control Theory (Melzak & Wall, 1965; Melzak, 1972, 1978). More than any other single development, this theory has led to a recognition of the non-sensory factors in pain which are described below. This is because the gate-control theory attempted to integrate sensory-discriminative factors with motivational-affective and cognitive evaluative factors. The gate-control theory is presently the ascendent sensory approach to pain. It took the development of the gate-control theory to allow for an integration of psychology into the treatment of pain patients and to create an opening which prompted the development of a number of competing theories of pain.
IV. PSYCHOLOGICAL PAIN TREATMENT MODELS

Gate Control Theory

As was stated above, Melzak and Wall's gate control theory is not a psychological pain treatment approach, but rather, a basic neurophysiologically focused model of pain. Nevertheless, the gate control theory's novel conceptualizations have been critical in the development of the psychological treatment models. For this reason, the basics of the gate control theory will be outlined here before discussing the two preeminent psychological treatment approaches, the operant and the cognitive behavioral.

Again, to understand the revolutionary quality of the gate control theory, one must recognize the wide acceptance of the sensory theory model of pain. The basic tenet of the sensory theory is that pain is a specific sensation and that pain will increase as peripheral signals of tissue damage increase. Given this view, the nonanalgesic treatment options for pain were primarily variations upon a neurosurgical approach. The neurosurgeon attempted to cut through the "pain pathway" at a point between the source of the specific pain signal and the hypothesized "pain center" in the brain. Clinical evidence however, shows the results to be quite mixed (Freidberg, 1985; Kliman, 1985; Melzak, 1986), with the pain often returning quickly following the surgery. The frustration of clinicians with poor treatment results and the frequency of unexplainable pain syndromes was partially responsible for the recognition of previously unrecognized pain factors that led to the gate control theory.

While there have been some refinements in the gate control theory since its introduction in the 1960's (Melzak & Wall, 1965), the basics of the theory have remained the same. Essentially, the gate control theory hypothesizes that while there is a pathway of peripheral pain messages, it is not a unidirectional closed system.
Instead, the gate control theory posits a multidirectional system open to influences at many levels of the nervous system, specifically including the central nervous system.

Anatomically, the gate control theory initially focused upon the point of entry of peripheral nerve fibers into the central nervous system, at the dorsal horns of the spinal cord. It is at this location that the "pain gate" for which the theory was named, was found. At this point there are two nerve fibers (labelled large and small fibers by Melzak), with two different functions related to sensation and with two differing effects upon the gate.

The small fibers specialize in nociception, or the signalling of tissue damage. These fibers, when stimulated specifically, tend to open the gate. The large fibers appear to respond to light touch and movement, and when these fibers are stimulated exclusively, they tend to close the gate. Thus, this gate in the dorsal horns has a system of matched signals, with the signals from the large fibers inhibiting the signals of the small fibers.

In addition, this gate in the dorsal horns is not operating independently at the level of entry. There is clear evidence that the gate is controlled by descending neural signals by a "central modulating structure," in the brain (Abbot & Melzak, 1982; Melzak, 1983; Melzak & Loeser, 1978; Woolf, 1984). Thus, before pain signals reach the brain, they are modified and moderated by both the pain gate and by influences upon the pain gate which eminate from the brain itself. The descending neural signals, shown to originate in the reticular formation of the midbrain (Rossi & Zanchetti, 1957), have profound effects upon the likelihood of incoming neural signals reaching the brain as the sensation of pain.

The fact that neurophysiologists have found projections from a number of cortical areas, especially the frontal cortex, to the pain center in the reticular formation, suggested a number of novel implications to Melzak and Wall. These connections suggested that a number of influences, such as past experience and attention, formerly thought irrelevant to the pain experience, could have a
great impact upon the perceptions of pain in any individual (Melzak, 1986). It is this suggestion that revolutionized the pain field and which provoked a great deal of research into the impact of higher cortical function upon pain. Despite some controversy about the clinical applications of the theory, such as the use of electrical "gate stimulators" (Freidberg, 1985), the general principles of the gate control theory have been widely supported and accepted (Chapman et al., 1985; Melzak & Wall, 1982).

One reason for the quick acceptance of the theory was the fact that the hypothesized implications of the theory matched a number of results that could not be explained by the sensory theory. For example, the reappearance of pain following surgery to eliminate the pain pathways (Freidberg, 1985), the existence of "phantom limb" pain in the location of an amputated limb (Melzak, 1986), and the fact that individuals react very differently to the exact same trauma depending upon the context (Beecher, 1952), were all disparate and unexplained findings prior to the gate control theory. The new theory not only explained individual differences and the importance of environmental factors, it predicted them, and forced recognition of the multiple levels of pain.

Acceptance of the new theory required accepting that pain cannot be scaled in a unitary way in terms of injury or damage alone. An individual's personal interpretation of stimuli, the presence of certain environmental circumstances, and past experiences with similar or dissimilar stimuli would all have an impact on the perception of pain. The new theory, while exciting, has also heralded a new era of complications and difficult questions for the study and treatment of pain. Since the gate control theory proposed that higher cognitive functioning, learning, affect, and expectations all impacted the experience of pain, traditional sensory approaches to understanding and treating pain were challenged. How can any laboratory study of pain, for example, create situations which exactly mimic the environment
surrounding naturally occurring pain, and if it could, would it be ethical? What are the behavioral repertoires that affect the pain response? How does learning impact perceptions of pain in a laboratory setting? The answers to these basic research questions are in the process of being addressed at present (Wolff, 1986). To a large extent, however, many of the basic theoretical issues and questions are being addressed in applied treatment settings. Due to the growth in pain treatment centers and the resultant economic focus upon treatment efficacy (Loeser & Egan, 1988), pain research is beginning to focus more upon clinical treatment issues.

In general, past research findings and traditional clinical treatments have not been abandoned, but have instead been reclassified as just one part of a complex multidisciplinary picture. One of the most dramatic changes resulting from a multidisciplinary approach, is the addition of psychological approaches to traditional neurosurgical and medical treatments. As Melzak (1986), puts it:

It is now recognized that every physiological explanation of pain contains an implicit psychological concept that has a profound impact on both the study and treatment of pain. The problem of pain, therefore, has been investigated increasingly by psychologists, and psychological methods are, accordingly, often used in the treatment of chronic pain problems (p. 1).

Operant Approach To Pain Treatment

Operant Conception of Pain

The operant approach to pain treatment (sometimes described as the behavioral approach), is exemplified by the work of Wilbert Fordyce (Fordyce, 1973, 1976, 1988). One reason for the rapid acceptance of psychological approaches to pain treatment was the conceptually complete and clinically thorough approach developed by Fordyce and his associates at the University of
Washington (Fordyce, 1976). Fordyce, operationalizing the importance of individual learning implied by the gate control theory, utilized basic operant conditioning principles to design an inpatient program for treating chronic pain. A testament to the prominence of this theoretician in operant pain treatments is a recent review of treatment approaches which used similarity to the Fordyce model as a test for whether the approach was truly "behavioral" (Hardardottir, James, & Owen, 1988). As the Fordyce approach is referenced extensively by virtually every behavioral program of pain treatment, this discussion of the behavioral approach will focus exclusively upon the model developed by Fordyce.

For a number of years, Fordyce avoided trying to define pain in the traditional sense, noting that: "pain is not an entity or thing; it is a label that observers, including the pain sufferer, have attached to the relevant phenomena they have observed or experienced" (Fordyce, 1976, p.11). Thus, while Fordyce discussed the gate control theory and its implications for behavioral approaches, the operant approach consciously limited its focus to the observable behaviors of pain. Thus, the operant solution to the definition problem was to operationalize pain as directly observable behaviors. Pain measurement, following this definition, was thus simplified. Fordyce followed the behavioral assessment technology already available (Ayllon & Michael, 1960; Ullman & Krasner, 1965) by charting only observable pain behaviors such as pain verbalizations, changes in body movement, and facial grimaces (Fordyce, 1976).

The operant approach discarded one aspect of the traditional biomedical approach to pain patients and chronic pain. Fordyce emphasized that the common division of patients into those who had physiologically caused pain, and those patients who had "so-called psychogenic pain," was not a useful division for treatment. Fordyce simply reemphasized the basic finding of the gate control theory, that higher cognitive processes were a part of all pain.
situations. The operant approach suggested that all pain complaints and pain behaviors could be modified behaviorally, and focused upon chronic pain cases typically resistant to traditional treatments.

Before discussing the specific treatment techniques of the operant approach, it is important to mention that Fordyce (1988) has recently expanded his discussion of the nature of pain. Perhaps responding to the cognitive Zeitgeist that has affected all of psychology in the past fifteen years, Fordyce has recently formulated a more detailed definition of pain that takes into account unobservable factors such as sensation, perception, and emotions. This new formulation allows for the role of cognitions in pain, but has not changed the primary treatment modalities, which still focus upon observable pain behaviors (Fordyce, 1990).

Actually, the recent pain formulations of Fordyce and his colleagues (Fordyce, 1988), were first proposed by Loeser (1980). The primary addition of Loeser's conceptualization is the division of pain into four distinct phenomena: nociception, pain, suffering, and pain behavior. The first phenomenon, nociception, is described as a "peripheral damage detecting system" (Fordyce, 1986). This refers to the activity studied in sensation threshold tests, specifically, the peripheral neural impulses related to stimulation of neural pain fibers.

The second phenomenon, labelled pain, refers to "perceived nociceptive input to the nervous system" (Loesser, 1980). Fordyce emphasizes that this perception is not linearly related to nociception (again, a heritage of the gate control theory). In fact, pain can occur without nociception and nociception can occur without pain (Fordyce, 1988).

Suffering, the third component phenomenon, is described as "a negative affective response generated in higher nervous centers by pain and other situations: loss of loved objects, stress, anxiety, etc." (Loesser, 1980, italics added). While this description includes a number of interesting factors, including the affective
component emphasized, Fordyce focuses upon implications of the higher nervous center involvement. The importance of this involvement is that such involvement opens the way for learning to play a large factor in suffering. Fordyce uses the example of a young child who turns to his mother after he falls and bangs his head, in order to determine if a negative affective response is appropriate for this particular pain. The child in pain may have variable levels of suffering, depending upon the mother's reaction. This role of learning accentuates the essential variability of the relationship between pain and suffering. As with nociception and pain, the relationship between pain and suffering is not linear. Pain can occur without suffering, and suffering can occur without pain.

The final component of pain, pain behavior, has always been the central focus of the operant approach. These behaviors, including facial expressions such as grimaces, verbal pain complaints, altered body posture, lowered or altered activity levels, requests for analgesic medication, and other behaviors which indicate pain to observers, are well catalogued by Fordyce (1976). It is the accurate measurement of these behaviors that has been the backbone of the behavioral treatment approach. For the key to the operant approach is that pain behaviors are subject to the rules of all behaviors, and thus can be modified.

Treatment Applications of the Operant Approach

As Fordyce himself notes, the operant approach to pain does not differ in method from the behavioral treatment of mental health problems (Fordyce, 1976). There are, however, some specific aspects of the focus upon pain that are different. While health psychology is presently quite well known, the application of behavioral principles to health problems rather than mental health problems was novel when Fordyce began his behavioral pain unit at the University of Washington. The specific treatment applications to pain were subject to the same criticisms which met
the initial use of behavioral methods with mental health problems (Fordyce, 1976).

The most common criticism has been that the operant approach, by focusing upon pain displays and observable pain behavior, ignores the underlying pain (Turk & Flor, 1987). Fordyce deals with this criticism by recognizing that the operant approach focused upon operant pain, or the pain that may be subject to influence by consequences following the display of pain. While the operant approach admitted that respondent pain, or the pain elicited by specific antecedent stimuli, may operate independently of the operant pain, there is evidence that the two are linked quite closely (Fordyce, 1976). One theoretical model to integrate the operant and respondent pain categories will be presented below in a section on paradigmatic behaviorism (Staats, 1981). In response to the specific question of whether a reduction in pain behavior results in a reduction of pain, Fordyce stated:

When a patient is helped to do more while requiring less ongoing treatment and those effects seem destined to persist for the lasting benefit of the patient, it is for others to worry, if they so desire, about whether the patient has undergone any beneficial change in pain (Fordyce, 1976, p.103).

Taking this perspective, the operant approach focuses more upon the change than upon the "meaning" of the change. The operant approach simply requires an acceptance by the practitioner that pain behaviors are learned, and can be replaced with newly learned behaviors that are incompatible with the old pain behaviors. Specifically, the operant approach targets four primary categories of behaviors for change: 1) Pain signals; 2) Functional impairment behavior; 3) Health care utilization behavior; 4) Effective well behavior (Fordyce, 1976).

The operant approach emphasizes that all of these pain behaviors may "occur as respondents, stimulated by peripheral
noxious stimulation," (Fordyce does not propose elicitation by self-generated cognitions), or they may "come to occur as operants, controlled by the consequences to which they lead" (Fordyce, 1976). Fordyce suggests that reduction of pain signals is a direct approach to controlling one of the most prominent aspects of pain that affects the significant others of the pain patient. The treatment follows a basic behavioral regimen of charting the pain signals over time (e.g., moans, sighs, cries, etc.), establishing a reinforcement schedule in which rewards for reducing the pain signals are agreed upon, then implementing the reinforcement schedule. In particular, behaviors that formerly were contingent upon the pain signals, such as paying more attention to the patient, are changed or eliminated. Paying attention might be done when the pain signals are absent, for example.

The area of functional impairment, typically inactivity, is countered directly by increasing suitable exercise. Inactivity is a major problem in chronic pain patients, as it often leads to further pain problems, such as atrophy of musculature necessary for supporting healing tissue (Dolce, Crocker, Moletteire, & Doleys, 1986). Activity levels and exercise levels are increased behaviorally by reinforcement for increased activity, and by setting exercise quotas (Doleys, Crocker, & Patton, 1982).

The third area of pain behaviors outlined by Fordyce in the 1970's, reduction of utilization of health care facilities, was far more controversial when initially proposed (Fordyce, 1973) than today. The trend towards Health Maintainance Organizations advocating limited use of facilities has put the operant approach squarely in the mainstream. Fordyce saw the overuse of health facilities as an unfortunate byproduct of the biomedical approach to pain, and a critical problem for chronic pain patients. Today's limited coverage health plans appear to act as powerful societal reinforcers for eliminating non-essential utilization of health care.

The final area of behaviors related to pain emphasized by Fordyce, well behaviors, was also ahead of its time in the 1970's.
A good operant definition of well behaviors is those behaviors that "gain access to effective reinforcement" (Fordyce, 1976). The emphasis on increasing these well behaviors follows from the behavioral principle that one way to decrease unwanted behaviors (e.g., pain behaviors), is to increase the rate of behaviors which are incompatible with the unwanted behaviors. Increasing days at work, exercise levels, or leisure time enjoyment may be more effective than directly focusing upon the pain behaviors (Doleys et al., 1986). Staats has called this phenomenon "the principle of behavior competition." (Staats, 1975, p. 281)

**Operant View of Association & Dissociation.** As the dimension of association and dissociation is a critical area in the proposed study, it is relevant to briefly mention, at this point, the operant view of this concept. While a strict behavioral analysis might not consider this primarily cognitive dimension, Fordyce's recent incorporation of Loeser's four-component pain definition has allowed some indirect discussion of this topic (Fordyce, 1988). Citing both laboratory work on the usefulness of distraction as a pain tolerance strategy, and also the perceived tendency of chronic pain patients to focus on their condition, Fordyce implies that chronic pain patients do not distract themselves from their pain as much as they might (Fordyce, 1988).

Despite this implication, there is no attempt to directly control or modify the cognitive styles of pain patients in the operant approach. The explicit focus upon the manipulation of cognitions of pain patients may be the most important difference between the operant and the cognitive-behavioral approaches to pain treatment. As will be discussed below in the section on a paradigmatic- behavioral interpretation of pain, however, the difference between operant and cognitive behavioral pain treatments may be one of emphasis rather than effect. Modification of pain patients' cognitions occurs in operant programs, and behavioral changes are critical to cognitive-behavioral programs.
Cognitive-behavioral Approach To Pain Treatment

As was mentioned in the last section, recent reconceptualizations by one prominent operant pain treatment program may be a tribute to the recent popularity of the cognitive-behavioral approach (Fordyce, 1988). Conversely, however, it will be emphasized that most cognitive-behavioral approaches to pain treatment adopt nearly all of the purely behavioral strategies as well. Therefore, by reviewing the two treatment approaches separately, differences may be overly emphasized. Despite this, cognitive-behaviorally oriented pain clinicians argue that the operant conditioning model can be interpreted from a cognitive-behavioral standpoint (Turk, Meichenbaum, & Genest, 1983), while behaviorally oriented clinicians argue that it is impossible to determine if anything is added by treating cognitions when so much of the treatment is the same (Turner & Clancy, 1988). A more detailed analysis of this question as it relates to treatment outcome comparisons will follow in a subsequent chapter. For the moment, it is useful to highlight the differences while recognizing the commonalities.

Cognitive-Behavioral Conception of Pain

The cognitive-behavioral treatment approach to pain attempts to integrate the sensory and affective factors highlighted by the gate control theory as well as the learning factors which are the focus of the operant approach (Turk & Rudy, 1986). Some basics of the cognitive-behavioral pain conceptualization are: 1) a longitudinal view of pain, emphasizing learning and changes, and; 2) a "reciprocal or synergistic" view of the interaction between sensory affective and cognitive factors as opposed to a unidirectional model of pain (Turk & Rudy, 1986). In particular, as suggested by the model's name, the cognitive-behavioral approach pays special attention to an individual's cognitions, or
"perspective," and how these perspectives modify an individual's reaction to painful stimuli or affective factors.

The cognitive-behavioral approach utilizes the IASP definition of pain listed in an earlier section, although the theoretical and treatment foci of this approach have emphasized the affective and cognitive aspects of the IASP definition rather than the sensory (Turk et al., 1983).

TREATMENT APPLICATIONS OF THE COGNITIVE-BEHAVIORAL APPROACH

As the operant approach to pain treatment is a special utilization of behavioral techniques developed with mental health clients (Fordyce, 1968), so too is the cognitive-behavioral approach to pain an extension of cognitive-behavioral approaches for such problems as depression, anger control, and anxiety disorders (Turk et al., 1983). In fact, the term cognitive-behavioral has become a blanket term for a number of quite varied therapeutic approaches (Mahoney & Arnkoff, 1978). One commonality in the approaches is the recognition of the reciprocal quality of person and environment. The importance of this interaction has been noted by a number of prominent theorists in psychology (Lewin, 1935; Meichenbaum, 1977; Staats, 1963, 1968, 1971).

In the specific application of cognitive-behavioristic approaches to the problem of pain, the work of Turk et al. (1983) has been prominent. The primary contribution of this work has been the transcription of cognitive-behavior theory to the specific dilemmas presented by pain patients. It may be useful to briefly outline one often utilized model of cognitive-behavior modification, that of Meichenbaum (Meichenbaum, 1977; 1985; Turk et al. 1983), before discussing specific applications to pain.

The first stage in this model is "Conceptualization of the Problem." The initial component of this stage is the emphasis upon understanding the client's point of view, or perspective, and trying to utilize that perspective as a forum for change if the perspective is maladaptive.
This change of perspective is called "Reconceptualization" (Meichenbaum, 1977), and is facilitated both by education and by enlisting the client to collect information that might challenge the initial maladaptive perspective. Meichenbaum emphasizes the importance of collaborating with a client rather than instructing the client, as a central factor in overcoming "resistance to change" (Turk et al., 1983).

The second stage of this cognitive-behavioral model is the active "Alteration of Thoughts, Feelings, and Behaviors." During this phase, the therapist helps promote new behaviors and helps develop the acquisition of cognitive coping strategies by the client. (Meichenbaum, 1977). In addition, the cognitive-behavioral model predicts that affective changes occur through modification of behaviors and cognitions, although the specific process of these changes is not clearly elaborated. As will be discussed in a later section, a paradigmatic behavioral approach proposes specific interactions between affect, cognitions, and behaviors, that help to explain the predictions of Meichenbaum's model.

The final stage of the Meichenbaum model of cognitive-behavior modification is the "Consolidation, Generalization, and Maintainance Phase." Inclusion of this stage indicates an awareness that many treatments are successful in the short run, or under certain environmental circumstances, but lose their treatment effects over time or when an environment changes (Turner & Clancy, 1988). Cognitive-behavioral models of treatment hope to avoid this occurrence by helping the client to expect difficulties and prepare strategies for dealing with the problems. In addition, the collaborative approach may help the client to recognize personal responsibility for his own improvement in treatment (Turk et al., 1983).

Applications To Pain. As the general procedures of cognitive-behavioral therapy are not a central focus of the present study, emphasis will be placed upon one unique application of the approach to pain: teaching cognitive strategies to help cope with
pain. This instruction occurs in the second phase of treatment, following the pain patient's reconceptualization of pain.

For some pain patients, one difficulty in utilizing psychological pain treatments is the view that talking to a psychologist about pain is akin to admitting that their pain is "all in their head." This byproduct of the specificity theory's biological/psychiatric dualism is not limited to patients. Many physicians still conceptualize pain problems in this way, and even the American Psychiatric Association's Diagnostic and Statistical Manual (DSM-III-R) (APA, 1986), still uses this outdated model of pain. The result is that many pain patients, initially seen by physicians, are referred for "psychiatric consultation" when a specific cause of pain cannot be found. The consequences of the referral are often defensiveness on the part of the pain patient, and a desire to prove that his pain is "real, not in his head".

Thus, the patient's reconceptualization of pain from a specificity model to a multi-dimensional model such as the gate control theory is a critical first step before he can utilize cognitive coping strategies. Once a client has reconceptualized pain as a reciprocal phenomenon, he is taught relaxation skills as well as a number of specific cognitive coping strategies for pain. It is in this specific skills training that the cognitive-behavioral approach is most unique. The relaxation training is common to many therapeutic approaches for a number of problems (Russo, Bird, & Masek, 1980), and has been shown to help alleviate aggravation of injury due to excessive muscle tension (Turner, 1979). In addition, the benefits of the relaxation may include a reduction of anxiety, which has been shown to decrease pain tolerance (Melzak, 1985). The utilization of cognitive coping strategies for pain is a novel addition based upon cognitively oriented laboratory and clinical studies (McCaul and Maliot, 1984; Turk & Rudy, 1986). Unfortunately, the role of relaxation itself, apart from cognitive strategies, has not been adequately explored (Turner, 1990).
Cognitive Coping Strategies. Initial recognition of cognitive approaches to pain came in a number of studies of tolerance to laboratory-induced nociceptive stimuli. Turk and his associates, (1983) categorized these cognitive approaches as strategies, which are "attempts to cope with the experience," and negative cognitions which "seem likely to worsen the experience" ( p. 89). The strategies are further broken down into two subclasses: strategies that actively divert attention, and those that attempt to alter the perception of the pain (Genest & Turk, 1979).

A recent review of cognitions and pain (Turk et al., 1983), specifically focused upon the use of strategies, and listed six strategies falling into two groups. One group of studied strategies are those that use imagery including: 1) imaginative inattention; 2) imaginative transformation of pain, and; 3) imaginative transformation of context. A second group of strategies do not use imagery, including: 1) focusing attention on physical characteristics of the environment; 2) mental distractions, such as doing arithmetic, and; 3) somatization. As cognitive coping strategies are a central focus of the proposed study, a brief review of Turk's description of these strategies will follow.

Imaginative inattention involves imagining some scene or behavior that is incompatible with pain, such as spending time in a favorite relaxing place. Imaginative transformation of pain utilizes images that reinterpret the pain as being unreal or part of a fantasy. Imaginative transformation of context is imagining another scene, such as an adventure story, in which the pain sensation is involved.

Focusing attention on the environment is simply the active use of sensations and perceptions in the surrounding context. For example, one could pay attention to sounds or sights in a room. Mental distractions are active thoughts that utilize mental energy, such as counting or making lists. Somatization involves "focusing attention, in a dissociative manner [italics added], on the part of
the body receiving the intense sensation" (Turk et al. 1983, p.90, ). This is described as separating oneself from the pain.

As one reads the descriptions of these strategies, one quickly realizes that the divisions between the various categories are not always clear. In addition, while the strategies are all described as methods of cognitive "distraction" (Turk et al., 1983), there appears to be a range of associative and dissociative strategies. In addition, the impact of the various strategies upon affective change as well as cognitive change has not been adequately addressed.

Teaching Cognitive Strategies. Turk and his associates (1983), stress that the teaching of psychological coping techniques such as distraction should always involve a collaboration with the client rather than being presented as a lecture. Meichenbaum (1985), states that this collaboration will greatly enhance the likelihood of success by altering the metacognitions of the client, or the client's thoughts about the therapy. These cognitive-behaviorists emphasize that an active partner will be much less likely to resist the treatment and much more likely to comply with treatment in the long run.

In order to increase collaboration, and in order to more effectively teach specific pain distraction techniques, the use of colorful metaphors that allow a patient to understand an interactional view of pain are recommended (Turk et al., 1983). The techniques are taught in the form of experiential imagery exercises, roughly following a script. In order to help consolidate the techniques, patients are given homework assignments involving practice of the exercises and techniques. At all times, the patient is told to use the techniques as options, and to choose those strategies that best fit the patient's own ideas.

One last reason for stressing the individual choice in selecting the cognitive techniques, is the cognitive-behavioral recognition that an individual has a learning history and may bring a well rehearsed pain strategy to treatment (Kanfer & Goldfoot, 1966; Turk & Rudy, 1986). A small number of studies focusing upon the
cognitions of individuals in so-called control groups in treatment studies have shown that some individuals use cognitive strategies despite having been told not to, and other individuals fail to use strategies suggested by the experimenter (Avia & Kanfer, 1980). This finding has been used to explain the lack of superiority of specific cognitive strategies (Turk et al., 1983). There has been little consideration of the fact that all the strategies taught are really teaching the same thing: distraction or dissociation from pain.

**Cognitive-Behavioral View of Association & Dissociation.**
The one commonality among all six cognitive pain strategies is that they all "tend to involve some sort of distraction" (Turk et al., 1983). While treatment studies have shown that none of these strategies have demonstrated superiority in increasing pain tolerance (Turk & Rudy, 1986), the fact that all the strategies use attention distraction is not seen as a problem. The logic of distraction as the only cognitive pain strategy is based upon a number of laboratory studies which demonstrated increasing pain tolerance in subjects instructed in distraction techniques (Coger & Werbach, 1975, Sternbach, 1985). The use of alternatives to distraction, specifically, an associative approach, will be discussed in a following section.
Effectiveness of Psychological Pain Treatment Models

Overview of the Field

While the importance of treatment efficacy studies for psychological pain treatments has been recognized for some time (Fordyce, 1976), the difficulties in interpreting a large body of different types of studies with different populations has been an obstacle to assessing the efficacy of various treatment approaches. In many ways, the methodological pitfalls recently faced by reviewers of the efficacy of pain treatments are similar to those earlier faced by reviewers of psychological treatment for mental health difficulties (Eysenck, 1979; Glass, McGraw, & Smith, 1981; Smith & Glass, 1980). A short list of problems for both areas include: 1) poor or mixed methodological quality of studies being reviewed; 2) limited number of true "controlled" treatment outcome studies; 3) eclectic and non-standard treatments; 4) varying subject populations and presenting complaints, and; 5) a wide variety of outcome measures. As has been true of results in the mental health field, these problems have led to reviews which appear to show a limited yet universal and undifferentiated treatment effect (Malone & Strube, 1988).

Two different approaches to reviewing the pain treatment literature, narrative review & meta-analyses, have been used. Turner & Chapman (1982), using a narrative review of treatment for a number of pain problems, were unable to show a differential effect for operant or cognitive-behavioral approaches. Trifletti (1984), in the most pessimistic analyses to date, argued that his narrative review showed that literature did not provide evidence for the consistent success of any pain treatment approaches. Trifletti emphasized the need in the literature for specific treatment comparison studies.

The first meta-analytic review in the pain area, in which the results of individual studies were statistically combined and compared across types of studies, was by Blanchard, Andrasik, Ahles, Teders, & Okeefe (1980), and it focused upon the treatment...
of headaches. Unfortunately, in this case, the meta-analytic methodology was unable to provide any more information than simple narrative reviews of the same area (Blanchard et al., 1980).

The most recent meta-analysis of the field of psychological pain treatments (Malone & Strube, 1988), has been more successful in emphasizing some important aspects of the treatment literature. Including 109 "non-medical" pain treatment studies with clinical populations between 1950 and 1984, the authors found some consistent results. As has been true in reviews of psychological treatments in mental health (Brown, 1987), differences between treatments were less noteworthy than commonalities. For "most treatments of most types of pain," the authors found positive yet modest effects. Interestingly, psychological approaches to pain treatment had little effect upon self-ratings of pain intensity, duration, or frequency, but mood and subjective symptoms were consistently improved by the treatments. Nearly all of the studies included in the meta-analysis had major methodological flaws (Malone & Strube, 1988), with the absence of control groups and long term follow-ups being most conspicuous.

Comparative Treatment Studies: Chronic Pain

At this point in time, there have been only two published treatment studies which have specifically compared the two most prominent psychological treatment approaches, the operant approach and the cognitive-behavioral approach. Kerns, Turk, Holzman, & Rudy (1986), looked at the two approaches with chronic back pain patients, and found that both approaches resulted in significant decreases in the amount of health care attention required by the subjects relative to controls at post-treatment and at a follow-up. The cognitive-behavioral group, however, also showed improvement on self-reports of pain and activity levels performance. Unfortunately, other observer ratings were not available as a check for the accuracy of these self-reports.
Another recent comparative study (Turner & Clancy, 1988), also looked at operant and cognitive-behavioral approaches in chronic low-back pain patients. Using a number of self-report and other-report measures, it was shown that, while both approaches were more effective than control conditions, the operant approach was more effective than the cognitive-behavioral approach at post treatment. At six and twelve months follow-up, however, the differences between the two treatments disappeared, resulting from a steady increase in improvement of the cognitive-behavioral group rather than a decrement in the operant group (Turner & Clancy, 1988).

A number of interesting issues were highlighted by this study. In both groups, cognitive errors in regard to pain were reduced, even though only the cognitive-behavioral approach focused on this factor during treatment. The authors speculate that both treatments may alter an individual's thinking about pain although only one treatment specifically focuses upon it. Another interesting finding was that ratings of the therapists differed for the two groups, with the cognitive-behavioral therapists being rated as warmer and more knowledgeable, despite the fact that the same therapists led both groups. This perception may have led to another finding that patients in the cognitive-behavioral group reported that treatment was more helpful to them, despite showing greater improvement, on a number of self-report measures, from the operant approach.

One interpretation of this study is that, while the operant approach is initially more effective at modifying pain behaviors and increasing functioning, the lack of attention to cognitive factors may limit the gains to be made by a patient following treatment especially as the operant approach appears to be modifying cognitions without a specific intervention (Turner & Clancy, 1988; Turner, 1990). Studies that determine how the two approaches might be more profitably integrated to maximise the treatment gains are needed. As will be discussed in a following section,
paradigmatic behaviorism provides a structure for utilizing and integrating the findings from both the operant and the cognitive behavioral approaches. In addition, the paradigmatic behavioral approach argues for a recognition of individual differences in learned cognitive strategies that might necessitate treatment-deficit matching to increase treatment effectiveness. As the following short section reveals, teaching distraction strategies has not proven to be effective with chronic pain populations.

**Treatment Studies on Cognitive Strategies**

Before discussing laboratory pain research and research with athletes on the question on the association and dissociation, it might be useful to briefly address the limited evidence of the effectiveness of distracting cognitive strategies in clinical populations. Rybstein-Blinchik (1979) looked at the effect of cognitive strategies on chronic pain and found that strategies which attempted to completely divert attention from pain were not effective in a chronic pain population. The author found that strategies which focused on the pain but reinterpreted them were successful in increasing pain coping. Rybstein-Blinchik maintained that this strategy was one of "attention-diversion," but was also a "relevent" strategy, as the nociceptive stimuli was not ignored.

Rosenstiel & Keefe (1983), also looked at specific strategy use in chronic pain patients, and they found that no distraction strategy was effective, but noted that "the use of certain strategies [was] related to poorer adjustment." (p. 42) In other words, differential use of the distraction strategies was only significantly related to bad outcomes. The authors expressed that the failure of the strategies might be due to the difference between clinical pain and experimental pain. They summarize the difference by stating:

While imagining something distracting may be feasible in an experimental pain situation in which one has to cope with
short-term pain, in coping with chronic pain the use of such a self-control strategy may not be feasible (Rosenstiel & Keefe, 1983, p. 42).

A more recent study by Turner and Clancy (1986), which found similar negative effects from the use of distraction techniques by chronic pain patients, made a more damning conclusion. These authors stated:

"It would appear, in summary, that it is probably not useful to incorporate training in attention diversion techniques in chronic pain treatment programs" (Turner & Clancy, 1986, P. 363).

Since the teaching of attention diversion techniques is a critical part of the cognitive-behavioral approach, an appropriate question might be: Might other cognitive strategies be taught that have a greater chance of success? The following section on association and dissociation suggests that associative strategies may be more effective in certain pain situations.
V. ASSOCIATION AND DISSOCIATION

When I'm on a tough climb, I don't use any mindgames. I don't try to take my mind off things and think about something else. I have to put my mind right where it's at. Alexi Grewal, gold medalist in olympic road cycling (1989, )

Sport Psychology Literature

Of the conventions that have developed in the area of writing about pain, one is to use examples from sports, typically an anecdote such as the football player who plays an entire game with a broken leg. These examples are almost always in the introductory paragraphs, as a preface to the problems of pain that make up the body of the work. These sports examples seem to serve two purposes: 1) to make the topic of pain more colorful, accessible, and less threatening to the reader, and; 2) to give an example of aberrant human behavior in response to pain. One purpose of the present paper is to suggest that the athlete's response to pain is less an exotic anomaly than a simple variation on the pain learning of all individuals. A second purpose is to suggest the variations found in athletic pain responses may provide useful information for researchers and clinicians who are attempting to devise psychological strategies for dealing with pain.

Interest in the psychological components of athletic success have been a central focus of sport psychology literature since the field began. Historically this interest was operationalized by assessing athletes using broad personality constructs and measures borrowed from personality theory, and attempting to correlate athletic success with particular personality "types" (Browne & Mahoney, 1983). Perhaps not surprisingly, this type of research did not produce any consensual research results or direction. Gradually, researchers began to shift their focus away from broad personality constructs and towards understanding the specific demands asked of athletes in various sports. Following trends
begun in clinical psychology, researchers in sport psychology began to investigate so-called "cognitive" variables in the 1970's (Browne and Mahoney, 1983).

Athletic Effort and Pain: Definitions

As was described in an earlier section, clinical pain is commonly divided into two categories, acute and chronic, and both types of pain are seen in athletes. Broken bones, torn knee cartilage, muscle tears, and other major and minor sports injuries resulting in acute pain of short duration are quite common in athletes. Chronic pain, with a longer time span and often indeterminate source, is sometimes present in elite athletes as a result of overtraining (Murphy, 1988). Indeed, pain from injuries is an almost universal problem among athletes. One study, for example, cited the incidence of running injuries in the careers of runners (serious enough to reduce or prevent the ability to run) at one-hundred percent (Van-Handel, 1986). In other words, all long-term runners have a disabling injury and pain at some point in their running career.

In other sports as well, pain from injury is a constant danger for athletes, and a problem for trainers and coaches. Recent training trends towards planned overtraining, more intense training sessions, interval training, plyometric weight programs, and simply increased hours of training, have all increased risk and have made staying pain and injury free a crucial factor in success. In professional sports, economic and other pressures create a situation in which athletes are more likely to compete with injuries, usually resulting in pain, and often resulting in further injuries. Even at the amateur level, elite programs have produced a generation of athletes who are as familiar with chronic aspirin and ice pack use as they are with sponsorship and scholarship legalities. In summary, injuries and pain are relatively common at the elite levels of sport, and athletes are typically at high risk for injury.
While these pain and injury issues have recently begun to receive greater attention, the current study focuses upon a different type of pain from those just described. This study addresses a specific literature which focuses upon the long hard efforts of athletes in endurance sports such as running, bicycle racing, and swimming. As muscular and cardiovascular systems are stressed by athletes in these sports, their bodies' energy and muscular metabolic waste removal systems are taxed to their limits. Heart rate and stroke volume per beat increases, lung function increases, and energy use at the muscular cell level increases. At a certain percentage of maximal effort, commonly referred to as the anaerobic threshold, the workload is so great that the byproducts of the effort begin to build up in greater levels in the blood and muscles. These work byproducts, including the metabolite lactic acid, produce a specific type of slow building yet intense pain in the muscles at work during exercise. This pain will be referred to as anaerobic pain (McCann, 1988).

Placing anaerobic pain in the context of our previous pain definitions, it appears that the frequency and duration of anaerobic pain for elite endurance athletes give it the characteristics of both acute and chronic pain. Like acute pain, the source of the pain is specific and identifiable. Unlike most types of acute pain, however, the pain is confronted by the individual endurance athlete over the many years of a competitive career, and during the competitive season, he or she confronts it with regularity. This temporal frequency and duration is more similar to the typical time periods cited in definitions of chronic pain. The affective and cognitive aspects of this pain to the athletes will be discussed following a review of the literature on the cognitive strategies used when facing this type of pain.

It should be noted, that the research studies discussed in this review do not all use the same nomenclature for pain. Some studies refer to fatigue, some refer to exertion, and some refer to pain. While the current study does not propose that these terms
all describe identical phenomena, a reading of the studies suggests
that the different terms describe more similar than different
phenomena. As was described in an earlier section, the
definitional process in pain is quite complex. For the purposes of
this review, however, the terms fatigue, exertion, and pain, will be
used as the authors of the individual papers used them, without an
attempt to contrast, compare, or rank the terms on a continuum of
pain.

Association and Dissociation Research

In the early 1970's, Morgan and others at the University of
Wisconsin began a systematic look at the psychological
characteristics of elite long distance runners (Morgan & Costill,
1972; Morgan & Pollock, 1977; Morgan, 1978). The study by
Morgan and Pollock (1977), used interview techniques with 19
competitive runners and included a focus upon the question of
cognitive activity during competition. One specific question was
whether these runners used Associative cognitive strategies, in
which they monitored their body, or Dissociative cognitive
strategies, in which they attempted to distract themselves from
their sensations of effort, fatigue, and pain. The authors
determined that the most successful elite runners used associative
strategies while less successful runners tended to use dissociative
strategies. This difference was described by the authors as "the
major distinguishing psychological dimension of the elite

This research finding attracted a great deal of attention in
the popular press and among coaches and athletes, becoming the
"definitive statement on the cognitive style of the elite distance
runner" (Silva & Appelbaum, 1988 p. 3). Following in the tradition
of sport personality research, there was a tendency to label the
association style as a unique "trait" of these elite runners. Morgan
and Pollock (1977) felt that the elite runners may possess special
physical abilities, brought about by training, that allow them to
tolerate the "cost" of an associative strategy. Unnoticed in the
attention to this one study, however, was a growing body of literature that apparently challenged the notion that an associative style increased performance.

**Research with Non-Athlete Populations.** Pennebaker and Lightner (1980), reported two experiments which attempted to affect the cognitive styles of college students asked to perform a running task. In the first study, all subjects were asked to run on a treadmill while wearing headphones. By alternately exposing subjects to either distracting stimuli (dissociation group) or amplification of their own breathing (association group), the authors attempted to control association or dissociation. The subjects in the dissociation group reported less fatigue than the subjects in the association group.

In the second study, unexperienced runners were asked to run identical 1800 meter distances on either a circular lap course or on a cross-country course. The authors reported that despite similar perceptions of fatigue for subjects in both groups, the cross-country group performed the same distance in less time than did the lap course group. The authors interpreted these results to mean that running in distracting circumstances results in a performance increase due to more attention to the environment and less to internal signals of fatigue.

Both studies can be faulted for their lack of a follow-up questionnaire to directly ascertain whether the experimental procedures actually produced a change in cognitive strategies. In addition, in the first study one can seriously question whether an amplification of one's own breathing should be considered a stimulus to facilitate an associative focus, or a negative and distracting stimuli. Given these criticisms, the findings of both these studies with college students directly contradict the early findings of Morgan and Pollock (1977), which found that the associative style of elite marathoners was related to increased performance.
A study with United States Army personnel on a treadmill running task also showed a performance benefit from a dissociative cognitive strategy (Morgan, Hortsman, Cymerman, & Stokes, 1983). Compared to control and placebo group subjects, subjects assigned to a dissociative group and instructed to use a dissociative strategy showed superior performance, despite similar results on a physiological measure of effort (blood lactate levels). Morgan et al. (1983), interpreted the results to mean that subjects in the dissociative group were using the strategy to increase tolerance of aversive stimuli and feel less fatigue.

Okwumabua, Meyers, Schleser, & Cooke (1983), investigated the cognitive styles of novice runners and attempted to determine the effect of teaching either associative or dissociative styles upon performance. College students in fitness classes were monitored over five weeks of running a one and one-half mile run after having been assigned to associative, dissociative, or relaxation control groups. Although the authors found that the instructional procedures did not effectively alter the cognitive strategies of the runners, post-hoc analyses showed that those individuals who used dissociative strategies showed the greatest reduction in running time over the five week class period. Okawumabua et al. (1983) interpreted the results as support for the hypothesis of Morgan and Pollock (1979), that novice runners do not have the special physical characteristics of elite runners, and therefore benefit more from a dissociative rather than associative style. Interestingly, however, Okawumabua et al. (1983), found that all of their subjects used relatively more associative strategies at the end of the study than at the beginning, whatever their group assignment and instructional messages.

To summarize these studies investigating the effects of various cognitive strategies on the running performance of college students and Army personnel, it appears that a dissociative strategy is most effective for increasing performance and endurance, and for decreasing fatigue and pain. These results at
first appear to contradict the landmark study of Morgan and Pollock (1977), which found that elite runners differ from non-elite runners in that elite runners use associative strategies to run faster. The results also appear to support the conclusion that elite runners may have "special" traits that make them somehow different from novice runners and non-athletes. A series of studies with elite athletes, however, suggests an alternative interpretation.
Eventually, all athletes get used to the pain of what they're doing. It's almost a good sign. At least you know you're working hard. - Alexi Grewel, gold medalist for the United States in olympic road cycling (1989, ).

**Research with Elite Athletes.**

Two studies by Schomer (1987, 1988), reinvestigated the question of associative versus dissociative styles in marathon runners. The studies were noteworthy for the utilization of headset microrecorders that allowed the author to record verbatim transcripts of the runners verbalizations during training. In the first study, runners of three differing ability levels were told to verbalize all their thoughts, without editing, and to periodically give ratings of their effort using the Borg Perceived Exertion Scale (RPE) (Borg, 1978). An analysis of the verbalization recordings for patterns of association and dissociation revealed a strong correlation between associative styles and the RPE ratings for runners of all groups. Specifically, as runners' ratings of exertion increased, so did the amount of association in their verbalizations. Schomer felt that this result, when considered with the results of Morgan & Pollock's earlier (1977) study, indicated that elite marathoners used a more associative style because their workouts were probably more difficult and painful. Schomer hypothesized that the associative style was a necessary approach in order to avoid the injuries that might accompany difficult training when a dissociative style that ignored pain levels was utilized.

A second study by Schomer (Schomer, 1987), attempted to train marathoners to increase the use of associative strategies during training. Using a similar taped verbalization technology, the author described a series of ten case studies in which the effects of the five-week thought intervention period upon the runners verbalizations were analyzed. In eight out of the ten cases, the author reports increased use of associative strategies and increased ratings of perceived exertion.
Schomer (1987), reports that the two subjects who did not increase the use of associative strategies did not attempt to practice these skills, and lacked the motivation to do so. Although not directly discussed, the two negative cases raise important issue of individual differences in learning history and learned reinforcers. Another key question is whether there is a limit to the amount of associative thinking an athlete can utilize during an event of long duration such as the marathon.

Silva and Applebaum (1988) dealt directly with the question of shifting cognitive styles during the length of a marathon. The authors interviewed 32 competitors at the 1984 Olympic marathon trials the night before the marathon. Using a questionnaire designed to determine the typical strategies used by the runners during a marathon, the authors determined strategy differences that successfully discriminated between top placers and lower placers. Specifically, the authors found that top finishers were characterized by a flexible approach to pain (shifting between associative and dissociative styles) and generally greater amounts of associative strategies. Lower placers, in contrast, tended to adopt a dissociative strategy fairly early on in the race and maintain this strategy through the remainder of the race.

The Silva and Applebaum is notable both for its introduction of new ideas into the literature of association/dissociation, and its methodology. While the general trend of increased use of associative strategies is consistent with earlier research with elite runners, the concept of flexibility between associative and dissociative styles is a new one and would appear to be an important addition in increasing the sophistication of studies investigating the cognitive strategies of athletes. Unfortunately, the methodology of asking about typical styles and then relating the answers to a specific and future performance is suspect. It is unclear if these typical styles were accurate representations of earlier races (with an unknown and varying
intervening time period before answering the questionnaire), and even less clear if these styles were utilized in the race the following day.

While this criticism must be weighed against the advantages of a field study, it was consideration of the issue of accurately controlling exertion when monitoring cognitive strategies that led to a study by McCann & Murphy (1988). In a unique setting at the United States Olympic Training Center at Colorado Springs, Colorado, there were a number of fortuitous conditions that enabled the authors to address some of the methodological issues that complicate interpretation of other studies.

The United States Cycling Federation each year holds training and selection camps at the Olympic Training Center, in which invited riders have a chance to be selected to national and international teams. During these camps, the riders are evaluated by means of a formula composed of road race results, time trial race results, and results of a physiologically monitored ergometer ride. The ergometer ride takes place in the Sport Science building of the Olympic training center, supervised by the Exercise Physiology staff. With the cooperation of the National Cycling Team’s coaching staff, the Sport Psychology staff were given access to all riders before and after the ergometer ride, and were able to examine pain strategies used by the athletes in a controlled competitive situation (McCann & Murphy, 1988).

The ergometer ride involved a series of incremental jumps in the amount of work required for the rider. Each rider began at a wattage level of work that was determined by his or her height and weight. The rider’s task was to maintain a constant cadence of 90 revolutions per minute for as long as possible. Every three minutes, the level of work required to maintain the cadence was increased as a percentage of the initial workload. As workloads increased beyond a certain point, the anaerobic threshold was reached and riders began producing more waste in the form of the
metabolite lactic acid than could be removed by the overtaxed cardiovascular system. Ischemic muscle pain increases until the rider can no longer maintain the required cadence. Self-report data on levels of perceived exertion and on levels of association and dissociation were collected immediately following conclusion of the ride.

There were three specific benefits of the conditions available to the authors. First, there was access to a true competitive situation with elite athletes thus increasing the saliency of the task for the athletes. Secondly, there was the ability to gather information on cognitive and behavioral strategies immediately before and after the competition, potentially reducing problems of memory of strategies. Thirdly, in addition to ratings of perceived exertion, the authors were able to gather detailed heart rate data and actual workload levels for the entire task. Given this advantageous environment, the authors were directly able to test the contention of Schomer (1987), that athletes use increasing association as levels of work increase. In addition, the authors were able to gather cognitive strategy information for a specific competitive setting when motivation would be quite high.

Analyses of the data revealed two main findings. The first is that Schomer's (1987) contention, that increases in associative strategies accompany increases in effort, was strongly supported. There was a significant linear trend of increasing association as the ride progressed and required effort increased. The second finding is that there was very little variance in the strategies. Nearly all the riders increased association as the effort and pain levels increased. This contrast with the results of earlier studies that showed varying cognitive strategies might be explained by the fairly homogenous nature of this elite sample. Unlike earlier studies, which showed the greatest difference between novice and experienced runners (e.g. Morgan & Pollock, 1977; Schomer, 1987), this sample consisted exclusively of experienced elite and "near-elite" athletes.
Summary of Research With Athletes

While early interest in the "personality" variables of successful athletes has waned, there has been a recent resurgence of research in one area of the psychological aspects of performance: the question of whether endurance athletes utilize associative or dissociative strategies when training or competing. The results at first appear confusing, with some individuals or groups (ie. college students, army personnel, and less experienced runners) performing better with dissociative strategies, while other individuals appear to utilize associative strategies successfully (ie. elite athletes). Morgan & Pollock (1977) explained this difference as the special abilities of super-fit athletes to "withstand" the effects of associating, while Schomer (1986, 1987), sees the difference as the simple effect of increased efforts during the workouts of elite runners. According to this theory, as effort increases, association must also increase. A study by McCann & Murphy (1988) supports this hypothesis, finding increasing association in periods of increased effort and pain.

Taken as a whole, the research in the cognitive styles of endurance athletes can be seen as strongly supportive of a learning theory of cognitive pain responses. As will be elaborated in a later chapter on the specifics of a Paradigmatic-Behavioral approach to pain, it appears that elite athletes have learned a distinctive "pain personality" (McCann, 1988), which supports and selectively rewards the use of an associative style. Despite the apparent benefits of an associative pain strategy for athletes, and despite the obvious overlap of this research with other research in laboratory and clinical pain, there is virtually no mention of this research in these two other areas. In fact, there is an apparently universal acceptance of dissociation as the only cognitive approach that might be tested in the laboratory and the clinic.
Laboratory Pain Research

As mentioned previously, pain research in the laboratory had its beginnings with von Frey's work on sensation and pain thresholds at Leipzig in the late 1800's. The beginnings of the modern investigation of pain in the laboratory has been ascribed to the work of Hardy, Wolff, and Goodell in the 1940's at Cornell (Wolff, 1986). From the beginning, experimental pain research has been controversial. Even in the days of less stringent ethical and legal research review boards, some of the early procedures for pain induction met with outcry due to ethical considerations (Chapman & Jones, 1944). In addition, researchers had to face the primary dilemma of finding a pain induction procedure that was close to clinical or naturally occurring pain while avoiding tissue damage or other trauma. This internal validity problem was a considerable hurdle even before the Gate Control Theory emphasized the importance of the context of pain (Melzak, 1986). In particular, the criticisms of Beecher, perhaps the most prominent clinical pain researcher of the 1940's and 1950's, that laboratory procedures were invalid (Beecher, 1956; 1957), hurt progress in laboratory pain research (Wolff, 1986).

Despite these obstacles, a growing recognition of the economic and social costs of pain helped to refine laboratory pain induction and measurement procedures. In addition, following an early period of disunity in pain induction procedures and foci of study, some standards and specific research foci have developed. Dimensions of the pain experience typically focused upon in the laboratory have been pain threshold, and pain tolerance. Pain threshold, or the point at which subjects just begin to feel pain, has gradually waned as an area of interest, in part due to the great difficulty in producing reliable measures, and in part due to the perceived lack of correlation between pain threshold and clinical pain (Beecher, 11959; Wolff, Kantor, & Cohen, 1976).
Pain tolerance, or the upper threshold of pain, has been a more recent area of interest (Clark & Bindra, 1956; Wolff & Jarvik, 1963). Study of the point when a subject ends the noxious stimulation in an experimental setting has gained ascendance in the laboratory pain literature. Part of the interest in pain threshold is due to a number of studies with analgesic medications showing this measure to be analogous to clinical pain reactions (Smith, Lowenstein, Hubbard, & Beecher, 1968; Wolff, 1977), thus increasing its face validity for clinicians and drug companies. In addition, Wolff (1986) notes that pain tolerance seems to have "proportionately much higher loadings of psychologic than physiologic factors" (p.142), a fact which has fostered the interest of psychologically oriented pain researchers.

Measurement Of Pain

While dimensions of the pain experience have been described, there are still some unresolved issues in defining pain. This has led to a considerable problem in pain measurement for both laboratory researchers and clinicians. As one pain measurement specialist succinctly put it, "it is not easy to measure something if one is not sure what one is actually measuring" (Wolff, 1986, p.121). Wolff suggests operationalized definitions such as Tolerance or Threshold as a means for beginning the process of pain measurement, but stresses the need to state the limits of these definitions. Unfortunately, however, most research in pain fails to recognize its limits. The primary failure is that measurement of pain typically focuses upon only one dimension of the pain experience, yet treats that measure as the total experience of pain (Karoly, 1985).

An integrative overview of pain measurement has been presented by Karoly & Jensen (1987). This conceptualization supports the multiple components of pain suggested by the IASP pain definition. These authors, describing measurement of chronic pain, refer to pain and its measurement as falling within four primary contexts: 1) Biomedical; 2) Focal/Experiential; 3) Meaning/
Relational, and; 4) Conceptual/ Sociological. A brief description of these contexts helps to place various assessment approaches in perspective.

The Biomedical Context focuses upon the mechanics of pain, as it attempts to locate a physiological origin of pain. Assessment and measurement of pain in this context is done by a number of means, including the following: taking x-rays; diagnosing a physical complaint; charting medication use; assessing biophysical and neurochemical status, and; giving a physical examination. When a physical source of pain cannot be located, the patient is typically referred to a psychiatrist or psychologist. Thus, the biomedical context refers to the "where and why" of pain (Karoly & Jensen, 1986).

The Focal/Experiential Context refers to the "how" of pain, (eg. how the pain feels to the pain patient). This context includes: the sensory-perceptual dimension of pain; the affective component of pain; the behavioral/performance aspects of pain; the interpersonal dimensions of pain, and; the verbal and cognitive dimensions of pain. As Karoly and Jensen note, it is this context that:

represents the heart of pain assessment for most researchers and nonmedical clinicians because it concerns itself with pain as experienced and expressed (p. 9).

It is within this context that nearly all of the recent changes in the view of pain have developed. In this context, the measurement of pain relies upon an individual's self report of pain. The present study will also focus on this experiential context of pain as will be indicated below.

The other two pain "contexts" described by the Karoly and Jensen are less important to basic pain researchers but especially relevent to professionals in health psychology and pain management. The Meaning/Relational Context of pain refers to the relationship of the pain to the individual's functioning in a number
of areas, including relationship to vocational situation; relationship to family; the temporal development of the pain; motivational factors, and importantly; overall mental health. As Karoly and Jensen (1986) put it, it is this context which asks the question "What difference does the pain make?" The final context of pain outlined by Karoly and Jensen, the Conceptual/Sociological Context, refers to third person views of an individual's pain, including the insurance company, a legislature designing disability plans, or a the personal biases of a clinician attempting to work with a pain patient.

**Specific Pain Measures.** While the specific pain measures chosen for the proposed study will be presented in a following section, a brief presentation of the types of commonly used pain measures follows. In terms of the Contextual Fields Model of Karoly and Jensen, described above, the following pain measures and measurement areas fall into the Focal/Experiential Context of pain measurement.

There are a number of specific interests in the measurement of pain, but nearly all can be subsumed by four primary interest areas in pain measurement, which are: 1) pain intensity; 2) the affective nature of pain; 3) the sensory quality of pain, and; 4) the location of pain (Karoly & Jensen, 1987). The measures typically used to assess these areas share some commonalities, including a reliance upon self-report or guided self-report, and a historical reliance upon psychophysical scaling models (Wolff, 1986).

Pain location is measured quite simply by a subjects response to variations of a pain drawing task. While a number of refinements have been used (Melzak, 1975; Margolis, Tait, and Krause, 1986; Ransford, Cairns, & Mooney, 1976), all of these tasks refer to a simple line drawing of the front and back of a human figure. Subjects are typically asked to point to the location of the pain (Karoly & Jensen, 1987).

The sensory quality of pain has been assessed primarily through the McGill Pain Questionnaire (MPQ) (Melzak, 1975), which
is also commonly used to assess the affective quality of pain. The MPQ is a very interesting test, as it is composed of a series of 102 words selected to elicit meaningful self-descriptions of the sensory, affective, and evaluative quality of pain. Melzak has divided the words into 20 subclasses which can be analyzed numerically to produce a pain rating scale. The widespread use of the MPQ by members of all pain disciplines is a testament to its face validity, although it is currently undergoing tests of its clinical validity (Wolff, 1986).

The affective quality of pain is measured by the affective subscale of the MPQ, and also by Verbal Rating Scales (VRSs) (Tursky, Jamner, & Freeman, 1982). The Tursky et al. VRS presents a list of twelve words ranging from "Bearable," to "Unpleasant," to "Agonizing," and asks subjects to choose the affective word that best describes their pain. The specificity of these scales for measuring the affective component of pain has been demonstrated (Karoly & Jensen, 1987).

Measurement of the intensity of pain has been a central focus of laboratory pain research and clinical analgesic research for a number of years, dating from the time of von Frey, (1894). The two basic methods of determining pain intensity are through measurement of "involuntary evoked responses" in the autonomic nervous system (ANS), and through voluntary pain responses such as response to a questionnaire (Wolff, 1986). Traditional psychophysical approaches have resulted in a number of self-report scales designed to measure stimulus and sensation intensity. Although recent work has demonstrated that reports of pain intensity do not maintain a linear relationship with sensory intensity (Melzak, 1986), the use of scaling systems such as number anchored pain intensity scales is common (Borg, 1970; Tursky, Jamner, & Freeman, 1982). Like the scales measuring affective quality, the VRSs for pain intensity typically ask a subject or patient to choose a word from a list of words that describe a range of pain intensities.
Psychometric Status of Pain Measures.

In a recent review of pain measurement, Chapman and his associates (1985), characterized the progress of pain measurement as slow relative to the development in pain theory. A particular problem has been the utilization of measures which take a unidimensional approach to conceptualizing pain. Typically, these measures, focusing upon sensory stimuli only, have poor reliability across trials and poor validity as measured by response to treatment. In contrast, however, the McGill Pain Questionnaire (MPQ) was lauded for integrating current multidimensional theory. In addition, the MPQ was noted for the large number of studies which gave support for its reliability (Graham, Bond, Gerkousch, & Cook, 1980; Melzak, 1975), and validity in both laboratory and clinic settings (Byrne, et al., 1982; Reading, 1979; Reading, Everitt, and Sledmere, 1982). One limitation of the MPQ noted by Chapman et al. (1985), however, is that it may not be appropriate for individuals without a high school reading level, due to its vocabulary requirements.
Methods of Laboratory Pain Research

Turk and his associates (1983), in a review of pain induction procedures, list the five most common methods as: 1) cold-produced pain typically involving immersion in icy water (Lovallo, 1975); 2) radiant heat pain produced by focusing intense light on the skin (Hardy, Wolff, & Goodell, 1948); 3) pressure pain produced by an apparatus which exerts pressure on the skin over some bony surface (Scott & Barber, 1977); 4) electrically produced pain generated by electrical currents applied to the skin surface, and; 5) muscle-ischemic pain in which the typical method of pain induction is the application of pressure upon an arm's blood vessels by overinflating a blood pressure cuff. This method, combined with exercise in the cuffed arm, results in a decreased level of oxygenation in the arm muscles, and an increased level of exercise waste metabolites, including lactic acid. Essentially equivalent to the sensations of anaerobic pain, muscle-ischemia results in a gradually increasing, aching pain.

Of all these measures, the muscle ischemia procedure has become the most acceptable method among both pain researchers and clinicians. A history of laboratory pain measurement criticism (Wolff, 1986), notes that even Beecher, the most outspoken critic of the validity of laboratory pain procedures, has given support to the validity of the muscle ischemia procedure (Smith, Egbert, Markowitz, & Beecher, 1965). One reason for the greater acceptance of this procedure is that unlike the other procedures listed above, the muscle ischemia procedure lasts more than a few seconds, without creating tissue damage. In addition, the slow build-up of pain appears to more rigorously test any coping strategy being utilized by the subject.

Despite the aspects of the muscle ischemia technique that makes it more accepted by clinically oriented researchers, it shares some limitations that must be stressed in any discussion of the laboratory pain procedures. The elements of ecological validity, first raised by Beecher in the 1950's are all the more relevant in
the context of the gate control theory which emphasizes the interaction of psychological and physiological factors in pain. Pain patients may not know or understand the source of their pain. They may be concerned that the pain is a signal of some serious tissue damage or disease process. They may not be certain if the pain will ever stop. In the laboratory, these and other pain related psychological factors are not typically engaged. While laboratory pain procedures are a necessary and useful part of the work in understanding pain, laboratory pain research is necessarily limited. Despite improvements in methods (Wolff, 1986), it is best to remain cautious in interpreting the clinical significance of laboratory pain studies.

Association and Dissociation Research. The most concise statement concerning the state of laboratory pain research on the question of association and dissociation is that it doesn't exist. As is true of the cognitive coping strategies described in an earlier section, "all of the methods involve some sort of distraction" (Turk et al., 1983). The similarity should not be surprising, as the cognitive coping strategies were derived from laboratory work. This focus upon distraction appears to be based upon selected research which has found the effectiveness of distraction strategies for some pain (Barber, 1977). The absence of specific research on association and dissociation creates a situation in which all laboratory studies of cognitive coping strategies are really comparing distraction with distraction. Thus, it is not surprising that a thorough review of laboratory studies comparing cognitive strategies finds "equivocal results" in which no strategy is more effective than another (Turk et al., 1983).

In fact, reviews of clinical and laboratory research into purely dissociative cognitive strategies reach the same conclusion: no specific technique shows superiority, but the presence of maladaptive or catastrophic cognitions in a subject or patient predicts poor outcome for any strategy (Turk & Rudy, 1986). Advocates of the cognitive approach have argued that the key to
these results may not be the impotence of the strategies, but rather the methodological difficulty in controlling cognitions (Turk et al., 1983; Turk & Rudy, 1986). These authors argue that what may be happening is that subjects in control groups are using their own distraction techniques even they have been told not to. In addition, these authors stress that very few studies have monitored to see if subjects in the treatment group are using the strategies taught to them. There has, however, been no concern that the subjects in treatment groups may bring an associative strategy to treatment that is interfered with by the teaching of a dissociative approach.

The only controlled research focusing upon the association and dissociation question that is cited by clinically oriented pain researchers is the Pennebaker and Lightner (1980) study described above in the section on athletic pain studies with non-elites. As was already mentioned, this study attempted to create an "associative" environment by playing back to subjects an amplified version of their own breathing as they ran on a treadmill. The decreased performance of these subjects has been cited as evidence that paying attention to pain "typically exaggerates its aversiveness" (Chapman, 1986). The intuitive correctness of that statement to most pain researchers has allowed the remarkable absence of studies on this question to go unnoticed.

The methodological issues of the Pennebaker and Lightner (1980), study have also gone unnoticed. Is amplification of a subjects heavy breathing during exercise an associative procedure? Or might it lead to the catastrophic thoughts described as the most damaging to any cognitive strategy (Turk et al., 1983)? An analogous study might be to investigate which depressed subjects do better, those who try not to listen to their depressed cognitions, or those that listen to "amplified" versions of the thoughts (e.g. instead of, "oh boy, I think I'm doing poorly," hearing "oh my god, this is the worst job you've ever done, you stupid moron!"). The absence of questions about the logic of the
Pennebaker and Lightner "associative" manipulation is noteworthy, as is the absence of studies upon successful pain copers.

The fact that we have limited information on successful pain coping was made by Turk and his associates in the major text on the cognitive behavioral approach to pain (1983). In this same volume, the authors noted that there had been a recent emphasis upon those individuals who can successfully cope with stress and exhorted pain researchers to do the same. As will be emphasized in the next section, a paradigmatic behavioral view of pain acknowledges that the associative pain coping strategies of athletes may be useful for providing successful pain coping models. Rather than emphasize the differences between athletes and pain patients, the paradigmatic view emphasizes the common steps all individuals must take to learn pain personalities.

Prior to presenting a paradigmatic behavioral analysis of association and dissociation, it is important to ask whether formulating another theoretical view is a necessary or even useful endeavor. Specifically, the strengths and weaknesses of prior theories should be explored. This paper has discussed the operant and cognitive behavioral approaches to pain and pain treatment. A paradigmatic behavioral analysis is not intended to replace either theory. As will be stated below, one of the primary goals of a paradigmatic behavioral approach to theory building is to incorporate and specify strengths of other theories. A paradigmatic view of association and dissociation is useful because it draws upon the learning models of the operant approach, as well as the specific focus upon cognitions from the cognitive behavioral approach. Paradigmatic behaviorism developed in and has made continued contributions to both the behavior analytic and cognitive-behavioral approaches, beginning in the mid 1950's. It's development has always included and been part of both, as all the behavioral approaches are.

There are specific deficits in the other two theories, in regards to an analysis of association and dissociation, which create
a need for the paradigmatic behavioral approach. The operant approach's focus upon directly observable pain behaviors was fairly revolutionary when first introduced, and it's success as a treatment approach derives from its specific and limited focus. Unfortunately, however, association and dissociation are not directly observable phenomenon, and thus the operant approach does not specifically address this or other private aspects of pain. While the cognitive behavioral approach does specifically address cognitive aspects of pain, the approach has been characterized by a generally unitary strategy for analyzing and treating cognitive pain issues. Cognitive behaviorists have almost exclusively focused upon the teaching of dissociative distraction techniques as a method of coping with pain. As has been noted, associative pain strategies have generally been ignored by the cognitive behavioral approach. A paradigmatic behavioral analysis of association and dissociation is a useful means for drawing from the strengths of the operant and cognitive behavioral approaches, while also addressing the deficits of each.
VI. A PARADIGMATIC BEHAVIORAL ANALYSIS OF ASSOCIATION AND DISSOCIATION

The recent recognition of the importance of learning, affective, cognitive, and sensory factors in pain (Melzak & Wall, 1980), has revitalized the pain research area. Unfortunately, the revitalization seems to have occurred in separate areas with little integration of the research from one area to another. The gate control theory has stimulated interest in understanding the basic sensory pathways of nociceptive stimuli. Fordyce's successful application of operant principles to chronic pain has placed an emphasis on the learning of pain behaviors. The recent addition of the cognitive zeitgeist, in the form of cognitive-behavioral pain treatments, to the problem of pain has created a tremendous interest among health psychologists (Jamner & Schwartz, 1983). Despite these separate developments, there has been no successful attempt to integrate the different research areas. In addition, the role of affective factors in clinical pain has not been sufficiently addressed by either the operant or the cognitive treatment approaches.

In addition to the disintegration apparent in the basic research areas of pain, research in the extended areas of pain, such as athletic pain and laboratory pain research, has suffered from a lack of integration. One cause of the disunified state of research is the lack of an overarching theory to link the separate areas. Another is the tendency for new theories to emphasize singular and unique aspects of the theory rather than commonalities. This appears to be true of the two prominent pain treatment approaches, the operant and the cognitive-behavioral, which are presently expending a great deal of energy criticising the major aspects of the other's approach (Hardardottir, James, & Owen, 1988; Turk & Flor, 1987). Unfortunately, the state of pain research is simply a microcosm of the state of psychological research in general, which has been characterized by
Staats as a disunified science (Staats, 1981; 1983; 1988). While the disunity of the pain research area is a problem beyond the scope of the present study, the potential solution to that problem—utilizing an overarching, integrating theory—may be quite helpful as a means for uniting the apparently disparate results in the research area of dissociation and association in response to pain.

**Paradigmatic Behaviorism**

While a number of theories have attempted to be overarching, grand theories, most have been more concerned with supplanting old theories than incorporating them (Staats, 1981). A terrible waste of information and ideas has resulted, as trends, personalities, and elegant jargon dictate the rejection of the old. From its beginnings, Staats' paradigmatic behavioral theory has been more concerned with utilizing past theory and respecting historical developments than with carving out a singular theoretical niche. Thus, paradigmatic behaviorism (PB) has tried to integrate and unify psychological approaches rather than tear them down. It is in this spirit that Staats refers to PB as a fourth generation behaviorism, referring to the prior conceptualizations of other behaviorists. The specific history of PB as it relates to other behavioral approaches has been documented (Staats, 1981), and will not be repeated here. Instead, a brief summary of some key aspects of the theory will be presented, followed by a discussion of the utility of the theory for explaining the research in association and dissociation.

**Basic Principles of PB.** In traditional behavioral terms, PB combines both operant and classical conditioning models of learning, stating that both types of learning occur simultaneously and impact upon each other. Paradigmatic behaviorism is an interactional learning theory which emphasizes the reciprocal interplay between individuals and their environment. Another unique aspect of the theory among behavioral approaches is the specific incorporation of personality theory.
In PB, personality is considered both a product of behavior and environment as well as a cause of behavior. In addition, PB breaks down the elements of an individual's personality into subcomponents referred to as Basic Behavioral Repertoires (BBR's). The PB model of personality is essentially a tripartite one, consisting of BBR's in three areas, sensorimotor, language-cognitive, and emotional-motivational. Interestingly, these areas appear to overlap quite remarkably with the key areas of pain suggested by the gate control theory (Melzak & Wall, 1965). It is important to note that most complex human behaviors involve all three repertoires, although one repertoire may be more primary to the behavior.

The sensorimotor area has long been a study of learning theorists, with many laboratory studies of the acquisition of motor skills, for example. This area has not, however, been considered in personality terms. Staats emphasizes, however, that the acquisition of certain sensorimotor BBR's, such as aggressive BBR's can have a great impact upon future interactions with the environment and subsequent personality development (Staats, 1975; 1981).

The language-cognitive system is a complex set of BBR's which have recently become the focus of cognitive-behavioral theorists (Mahoney, 1977; Meichenbaum, 1977). In addition to the acquisition of language through operant learning functions, PB predicts that words and language can become classically conditioned to images, emotions, and behaviors. The repertoire of language and linked cognitions will have a critical impact upon personality (Staats, 1975). The learned affective value of language may play a key role in association and will be discussed further below.

The emotional-motivational system consists of BBR's elicited by conditioned emotional and motivational stimuli. These stimuli, classically conditioned in both a direct and vicarious manner (eg. through language), are most important for directing the individuals
behavior towards or away from further stimuli, thus affecting future personality development (Staats, 1981).

The interdependent quality of these three systems of BBR's is quite rich and complex. The utility of the PB framework for understanding clinical issues as diverse as abnormal behavior (Staats & Heiby, 1985), language behavior therapy (Hekmat & Vanian, 1977; Staats, 1972), and the treatment of chronic pain (Dietrich, Hekmat, & Schwieger, 1988). The latter study determined that a PB based language behavior therapy intervention for a population of elderly osteoarthritic patients significantly reduced self-reported pain levels and increased levels of functioning. Interestingly, the role of affective factors, emphasized by the PB framework, was shown to be the most critical dimension for this group of patients. In addition, building self-control and individualizing imagery procedures appeared to be a necessary component of the intervention.

While the general applications and heuristic potential of PB theory are well established, a specification of the role of the BBR's upon association and dissociation is helpful in understanding the utility of the PB model in explaining complex phenomenon such as the experience of pain. Therefore, the following tentative analysis of association and dissociation utilizes a PB framework as a means for understanding the apparently conflicting research findings presented above. This analysis will point to specific research questions which may provide initial tests of the utility of the PB model.

**PB Analysis of Association and Dissociation.** To understand the constants in the seemingly divergent literature on association and dissociation, one must first emphasize that a learning theory such as PB suggests that any analysis is aided by a deliniation of specific learning tasks. Thus, it is important to determine the learning that takes place in affecting whether an individual uses an associative or dissociative strategy when responding to hard effort and pain. By specifying learning tasks, we can understand
how one individual (eg. a non-athlete) learns to dissociate in response to pain, while another (eg. a competitive athlete), learns to associate to the same stimuli. By emphasizing a cross sectional approach, previous studies in association and dissociation have led to a focus upon differences. Using a learning theory such as PB, leads instead to a focus upon similar learning tasks which provide an opportunity for learning differences.

McCann (1988), proposed that the athlete's tasks in learning to associate to hard efforts and pain can be grouped into two main areas: 1) learning the meaning of pain stimuli, and; 2) learning fine differences in pain stimuli. Before describing the learning process of athletes, it is useful to contrast the contexts in which non-athletes and athletes learn. In the traditional, biomedical views of pain, and even in the more recent and complex definitions of pain discussed earlier, pain is seen as a symptom of damage, or at least as an unwanted phenomenon. Removal of the pain is the goal of most biomedically based treatments, either through analgesics, surgery, or bed-rest. Given this orientation, it is perhaps not surprising that only dissociative cognitive strategies are taught to pain patients (Turk et al., 1983), and it is also not surprising that clinicians have a difficult time understanding how an associative style might develop.

In elite endurance sports, in contrast to a bio-medical context, pain is a necessary means to achieve some goal (note however, that pain may also be a necessary part of some physical rehabilitation programs, for example). As was mentioned in an earlier section, the familiarity of elite endurance athletes with the hard efforts and anaerobic pain provides a great number of trials for learning and can produce a unique perspective on the meaning of pain. For elite endurance athletes, pain may be the norm, and may come to be associated with success. As Greg Lemond, the only
American cyclist ever to win the grueling month long Tour De France, describes it:

In pro cycling everything hurts, but you just ride through it... the best climbers are those ones who can stand the most pain (Avins, 1986).

PB theory is useful for describing the impact of these different views of pain upon the behaviors of both athletes and non-athletes. The theory suggests that these divergent pain meanings contribute to different pain personalities in the PB sense of personality.

It is important to emphasize that the elemental process of learning meanings for pain involves the same processes for both athlete and non-athlete populations. Both groups and all individuals, through a lifetime of exposure to nociceptive stimuli, learn idiosyncratic pain meanings. As will be deliniated below, all of the three major personality systems, sensorimotor, language-cognitive, and emotional-motivational, are involved in this process. It is suggested here that athletes learn, as exemplified by the quote by cyclist Greg Lemond, to link pain with success. This positive learning may result in greater pain tolerance.

While pain is rewarded with success in difficult sports such as bicycle racing and endurance running, pain is not rewarded indiscriminately. It is this pragmatic reality that emphasizes the importance of the second major task for athletes: the learning of fine discriminations of pain. Certain types of pain and certain levels of pain are rewarded, and others are not. Physiological analyses of endurance sports demonstrate that there are different optimum efforts for endurance tasks of different lengths (Bradley et al., 1985). In longer events, giving too great an effort too early (with a concomitant increase in nociceptive stimuli), will result in using too much of a body's resources and can lead to a poor performance (Van Handel, 1986; Silva, 1988). The different effects of various levels of effort result in different learning opportunities.
Extra effort and greater levels of nociceptive stimuli may be rewarded in the short term by an early lead and the positive affective state which may occur for the athlete who leads a competition, but the long term effects of the effort are negative. An athlete who moderates her effort, resulting in slightly lower levels of nociceptive stimuli, may experience greater success in competition.

It is obvious that an awareness of nociceptive stimuli can therefore be useful for athletes. McCann (1989), has referred to the monitoring of these stimuli as an athletes' self-generated biofeedback system. Having learned a more positive meaning for pain, the athlete's first task, enables greater pain tolerance. To ultimately succeed, however, the athlete must refine her level of nociception and effort. In order to do this, an athlete must pay close attention, or associate to the nociceptive stimuli. In addition, PB theory would predict that the greater the effort expended (with a greater likelihood of exceeding her anaerobic threshold) the greater the need for close attention to effort. Thus the athlete is exposed to a learning context in which association is rewarded.

Examples of BBR's in Association and Dissociation. As has been stated numerous times throughout this paper, the current view of pain emphasizes its complexity. The same is true for the learning processes involved in developing associative and dissociative styles. Utilizing some examples from PB theory, however, one can begin to develop an understanding of how BBR's underlying the two learning tasks described above might differentially affect the learning of an individual pain personality.

The sensorimotor system is an essential element of an individual's pain personality. Before an individual can learn to successfully cope with nociceptive stimuli, the individual must learn a sensorimotor BBR that produces and maintains these stimuli. In the case of athletes, maintaining a hard enough pace to approach the anaerobic threshold is a basic sensorimotor skill BBR. In experimental pain research, a subject may need specific
sensorimotor skills such as the ability to hold one's arm in ice water, before a coping strategy can be taught. A patient recovering from back surgery must be able to get out of bed and overcome initial pain in order to exercise atrophied muscles necessary for recovery. An individual who has, alternatively, developed escape or avoidance behaviors such as withdrawal may not have an opportunity to experience certain types of learning situations. Interestingly, fear of initial pain and avoidance of pain appears to be a major problem for some chronic pain patients (Fordyce, 1988).

The impact of the BBR's in the emotional-motivational system are directly related to the potential for learning associative or dissociative styles. The PB view of personality suggests that if nociceptive stimuli or stimuli which accompany pain are conditioned to specific emotions, then they will have a powerful impact upon the motivational value of the situation. The importance of affect in pain has been emphasized by the gate control theory, but no treatment approach has dealt sufficiently with this factor. The recurring finding that anxiety is correlated with lowered pain tolerance (Sternbach, 1986), is an example of a specific BBR that can be modified to affect the pain situation. The detrimental impact of anxiety upon the ability of an athlete to compete in painful situations has also been demonstrated (McCann & Murphy, 1988).

The language-cognitive system has been investigated extensively by recent cognitive-behavioral approaches to pain, and a recurring finding is that catastrophic thoughts lead to lowered pain tolerance (Turk & Rudy, 1986). Interestingly, there has been no consideration of the role of the cognitive approach of association on pain tolerance. For example, if an individual is relying upon a distraction technique, might he be more likely to have catastrophic thoughts if the nociceptive stimuli can not be dissociated from? This question has relevance when one considers that distraction techniques may be most useful for only mild pain (McCaul & Mallot, 1984). A PB
approach to understanding association and dissociation suggests that the next step in understanding the phenomenon is to begin to investigate the tendency for non-athletes to associate or dissociate in response to pain. Once information is gathered from non-athletes, we can begin to formulate a general model of association and dissociation for all populations. In addition, this information will help determine the feasibility of developing BBR's underlying an associative style in a non-athlete population.
Rationale For The Proposed Study

As the review of the literature of association and dissociation shows, there are a number of questions concerning the usefulness of dissociation as a strategy for increasing pain tolerance. Unfortunately, however, it appears that, in the case of applied pain management, the basic questions have been superseded by basic assumptions. The situation in the field of psychological pain management is summarized by the primary reference in the field (Turk et al., 1983), which states that:

"all of the cognitive strategies...involve some sort of distraction. This is not surprising; a widely reported phenomenon is that distraction or withdrawal of attention from a painful stimulus can increase pain tolerance." (Turk et al., 1983, p.90).

While the authors are correct to point out the research supporting dissociation as a strategy, they make no reference to the literature with athletes showing the usefulness of an associative strategy. The cognitive behavioral model of cognitive coping strategies is unitary, with little recognition of the potential for the individual differences predicted by a paradigmatic behavioral model. Turk and his associates should not be singled out, however. Despite two reviews, subsequent Turk et al.'s 1983 book, which show that a distraction strategy may only be useful with mild forms of pain (Turner & Clancy, 1984; McCaul & Mallot, 1984), this author has found not a single reference to the athlete association/dissociation literature in his review of the literature in the area of psychological pain treatments. Why?

There are probably a number of answers to the question. One answer is the general tendency of psychology today to follow narrow paths of research without integrating even closely related areas of knowledge (Staats, 1981). A second answer is the newness of the field of clinical sport psychology. Challenges
presented to clinical sport psychologists simply have not existed for clinicians working with non-athlete populations (McCann, 1988; McCann & Murphy, 1989), and these challenges have required new questions with occasionally surprising answers. The finding that highly successful athletes use associative strategies in dealing with pain is one of those surprises that challenges traditional approaches to pain. The fact that these traditional approaches have been in the service of a medical model is the third answer to the lack of integration of literature. There has been an extensive history of pain treatment which relies upon removal of pain, and the multi-million dollar analgesic industry fosters a traditional view of pain in which dissociation becomes a common-sense assumption.

It is the contention of this study that this assumption needs to be tested. Research evidence exists that suggests that highly successful athletes perform better in painful situations by focusing upon the pain (Schomer, 1987; Silva & Applebaum, in press). Further evidence exists that as an athlete's effort increases, so does his or her tendency to use an associative strategy (McCann & Murphy, 1988). In traditional clinical settings, however, when a patient's pain increases, the response by the medical model has been to increase amounts of analgesic medications.

In the more recent case of psychological pain management, the referral request typically asks for instruction in methods of distraction. If it is true that patients, like athletes, increase their associative strategies as pain increases, then the failure of distraction as a method for coping with intense pain is understandable. If individuals have a general tendency to increase association to increasing effort or pain, then we may be doing exactly the wrong thing by teaching distraction.

Before we can begin to resolve these clinical issues, we need to ask the basic research question: do non-athletes use the same strategies as athletes? If the answer is positive, we need to rethink psychology's role in teaching cognitive pain management...
strategies. If we find that athletes and non-athletes cope differently with pain, we should begin to investigate how athletes have learned an alternative strategy and determine its usefulness as an approach for non-athletes.

In any case, the basic question, whether non-athletes and athletes demonstrate the same tendency to increase association as effort and pain increases, needs to be asked. This study proposes a first step in answering that question, by comparing the responses of non-athletes to athletes on an ergometer ride task requiring increasing effort and pain.

In addition, the study will begin to investigate association and dissociation patterns in a range of other pain experiences, by using an exploratory Pain History Questionnaire (PHQ). This self-report questionnaire will allow for retrospective comparisons of the cognitive coping strategies of common "minor" pain experiences and major "worst" pain experiences.

Hypotheses and Expected Findings

The first hypotheses deal with expected results with the pain history questionnaire (PHQ). A paradigmatic behavioral view of pain suggests that certain sensory, affective, and cognitive approaches to pain may result from different exposures to different learning situations, and that these approaches will become relatively stable over time. Hypothesis I refers to the association/dissociation dimension measured by the PHQ. Based upon and extending recent research with elite athletes, Hypothesis I predicted that all subjects would show a history of increasing association as their ratings of pain increase. In other words, Hypothesis I predicted that subjects would have greater pain ratings for their worst remembered pain relative to their minor remembered pain, and that subjects would report having used more association with their worst pain than with their minor pain.

Hypothesis II focuses upon the relationship of these historical pain experiences, as measured by the PHQ, to a current pain
experience, the ergometer ride. Hypothesis II predicted that, for all subjects, history of pain coping strategies and sensory, affective, and cognitive evaluations of pain as measured by the PHQ, would be positively correlated with similar evaluations of pain on the ergometer ride. In addition, the hypothesis predicted pain coping strategies for the PHQ pain experiences would be correlated with pain coping strategies for the ergometer ride. Thus, the hypothesis predicted positive correlations between the Association and Dissociation scores (A/D scores) for the PHQ pain experiences, and A/D scores for the ergometer ride.

Hypotheses III explores the potential for group differences in association and dissociation, and relates to the ergometer ride portion of the study. Hypothesis III states that during the ergometer ride, competitive athletes would show greater absolute levels of association, pain ratings, and perceived exertion than non-athletes. This hypothesis is based upon a PB analysis of association and dissociation which emphasizes the potential for individual differences in pain personalities due to the impact of individual learning histories. In particular, the learning history of endurance athletes is hypothesized to be compatible with a tendency for greater association in response to pain.

Hypothesis IV is based upon recent research on association and dissociation with elite and non-elite athletes. This research suggests that despite the different learning histories of athletes and non-athletes, and despite predicted differences in absolute levels of association to pain predicted by Hypothesis III, individuals may generally show a tendency to increase association as effort and pain increase. Thus, Hypothesis IV predicted that all subjects would show a trend towards greater association as effort and pain increase during the ergometer ride.
Subjects
Subjects for the study were drawn from two populations, competitive endurance athletes, and non-competitive but healthy college students. For the purposes of the study, non-competitive was operationalized as meaning that the subject had not competed in an endurance sport competition in the last year. Competitive was operationalized as having participated in an endurance sport competition within the last year. Both groups contained both males and females, as previous research has shown no significant differences between male and female subjects on measures of association and dissociation (Okwumbua et al., 1983; Schomer, 1987). The competitive athlete group consisted of 15 subjects (8 females, 7 males), and the non-athlete group consisted of 28 subjects (19 females, 9 males), for a total number of 43 subjects. See Table 1 for further description of the subjects.

Measures
Psychological measures for the study included a pre-test recruiting packet including: 1) an informed consent form; 2) a demographic and competition history questionnaire; 3) A health screening inventory, and; 4) a pain history questionnaire (PHQ).

The pain history questionnaire is an exploratory measure devised by the author, which attempts to collect information on an individuals' learning history of pain. The questionnaire asked subjects to recall two separate pain experiences, their worst pain experience and a minor pain experience. For each experience, the subjects were asked to rate the pain using the short form of the McGill Pain Questionnaire (MPQ) (See appendix A), and to rate their cognitive coping style in response to the two pain experiences using an association/dissociation measure.
At the time of the ergometer ride, other measures collected were: 6) two presentations of Borg's Rating of Perceived Exertion Scale (RPE) (Borg, 1970); 7) an Association/Dissociation scale, and; 8) the short form of the McGill Pain Questionnaire (Melzak, 1987).

In addition to the psychometric measures listed above, which were variables in the study's four major hypotheses, two other psychological measures were presented to all subjects, but will not be discussed in the context of the study's hypotheses, as they were post-hoc exploratory additions to the study. The two measures were the trait form of the Spielberger Trait/State Anxiety Inventory (Spielberger, Gorsuch, & Lushene 1970) (STAI), and the Competitive State Anxiety Inventory-2 (CSAI-2), a multidimensional measure of pre-performance anxiety (Martens, Burton, Vealey, Bump, & Smith, 1983). A table of the relationship of these measures to the study's primary measures is presented in Appendix C.

Psychometric Status of the Measures. Two of the psychological measures are exploratory. The Pain History Questionnaire (PHQ), was conceived as a method for exploring the learning processes in pain predicted by both gate control theory and a paradigmatic behavioral view of association and dissociation. The PHQ asks the subjects to recall two specific pain experiences, a minor pain experience and a worst pain experience, and to recall the sensory, affective, and cognitive aspects of these experiences using the short form of the MPQ (Melzak, 1987). In addition, the PHQ asks subjects to recall their levels of association and dissociation for the two pain experiences.

While a number of researchers have expressed the importance and impact of pain experiences upon laboratory and clinical pain, the author is unaware of any measure for assessing pain history. The PHQ is an exploratory attempt to investigate this area, but there are a number of psychometric obstacles to overcome. One question is the reliability of this scale. The test-retest reliability of this measure for college students was established prior to the main
process of data collection through the administration of the scale at a one week test-retest interval to an undergraduate class at the University of Hawaii (N=21), with a mean test-retest item reliability of r=.84 (median reliability was r=.88).

A more difficult question is the validity of the retrospective self-reports. Although a large part of the questionnaire is the retrospective use of the MPQ, a measure with quite strong reliability and validity (For further discussion of the MPQ, see below), it is uncertain how the temporal delay between the pain experience and the completion of the PHQ will effect scores. While a study by Hunter et al. (1979) found high consistency of retrospective MPQ scores over three different time periods, the periods between pain experience and recall in the current study are generally much longer than in the Hunter et al. study.

The second exploratory measure in the proposed study is the association/dissociation (A/D) scale used in both the PHQ and for the ergometer ride. While the proposed scale is closely based upon scales already utilized in the literature with athletes (McCann & Murphy, 1988; Silva & Applebaum, 1989), and which have demonstrated good reliabilities (test-retest reliability for the Silva & Applebaum scale is, r=.73) (Silva & Applebaum, 1989), these measures have not been previously used with non-athletes.

The other measures in the study have a history of use in a number of clinical and laboratory studies. With a focus upon the clinical predictive validity of the McGill Pain Questionnaire (Melzak, 1975; 1987) the scale has been described as psychometrically "impressive" (Chapman, Casey, Dubner, Foley, Gracely, & Reading, 1985) and has been recognized as the most universally used measure of pain (Chapman et al., 1985; Reading, 1984). Specifically, reports of test-retest reliability for the MPQ with patient populations range from 75% (Graham, Bond, Gerkousch, & Cook), to 70% (Melzak, 1975). Karoly & Jensen (1987), however, state that "estimates of the stability and internal consistency of the subscales have not been provided" (p. 52),
although these authors state that the confirmed utility of the MPQ in clinical and experimental settings recommend it as the first choice of pain measures. (Karoly & Jensen, 1987).

It appears that Part of the success of the MPQ is its easy application, its utility in both clinic and laboratory, and its utilization of a multidimensional model of pain. The MPQ yields measures of the affective, sensory, and cognitive/evaluative components of pain. The MPQ short-form (Melzak, 1987), utilized in the present study, has high correlations with the standard MPQ on all dimensions, when rating musculoskeletal pain (r = .67 [sensory dimension], r = .70 [affective dimension], r = .93 [total evaluative dimension]) (Melzak, 1987).

The RPE (Borg, 1970) has been used in a number of studies of motor performance and exercise physiology (Borg & Noble, 1974; Winborn, Myers, & Mulling, 1988) and has been shown to have good reliabilities (Borg, 1970), and validity as a measure of physical exertion (Bar-Or et al., 1972; Milhevic, 1981).

Physiological Measures

While the study was primarily focused upon self-report measures describing "private" phenomena not directly observable, the ergometer ride portion of the study allowed for additions to the self-report measures. The physiological measures collected during the ergometer ride were a means for attempting to provide concurrent support for the contention that the subjects were exerting themselves significantly during the ride. Non-psychological measures recorded during the ergometer ride included heart rate at one minute intervals during the ride, peripheral blood lactate levels immediately following the ergometer ride, and overall time on the ergometer.

Heart rate, which is strongly correlated with levels of exertion (McArdle, Katch, & Katch, 1986), was monitored constantly throughout each subject's ride by means of a UNIQ C.I.C. "Pro/Trainer," radio telemetry heart rate monitor, with a strap-on
electrode belt and heartbeat transmitter, and a separate digital display receiver. The heart rate monitor was placed on each subject following the subject's completion of the initial psychometric measures.

Blood lactate levels have been found to rise during progressive exercise and are strongly correlated with measures of endurance performance (Williams, Armstrong, & Kirby, 1990), and in addition, the rise in blood lactate levels has been seen as a marker of an individual's anaerobic threshold (Wasserman et al., 1973). As was described earlier, the increase in lactic acid in the blood is generally described as quite painful (Wolff, 1986). In order to determine blood lactate levels, one minute after completing the ergometer ride, a capillary blood sample was drawn from each subject using a sterilized fingertip pricking device and was placed in a heparinized capillary tube. These samples were quickly prepared with lysing solution and then analyzed by means of a blood lactate analyzer.

Time on the ergometer was determined by means of the stop watch function on the heart rate monitor. The timing began at the point when the subject indicated he or she was ready and reached ninety revolutions per minute, and ended when the subject could either no longer maintain the cadence, or when the subject had been warned two times due to a slow cadence. Adherence to the proper cadence was determined by means of a metronome observed by the experimenter.

Procedures

Recruitment. Subjects for the study were recruited from psychology classes at the University of Hawaii, in return for extra credit bonuses in their classes, and from organizational meetings of local endurance athletic teams. A majority of the non-athlete group came from the psychology class sample, and a majority of the athlete group came from the local endurance team meetings, although there were a number of individuals from the psychology
classes sample in the competitive athlete group. It is important to note that the recruitment from two different sources may have resulted in differential levels of motivation for participating in the study.

**Collecting Measures.** The procedure for all subjects, regardless of group membership, involved two measurement collection stages. At the time of recruitment, all subjects were asked to fill out a pre-test packet consisting of an informed consent form, a health screening inventory, a demographic and pain history questionnaire, the STAI, and a competition history questionnaire. At this time, an appointment was made with subjects for the ergometer ride portion of the experiment, and directions were given to the exercise physiology lab where the ergometer ride took place.

**Ergometer Ride.** The final contact with subjects was at the time of the ergometer ride, and it took place in the exercise physiology laboratory at the University of Hawaii's Aquatic Research Center. At this time, a scripted monologue was read by the experimenter in order to gain greater control of the verbal messages given to all subjects. This monologue was written to: 1) give a general description of the task (ie. the ergometer ride); 2) Inform the subject that psychological measures will be given before, during, and after the ride, and briefly describe the measures; 3) Inform the subject that non-psychological measurement would also take place, and describing the measures including radio telemetry monitoring of heartbeat and blood lactate levels by using a fingertip pricking device. 4) Inform the subject that he or she could stop at any point, including before or during the ride 5) Explicitly state that the experiment was not interested in the performance of any subject versus another, or even in performance at all. It stated that the experiment asks you to try and do your best, whatever that might be, and; 6) Inform the subjects again that the ride will require heavy exercise levels, and
again allow subjects to leave if they do not wish to participate further.

Despite the attempt to control stimuli presented prior to and during the ergometer ride, a number of elements were not well controlled, partially due to physical space limitations. The laboratory is a large open space, without a separate waiting or warm-up room. The rides were generally scheduled so that only one rider would be present at a time, but many subjects arrived early or late and requested to warm-up on another ergometer while waiting for their ergometer ride. In addition, many individuals had overlapping times while filling out the pre-ride and post-ride psychometric materials. Therefore, a number of subjects were able to see another subject's ride. It is difficult to determine the exact effects of this exposure, but based on comments by subjects, it appeared to foster competitive urges in some. Unfortunately, methodological controls for this exposure were not instituted, and it is uncertain how many subjects were potentially affected.

Following the initial introduction to the tasks, the subjects were given the CSAI-2 competitive state anxiety measure and were introduced to the BPE and told that they would be asked to rate their efforts on the scale at an early point in the ride. After completing the CSAI-2, the subjects strapped on the radio telemetry heart rate monitor and were fitted to the ergometer. Following a warm-up period, the ergometer ride began, with another verbal reminder of the procedure, the fact that time spent on the ergometer is not important to the experiment, and that they could stop participation at any time during the ride (see Appendix A).

The ergometer ride followed the procedure of an earlier study (McCann & Murphy, 1988a), in which the subject's task is to maintain a pedalling pace of ninety revolutions per minute for as long as he or she can. The initial resistance level for the ergometer is based upon a formula derived from the subjects height and
weight to simulate resistance encountered in road riding developed at the United States Olympic Training Center (Kearney, 1988).

Following one minute of riding, all subjects were presented with a BPE and asked to rate their efforts at that moment, in order to establish a baseline level of exertion. The subject's heart rate was monitored continually throughout the ride by means of a radio telemetry heart rate monitor, and was recorded by the experimenter at one minute intervals. There were no difficulties encountered in monitoring heart rate.

Every three minutes, the resistance on the ergometer was raised at a fixed proportion of the riders initial level (as per Kearny, 1988). At this three minute mark, the experimenter issued a standard verbal reinforcement to all subjects (see Appendix A). All other verbalizations, exhortations, or comments, were kept to a minimum by the experimenter, as these interactions have been shown to effect performance on the ergometer (McCann & Murphy, 1988b). If the subject's pace fell below ninety rpm's, he or she was warned once. No rider attempted to continue after a second warning, and nearly every rider stopped quite abruptly, apparently due to fatigue.

Immediately following completion of the timed portion of the ride, while still seated on the ergometer, the subjects were asked to rate their final level of effort on the BPE scale. One minute after finishing the timed portion of the ergometer ride, blood was drawn from the fingertip of each subject for blood lactate analysis. Due to both experimenter error and mechanical difficulties in the blood lactate analyzer, a number of subjects' blood lactate levels were unable to be accurately determined. Despite this, all subjects had fairly identical experiences of blood being drawn for analysis.

Immediately following a brief cool down period on the ergometer, the subjects were asked to fill out the final questionnaire consisting of the association/dissociation scale and the short form of the McGill Pain Questionnaire.
IX. RESULTS

Description of the subjects

Forty-eight subjects completed the first, questionnaire portion of the study, and forty-three completed the entire study including the ergometer ride. Of the five subjects who did not complete the study, three had scheduling conflicts, and two were screened out after reporting recent injuries on the medical screening form. Only those subjects who completed both parts of the study were included in the data analyses. Prior to direct investigation of the main hypotheses, descriptive statistics for the all subjects were performed. The means and frequencies for the demographic variables are presented in Table 1. As is shown in the table, the overall sample of subjects can be described as generally young (mean age= 24.6 years, S.D.= 6.5 years), female (67% female, 33% male), single (74% unmarried), well educated (98% with at least one year of college education), and primarily Caucasian-American or Japanese-American (76% of the sample). In addition, as shown in Table 1, a large majority of the subjects (88%) had a history of competing in a sport sometime in their lives.

In addition to the overall group descriptive statistics, the same variables were assessed following division of the sample into athlete or non-athlete groups (as described above, Athlete was operationalized as having competed in an endurance sport competition in the past year). Following division into groups, analyses were performed in order to determine if the groups differed upon the demographic variables (T-test comparisons were made for mean age, and chi square analyses were made for gender, marital status, educational history, and ethnicity). These analyses revealed no significant differences between the athlete and non-athlete groups in age, gender, education, or ethnic composition. (See Table 2.)
Table 1. *Descriptive Demographic Statistics For the Overall Sample (N=43)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample Means and Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>$M = 24.6$ years, $S.D. = 6.5$ years</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>67% Female</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td>74% Single</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td>44% Caucasian-American</td>
</tr>
<tr>
<td><strong>History of Ever Competing in A Sport</strong></td>
<td>88% Had Competed 12% Had Not Competed</td>
</tr>
</tbody>
</table>
Table 2. Demographic Descriptive Statistics By Athlete and Non-Athlete Groups, With Significance Tests For Differences Between Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Descriptive Statistics</th>
<th>Difference Tests</th>
<th>Alpha Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athlete Group</td>
<td>M=25.1</td>
<td>SD=4.6</td>
<td>p=.69 a</td>
</tr>
<tr>
<td>Non-Athlete Group</td>
<td>M=24.3</td>
<td>SD=7.3</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athlete Group</td>
<td>53% Female</td>
<td>47% Male</td>
<td>p=.148 b</td>
</tr>
<tr>
<td>Non-Athlete Group</td>
<td>75% Female</td>
<td>25% Female</td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athlete Group</td>
<td>73% Single</td>
<td>27% Married</td>
<td>p=.69 b</td>
</tr>
<tr>
<td>Non-Athlete Group</td>
<td>75% Single</td>
<td>18% Married</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athlete Group</td>
<td>73% Ca-Am, 7% J-Am, 21% Other</td>
<td>p=.11 b</td>
<td></td>
</tr>
<tr>
<td>Non-Athlete Group</td>
<td>46% J-Am, 29% Ca-Am, 14% Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* a T-test for comparison of means
* b Chi-Square analyses
**Pain History Questionnaire**

In addition to the measurement of associative and dissociative pain strategies, the Pain History Questionnaire had three primary components: a) the subjects were asked to describe the location and cause of both minor and worst pain experiences.; b) the subjects were also asked to estimate when each pain experience occurred and the duration of each pain experience, and finally; c) the subjects were asked to rate each of the pain experiences using the sensory, affective, and cognitive scales of the McGill Pain Questionnaire (MPQ). This information is helpful in understanding the qualitative and quantitative similarities and differences between the minor and worst pain experiences.

Although the subjects' responses to questions concerning pain location and cause of pain were not specific foci of the current study, the author attempted to summarize the open-ended data in order to give a qualitative sense of the responses. As these grouping summaries were not intended for use in data analyses, there was no check for the reliability of the categories. Given these limitations, the summaries for perceived location and cause of the pain experiences are presented in Tables 3 and 4, respectively. As Table 3 shows, the two most common body locations reported for the minor pain experience were "muscles" (23%), and "skin" (16%), while the two most common body locations for the worst pain experience were "bones" (19%) and "viscera" (19%). As shown in Table 4, in both the minor and worst pain experiences, the two most frequent causes for the pain were overuse/exertion, and trauma, although the high percentage of subjects who cited trauma as the source of the worst pain (47%) is especially noteworthy.

There were also notable differences in the temporal qualities of the two pain experiences: how long since each pain experience occurred, and how long each pain experience lasted. The minor pain experiences were generally much more recent than the worst
Table 3. Pain History Questionnaire:
Location of Minor Pain and Worst Pain

<table>
<thead>
<tr>
<th>Location of Minor Pain</th>
<th>Location of Worst Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>23% Muscular Tissue</td>
<td>19% Bone Tissue</td>
</tr>
<tr>
<td>16% Skin Tissue</td>
<td>19% Viscera</td>
</tr>
<tr>
<td>14% Digestive Tract</td>
<td>16% Muscular Tissue</td>
</tr>
<tr>
<td>14% Combination Soft &amp; Hard Tissue</td>
<td>16% Combination Soft &amp; Hard Tissue</td>
</tr>
<tr>
<td>12% Head</td>
<td>12% Soft Tissue</td>
</tr>
<tr>
<td>9% Soft Tissue</td>
<td>7% Skin</td>
</tr>
<tr>
<td>5% Bones</td>
<td>5% Digestive Tract</td>
</tr>
<tr>
<td>5% Viscera</td>
<td>5% All Over</td>
</tr>
</tbody>
</table>
Table 4. Pain History Questionnaire:  
Perceived Cause of Minor Pain and Worst Pain

<table>
<thead>
<tr>
<th>Cause of Minor Pain</th>
<th>Cause of Worst Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>28% Overuse/Exertion</td>
<td>47% Trauma</td>
</tr>
<tr>
<td>26% Trauma</td>
<td>14% Overuse/Exertion</td>
</tr>
<tr>
<td>12% Burn</td>
<td>7% Childbirth</td>
</tr>
<tr>
<td>12% Toxins</td>
<td>7% Surgery</td>
</tr>
<tr>
<td>5% Sickness/Disease</td>
<td>7% Sickness Disease</td>
</tr>
<tr>
<td>16% Other/Undetermined</td>
<td>5% Toxins</td>
</tr>
<tr>
<td></td>
<td>10% Other/Undetermined</td>
</tr>
</tbody>
</table>
pain experiences, with the mean time since the minor pain experiences at 1.5 months and the mean time since the worst pain experiences at 57 months (t=9.99, DF=40, p<001). Table 5 presents the duration of each of the pain experiences, with a higher percentage of the worst pain experiences lasting over 24 hours (X² =41.7, DF=30, p<.10).

Mean scores on the McGill Pain Questionnaire subscales for the two pain experiences are presented in Table 6. If the two experiences had truly different levels of pain, one would expect significantly different MPQ scores on each of the MPQ subscales. This did occur, as shown in the table. There were higher scores for the worst pain experience than for the minor pain experience, on all of the MPQ subscales. Paired samples t-tests revealed significant differences on the Sensory Scale (t=6.8, df=41, p<.001), Affective Scale (t=5.2, df=41, p<.001), and the cognitive Evaluative Scale (t=7.1,df=41, p<.001).

In summary, qualitative and quantatative results for the Pain History Questionnaire, (PHQ) a self-report measure designed for this study to sample two distinct historical pain experiences for each of the subjects, appear to support the contention that the subjects were able to recall and describe two different and distinct pain experiences. The Minor Pain Experiences can be characterized as occurring fairly recently, having a shorter duration, and resulting in lower pain levels as measured by the Sensory, Affective, and Evaluative Subscales of the MPQ. The Worst Pain Experiences generally took place longer ago, lasted longer when they did take place, and produced significantly different levels of pain as measured by the MPQ.

While these differences give support for the construct validity of the PHQ, and support its use for further data analyses, it should be stressed that the reliability of the measure in its current use is unknown. In addition, the current study's structure does not permit criterion-related validity of the retrospective pain histories.
Table 5. Pain History Questionnaire:
Duration of Minor and Worst Pain Experiences

<table>
<thead>
<tr>
<th>Duration of Minor Pain</th>
<th>Duration of Worst Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>28% Greater than 24 hours</td>
<td>60% Greater than 24 hours</td>
</tr>
<tr>
<td>9% Less than 24 hours</td>
<td>5% Less than 24 hours</td>
</tr>
<tr>
<td>14% Less than 12 hours</td>
<td>12% Less than 12 hours</td>
</tr>
<tr>
<td>14% Less than 2 hours</td>
<td>5% Less than 2 hours</td>
</tr>
<tr>
<td>21% Less than 30 minutes</td>
<td>12% Less than 30 minutes</td>
</tr>
<tr>
<td>12% Less than 10 minutes</td>
<td>5% Less than 10 minutes</td>
</tr>
<tr>
<td>MPQ Subscale</td>
<td>Minor Pain Score</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Sensory Scale a</td>
<td>M=7.2, SD=5.0</td>
</tr>
<tr>
<td>Affective Scale b</td>
<td>M=1.0, SD=1.8</td>
</tr>
<tr>
<td>Total Rating Scale c</td>
<td>M=8.2, SD=5.8</td>
</tr>
</tbody>
</table>

a Sensory Scale scores may range from 0-33  
b Affective Scale scores may range from 0-12  
c Total Rating (Evaluative) Scale scores may range from 0-45  

***p<.001
Hypothesis 1

Hypotheses 1 and 2 made predictions for all subjects, across group membership, and thus all data analyses involved all 43 subjects. Hypothesis 1 predicted that cognitive pain coping strategies of association and dissociation would vary between minor pain experiences and worst pain experiences. Specifically, based on recent research in Sport Psychology, Hypothesis 1 predicted that subjects would report greater association to the body during worst pain experiences than during minor pain experiences. Operationally, this means that higher scores on the PHQ association/ dissociation (A/D) scales would be expected for the worst pain experience. This, in fact, did occur. A paired samples t-test on the PHQ A/D scores resulted in t=5.4 (df=41, p<.001), with significantly more associative pain coping reported for the worst pain experience than was reported for the minor pain experience, supporting the hypothesized difference. Thus, it appears that paying attention to one's body during a painful experience is significantly increased as pain levels increase.

Hypothesis 2

The Ergometer Ride

Hypothesis 2 addressed the relationship of the PHQ subscales (MPQ scores and A/D scores) to the MPQ scores and A/D scores for the ergometer ride. As was discussed earlier, a paradigmatic behavioral conception of pain and pain coping suggests that certain pain "repertoires" or pain behaviors may develop and become fairly stable over time. Based upon this conception, Hypothesis 2 predicts that the previous assessments of pain and responses to pain, as described by the PHQ, will be positively correlated with current assessments of and responses to the ergometer ride. Before investigating this relationship, descriptive statistics for measures collected at the ergometer ride are presented in Table 7.

As the table shows, the average ergometer ride lasted 373 seconds, or 6.2 minutes (s.d.= 167 seconds). The average heart rate
Table 7. **Ergometer Ride:**

Mean Scores and Standard Deviations For All Subjects (N=43) on
Psychometric and Non-Psychometric Measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Score</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Psychometric Measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of Ergometer Ride seconds</td>
<td>M=373 seconds</td>
<td>SD=167</td>
</tr>
<tr>
<td></td>
<td>(6.2 minutes)</td>
<td></td>
</tr>
<tr>
<td>Two Minute Heart Rate</td>
<td>M=142.9 bpm</td>
<td>SD=18.5 bpm</td>
</tr>
<tr>
<td>Maximum Heart Rate&lt;a</td>
<td>M=179.1 bpm</td>
<td>SD=12.5 bpm</td>
</tr>
<tr>
<td>Blood Lactate Levels&lt;a</td>
<td>M=4.5 mM/l</td>
<td>SD=2.2 mM/l</td>
</tr>
<tr>
<td><strong>Psychometric Measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borg Perceived Exertion Scale (RPE) b, at 1 minute</td>
<td>M=10.5</td>
<td>SD=1.9</td>
</tr>
<tr>
<td>RPE score at End of Ergometer Protocol</td>
<td>M=16.0</td>
<td>SD=3.8</td>
</tr>
</tbody>
</table>

*a*see text for details on mean hr and blood lactate levels

*b*RPE scores may range from 6-20
at two minutes into the ride was 142.9 beats per minute (s.d.= 18.5 bpm), and reached an average maximum of 179.1 bpm (s.d= 12.5) by the end of the ergometer ride. This heart rate is indicative of considerable effort, as it falls in the range of maximum heart rate for healthy adults of the sample's age during a maximal stress test (175-200 bpm) (Wolthuis, Froelicher, Fischer, & Triebwasser, 1977).

Blood lactate levels, which rise as the intensity of aerobic increases and individuals approach or exceed their anaerobic threshold, averaged 4.5 mM/l of blood (s.d. = 2.2) when measured one minute following the ergometer ride. As a point of reference, Iwaoka et al. (1988), found that non-elite but trained adults produced a blood lactate level of 4 mM/l, at 84% of their maximal effort using a three minute exercise protocol, and Yoshida (1984), found that a 4 mM/l level was found at 77% of maximal aerobic capacity in untrained adult males. Thus, while blood lactate levels are but one measure of performance and effort, the mean blood lactate levels for subjects in the current study are in a range which suggests the subjects gave considerable efforts and had reached the point of onset of blood lactic acid accumulation (Williams, Armstrong, & Kirby, 1990).

Psychometric measures collected at the ergometer ride included: Borg's Perceived Exertion Scale (RPE) given at one minute to assess exertion under lighter loads, and the same scale given immediately following termination of the ride, and also; The Short Form MPQ's three subscales. As shown in Table 7, the mean RPE score at one minute was 10.5 (s.d.=1.9) and the mean RPE score at the termination of the ride was 16.0 (s.d.=3.8). The RPE ranges from 6 to 20, and the mean scores at one minute of 10.5 falls between the cue words "very light," and "fairly light." The mean score of 16 at termination falls between the cue words of "hard," and "very hard." Table 8 presents the MPQ subscale scores for the ergometer ride.
Table 8. Ergometer Ride: McGill Pain Questionnaire (MPQ) subscale scores for all subjects (N=43)

<table>
<thead>
<tr>
<th>MPQ Subscale</th>
<th>mean score</th>
<th>standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Scale</td>
<td>M= 5.2</td>
<td>SD=5.4</td>
</tr>
<tr>
<td>Affective Scale</td>
<td>M= 2.4</td>
<td>SD=1.5</td>
</tr>
<tr>
<td>Total Rating Scale</td>
<td>M= 7.6</td>
<td>SD=6.5</td>
</tr>
</tbody>
</table>

a Sensory Scale scores may range from 0-33
b Affective Scale scores may range from 0-12
c Total Rating (Evaluative) Scale scores may range from 0-45
As Table 8 shows, the MPQ scores for the Sensory (x=5.2, s.d.=5.4), Affective (2.4, s.d.=1.5), and Evaluative (x=7.6, s.d.=6.5), scales are similar to the MPQ scores for the Minor Pain experience on the PHQ.

Hypothesis 2, based upon a paradigmatic behavioral conception of pain, suggests that learned behavioral repertoires for pain may lead to fairly stable experiences of pain for an individual. Thus, there is an expectation of a correlation between a subject's assessment of and responses to historical occurrences of pain, as measured by the PHQ, and a current pain experience, such as the ergometer ride. Specifically, Hypothesis 2 predicts positive correlations between MPQ scores for each of the PHQ pain experiences and the MPQ scores for the ergometer ride. The hypothesis also predicts positive correlations between the A/D scores for the PHQ and for the ergometer ride.

As Table 9 shows, MPQ pain assessments for the ergometer were positively correlated with MPQ assessments of the Minor pain and Worst pain experiences of the PHQ. Pearson correlations between the ergometer ride MPQ scales and Minor pain MPQ scales were: r=.43 (p<.01) for the Sensory scale, r=.27 (p<.10) for the Affective scale, and r=.40 (p<.01) for the Total Rating scale. Correlations between MPQ ratings for the Worst pain experience and the ergometer ride were: r=.37 (p<.05) for the Sensory scale, r=.35 (p<.05) for the Affective scale, and r=.39 (p<.05) for the Total Rating scale. Thus, the hypothesized positive correlations between assessment of historical and current pain experiences were supported. Individuals whose historical pain ratings were high also had high pain ratings on the ergometer ride.

The second set of hypothesized correlations- those between A/D scores for the PHQ and A/D scores for the ergometer ride- were less consistent, as shown in Table 10. Both Easy and Hard A/D scores on the ergometer ride were positively correlated with the A/D score for the Minor pain experience (Least Painful A/D and Minor pain A/D, r=.29, p<.10; Most Painful A/D and Minor Pain A/D,
r=.32, p<.05). However, Worst pain A/D was not significantly correlated with the Hard A/D scores (r=.20), and Worst pain A/D was negatively correlated with the Easy A/D scores (r=-.34, p<.05). Thus, association patterns for the Minor pain experience were positively correlated with association patterns for both parts of the ergometer ride- when the ride was easy and when it was hardest. In contrast, the Worst pain experience association patterns were negatively correlated with association patterns described for the easier part of the ergometer ride.
Table 9. **Pearson Correlation Coefficients for Relationship Between MPQ Subscale Assessments of Ergometer Pain and PHQ Minor and Worst Pain Experiences**

<table>
<thead>
<tr>
<th>Ergometer Ride Pain Assessments on MPQ Subscales</th>
<th>Sensory Scale</th>
<th>Affective Scale</th>
<th>Total Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minor Pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MPQ Subscales</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory Scale</td>
<td>.43**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective Scale</td>
<td>.27^a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Rating Scale</td>
<td>.40**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ergometer Ride Pain Assessments on MPQ Subscales</th>
<th>Sensory Scale</th>
<th>Affective Scale</th>
<th>Total Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Worst Pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MPQ Subscales</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory Scale</td>
<td>.37^*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective Scale</td>
<td>.35^*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Rating Scale</td>
<td>.39^*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^a p<.10  
* p<.05  
**p<.01
Table 10. Pearson Correlation Coefficients for Relationship Between the Two Ergometer Ride Association/Dissociation (A/D) Scores and the Two PHQ A/D Scores for All Subjects (N=42)

<table>
<thead>
<tr>
<th></th>
<th>A/D: Minor Pain</th>
<th>A/D: Worst Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ergometer Ride &quot;Least Painful&quot; A/D score</td>
<td>.29*</td>
<td>-.34*</td>
</tr>
<tr>
<td>Ergometer Ride &quot;Most Painful&quot; A/D score</td>
<td>.32*</td>
<td>.20</td>
</tr>
</tbody>
</table>

*a p<.10
*p<.05
In order to better understand the relationship between the Pain History experiences and the ergometer ride experience, MPQ scores and A/D scores were correlated following division of the sample into athlete and non-athlete groups. This decision to repeat the analyses of Hypothesis 2 following sample division was post-hoc, as specific group differences were not predicted for the relationship between the PHQ and ergometer scores. The correlations between the MPQ scores for the PHQ and Ergometer, by athlete and non-athlete groups, are presented in Table 11, and the correlations between A/D scores on the PHQ and the ergometer, by athlete and non-athlete group, are presented in Table 12.

As Table 11 shows, group membership does appear to make a significant difference in the relationship between the assessment of pain on the PHQ and the ergometer ride. One striking difference is that the non-athlete group's MPQ pain assessments are only correlated in one situation: the Affective subscale for the Minor pain experience is positively correlated with the Affective subscale on the Ergometer ride ($r=.47, p<.05$). Interestingly, this is the only situation in which the athlete's MPQ pain assessments on the PHQ were not positively correlated with MPQ pain assessments on the ergometer ride. In all other conditions, the positive correlations between MPQ scores on the PHQ and Ergometer ride for the athlete group were quite consistently strong and ranged between $r=.53$, $p<.05$, and $r=.58$, $p<.05$. Thus it appears that for the athlete group, pain assessments on the ergometer ride were quite similar to pain assessments in other situations. For the non-athletes, however, pain assessments of past pain experiences were generally unrelated to pain assessments of the ergometer ride.

As Table 12 shows, the relationship between patterns of association and dissociation in response to pain for the PHQ and the ergometer ride were also related to group membership.
Table 11. Pearson Correlation Coefficients for Relationship Between MPQ Subscale Assessments of Ergometer Pain and PHQ Minor and Worst Pain Experiences: By Athlete and Non-Athlete Groups

<table>
<thead>
<tr>
<th></th>
<th>Sensory Scale</th>
<th>Affective Scale</th>
<th>Total Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minor Pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MPQ Subscales</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory Scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletes</td>
<td>.57*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Athletes</td>
<td>.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective Scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletes</td>
<td>-.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Athletes</td>
<td>.47*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Rating Scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletes</td>
<td>.56*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Athletes</td>
<td>.29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Worst Pain**      |               |                |                    |
| **MPQ Subscales**   |               |                |                    |
| Sensory Scale       |               |                |                    |
| Athletes            | .53*          |                |                    |
| Non-Athletes        | .22           |                |                    |
| Affective Scale     |               |                |                    |
| Athletes            | .58*          |                |                    |
| Non-Athletes        | .15           |                |                    |
| Total Rating Scale  |               |                |                    |
| Athletes            | .57*          |                |                    |
| Non-Athletes        | .18           |                |                    |

*p<.05
Table 12. Pearson Correlation Coefficients for Relationship Between the Two Ergometer Ride Association/ Dissociation (A/D) Scores and the Two PHQ A/D Scores: By Athlete and Non-Athlete Groups

<table>
<thead>
<tr>
<th></th>
<th>A/D: Minor Pain</th>
<th>A/D: Worst Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ergometer Ride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Least Painful&quot; A/D score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletes</td>
<td>.15</td>
<td>-.52&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Non-Athletes</td>
<td>.40&lt;sup&gt;*&lt;/sup&gt;</td>
<td>-.22</td>
</tr>
<tr>
<td>Ergometer Ride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Most Painful&quot; A/D score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletes</td>
<td>.10</td>
<td>.31</td>
</tr>
<tr>
<td>Non-Athletes</td>
<td>.44&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.13</td>
</tr>
</tbody>
</table>

<sup>a</sup>p<.10

<sup>*</sup>p<.05
As Table 12 shows, for non-athletes, AID scores for the Minor pain experience were correlated with the Easy AID scores ($r = .40$, $p<.05$), and the Hard AID scores ($r = .44$, $p<.05$). For the athlete group, however, the only significant correlation was a strong negative correlation between the AID scores for the Worst pain experience and the Easy AID scores ($r = -.52$, $p<.05$). The positive correlation between Hard AID scores and Worst pain AID scores for athletes did not reach significance ($r = .31$). In summary, non-athletes association patterns in response to a minor Pain experience were positively correlated with their response to both easy and hard efforts on an ergometer ride. Athletes only showed a tendency to use opposite association patterns in response to their worst pain experience and than in response to the easy portion of the ergometer ride.

How does one explain these group differences? One possible explanation is that the relationship between the PHQ and the Ergometer ride was different for the two groups because of the questionable reliability of the PHQ. Another explanation is that the relationships are different due to differences between groups in their experiences of the ergometer ride. This explanation would be supported if the differences between the groups on the ergometer ride predicted by Hypothesis 3 are found.

**Hypothesis 3**

Hypothesis 3 was specifically interested in group differences between athletes and non-athletes. Thus, data analyses focused upon between group differences rather than the across group phenomena predicted by hypotheses 1, 2, and 4. Hypothesis 3 is primarily based upon research in sport psychology which has found greater levels of association in more successful endurance athletes, and research which has found increasing association in athletes as effort increases. Hypothesis 3 predicts that the athlete group will tend to produce a greater effort on the ergometer ride and will tend to use more associative coping strategies during the
ride than the non-athlete group. In order to determine if there were differences in the experience of the ride for the two groups, the measures collected before and during the ergometer ride, and which were presented in Tables 7 and 8, were reanalyzed following a division into athlete and non-athlete groups. The mean scores for both groups, along with dependent sample t-tests and probability alpha levels, are presented in Table 13 and 14.

As the tables show, the only measures of the ergometer ride for which the two groups did not differ were maximum heart rate and blood lactate levels. Athletes reported a lower perceived exertion at one minute into the ride and a lower heart rate at two minutes, both of which may reflect fitness levels. On the other measures, however, athletes' scores were consistent with a self-perception of a more painful ride. Athletes spent more time on the ergometer (x=517 seconds for athletes versus x=296 seconds for non-athletes), and rated their final perceived effort higher (at a level approaching significance). As shown in Table 14, the Athlete group also had higher pain assessment scores on all of the MPQ subscales. In fact, athletes Sensory, Affective, and Total Rating subscale scores for the ergometer were higher than the same scales for their Minor pain experiences on the PHQ while non-athletes MPQ subscale scores for the ergometer were lower than their Minor pain experience subscale scores.

Despite these group differences on the ergometer, athletes did not tend to use more associative pain coping strategies, as had been predicted by Hypothesis 3. Differences would be reflected in higher A/D scores for athletes than non-athletes, but as shown in Table 15, athlete and non-athlete groups did not differ in A/D levels for either the Least Painful A/D or Most Painful A/D conditions. Thus, the hypothesis was not supported.
Table 13. Ergometer Ride: Scores on Psychometric and Non-Psychometric Measures: By Athlete and Non-Athlete Groups, and T-Test Scores for Differences Between the Groups

<table>
<thead>
<tr>
<th>Measure</th>
<th>Athletes</th>
<th>Non-Athletes</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time on Ergometer</td>
<td>M=517 seconds</td>
<td>M=297 seconds</td>
<td>5.3***</td>
</tr>
<tr>
<td></td>
<td>SD=189 seconds</td>
<td>SD=85 seconds</td>
<td></td>
</tr>
<tr>
<td>Two Minute H.R.</td>
<td>M=134.8 bpm</td>
<td>M=147.4 bpm</td>
<td>2.2*</td>
</tr>
<tr>
<td></td>
<td>SD=19.8 bpm</td>
<td>SD=16.4 bpm</td>
<td></td>
</tr>
<tr>
<td>Maximum H.R.</td>
<td>M=183 bpm</td>
<td>M=177.1</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>SD=10.8 bpm</td>
<td>SD=13.1</td>
<td></td>
</tr>
<tr>
<td>Blood Lactate Levels</td>
<td>M=4.3 mM/l</td>
<td>M=4.5 mM/l</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>SD=1.8 mM/l</td>
<td>SD=2.4 mM/l</td>
<td></td>
</tr>
<tr>
<td>Borg Perceived Exertion Scale (RPE)(a)</td>
<td>M=9.7</td>
<td>M=10.9</td>
<td>2.0*</td>
</tr>
<tr>
<td></td>
<td>SD=1.8</td>
<td>SD=1.9</td>
<td></td>
</tr>
<tr>
<td>RPE score at End of Ergometer Protocol</td>
<td>M=17.3</td>
<td>M=15.2</td>
<td>1.8(b)</td>
</tr>
<tr>
<td></td>
<td>SD=1.2</td>
<td>SD=4.5</td>
<td></td>
</tr>
</tbody>
</table>

\(a\) RPE scores may range from 6-20
\(b\) p<.10
*p<.05 **p<.01 ***p<.001
Table 14. Ergometer Ride: McGill Pain Questionnaire (MPQ) subscale scores for Athlete and Non-Athlete Groups, and T-Test Scores for Differences Between the Groups

<table>
<thead>
<tr>
<th>MPQ Subscale</th>
<th>Athletes</th>
<th>Non-Athletes</th>
<th>t=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Scale a</td>
<td>M= 8.5</td>
<td>M=3.4</td>
<td>3.3***</td>
</tr>
<tr>
<td></td>
<td>SD=6.5</td>
<td>SD=3.7</td>
<td></td>
</tr>
<tr>
<td>Affective Scale b</td>
<td>M= 3.1</td>
<td>M=2.0</td>
<td>2.3*</td>
</tr>
<tr>
<td></td>
<td>SD=1.2</td>
<td>SD=1.5</td>
<td></td>
</tr>
<tr>
<td>Total Rating Scale c</td>
<td>M= 11.5</td>
<td>M=5.5</td>
<td>3.3***</td>
</tr>
<tr>
<td></td>
<td>SD=7.2</td>
<td>SD=5.0</td>
<td></td>
</tr>
</tbody>
</table>

a Sensory Scale scores may range from 0-33
b Affective Scale scores may range from 0-12
c Total Rating Scale scores may range from 0-45

*p<.05  **p<.01  ***p<.001
Table 15. Ergometer Ride: Mean Association/Dissociation (A/D) Scores By Athlete and Non-Athlete Groups, and T-Test Scores for Differences Between the Groups

<table>
<thead>
<tr>
<th></th>
<th>Athletes</th>
<th>Non-Athletes</th>
<th>t=</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Least Painful&quot;</td>
<td>M=3.7</td>
<td>M=3.3</td>
<td>.467</td>
</tr>
<tr>
<td>A/D Score</td>
<td>SD=2.4</td>
<td>SD=2.2</td>
<td></td>
</tr>
<tr>
<td>&quot;Most Painful&quot;</td>
<td>M=4.2</td>
<td>M=4.4</td>
<td>.316</td>
</tr>
<tr>
<td>A/D Score</td>
<td>SD=2.4</td>
<td>SD=2.2</td>
<td></td>
</tr>
</tbody>
</table>

Note. A/D scores range from 0-8 on a likert-like format, with 0 being most dissociative, and 8 being most associative.
Hypothesis 4

Hypothesis 4, the study's final hypothesis, is also concerned with A/D levels on the ergometer ride, and is based upon research with elite athletes which has found a tendency for these athletes to increase association levels as pain and effort increases. Hypothesis 4 predicts that this tendency will also be found in a non-elite athlete and non-athlete sample. Specifically, the hypothesis predicts that A/D scores will be greater for the Most Painful A/D condition than for Least Painful A/D condition, across all subjects. A paired samples T-test for the difference between the Least Painful A/D and Most Painful A/D revealed that A/D scores for the Most Painful A/D condition were higher than for the Least Painful A/D condition (mean difference .930), but the difference was not statistically significant (p=.12), in part due to rather large range and variation in the sample's scores for these variables (standard deviation difference = 3.5). Thus, the hypothesized prediction of differences in association levels at different levels of effort and pain was not found in the sample at large.

Following a direct test of the hypothesis for the overall sample, an unplanned analysis of the same variables (Easy A/D scores versus Hard A/D scores) was completed following division of the sample into athlete and non-athlete groups. The two paired sample t-tests, for the athlete and non-athlete groups, are presented in Table 16. Surprisingly, despite a sport psychology literature documenting greater association in athletes in response to increased effort and pain, Table 16 shows that it was the non-athlete sample who showed a greater difference between Easy A/D and Hard A/D scores (t=1.72, p=.098).
Table 16. **Ergometer Ride: Comparison of Least Painful A/D scores to Most Painful A/D scores, By Athlete and Non-Athlete Groups**

<table>
<thead>
<tr>
<th>Athlete Status</th>
<th>Least Painful A/D</th>
<th>Most Painful A/D</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athletes</td>
<td>M=3.7</td>
<td>M=4.2</td>
<td>.471 (ns)</td>
</tr>
<tr>
<td>Non-Athletes</td>
<td>M=3.3</td>
<td>M=4.4</td>
<td>1.72(p=.098)</td>
</tr>
</tbody>
</table>
One final unplanned analysis was performed subsequent to the formal hypothesis testing of A/D variables. Upon investigation of the total sample's MPQ pain assessment scores for the various pain experiences described by the subjects, a "ranking" of pain experiences emerged. Using MPQ scores, Minor pain was described as least painful, the ergometer ride was described as more painful, and the Worst pain was described as the most painful of the experiences. Would the levels of association to the body increase in a similar pattern?

Using the ranking obtained through comparison of the MPQ scores, three t-tests were performed comparing the A/D scores for each of these experiences, using the Bonferonni correction for the number of comparisons. These comparisons show that association levels, as measured by the A/D scores, did increase in an identical pattern to the pain assessment ratings. Most Painful A/D scores for the ergometer ride were higher than Minor pain A/D scores (t=2.47, p=.006), Worst pain A/D scores were higher than the ergometer ride's Most Painful A/D scores (t=3.1, p=.004), and as noted previously, Worst pain A/D scores are significantly higher than Minor pain A/D scores (t=5.4, p=0.00). Thus, subjects describe a phenomenon in which levels of association increase as pain increases, across situations.
X. DISCUSSION

The primary goal of this study was to bridge the literatures of two areas, research in sport psychology and research in pain and pain treatment, by expanding upon research findings in sport psychology— the utilization of increasingly associative pain coping strategies as pain increases— and to ask if this research is also relevant for non-athletes and for pain in non-sport situations. While the study produced a number of interesting findings, it is important to emphasize the limitations of the study before attempting to interpret the significance of the results.

Limitations of the Study. The study's limitations fall into three main areas: 1) subject sample characteristics; 2) Measurement reliability and validity, and; 3) appropriateness of the methodology for non-athletes. When choosing subjects for the current study, the questions of interest and proposed methodology created some limitations. All subjects needed to be healthy enough to be able to ride the bicycle ergometer, but not so experienced with active exercise that the study would be a simple replication of work with elite athletes. The subjects in the current study were quite healthy, and even the non-athlete group had a majority of subjects reporting some experience in competitive sports in their lives. These sample characteristics made the distinctions between competitive athletes and non-athletes less extreme than possible, and may have led to the study's negative findings for differences between the athlete and non-athlete group. In addition, the study's subject population needs to be considered when considering questions of generalizability and the implications for either sport psychology, or health psychology and work with pain patients.

In attempting to extend research begun with elite athlete samples, the current study used a sample of non-athletes and non-elite athletes. The results of the study, in particular the results of
the association/dissociation measures in athletes, showed a good deal of variance. This was a contributory factor in the difficulty in demonstrating significant differences in association at less and more painful points in the ergometer ride. Although one purpose of the current study was to determine if findings in research with elite athletes are also found in research with non-elite athletes, it may be that these cognitive factors are masked in a non-elite athlete sample. Some authors have suggested that psychological factors in sport performance are increasingly more important as athletes' physical capabilities become more homogeneous (Burton, 1988; Suinn, 1988). Given the range of abilities and experience in the current sample of athletes, and given the variance shown among the athletes on the A/D measures, it is difficult to make confident statements delineating the links between previous sport psychology research and the current study.

While the athlete group may not have been "elite" enough to make clear links to previous sport psychology research, the non-athlete group may have been too healthy to make links to health psychology and pain treatment research. While this criticism is not unique to the current study, and has been a problem for all non-clinical research in pain (Beecher, 1956; Chapman et al., 1985; Melzak, 1983; Sternbach, 1983), it is not a minor criticism. In addition to the criticisms typically made of laboratory pain research, exercise induced pain may initially appear less face valid to clinicians working in pain. While it is difficult to say what type of self-selection process occurred for the non-athletes who chose to participate in the study, it may be that the study selected for individuals less alarmed by pain than the "typical" pain patient. In fact, although there was no formal measure of feelings about the study following the ergometer ride, the experimenter's subjective impression was that a large majority of the subjects actually enjoyed the ergometer ride, despite describing it as painful.

There are also a few key questions about the measures used in the current study. The PHQ is composed of the short form McGill
Pain Questionnaire and A/D scales. While the MPQ is the most well established and validated psychometric pain measure available (Melzak, 1987; Karoly & Jensen, 1986), and A/D scales have been used in a number of other studies, neither have been utilized precisely as this study requires. Previous use of the MPQ for pain memories showed good reliability in one study (Hunter et al., 1979), but in that study, the time period for recall was only a matter of weeks.

The current use of the PHQ relies upon the ability of subjects to remember pain experiences clearly, despite the passage of time. Specifically, the retrospective self-report of two separate pain experiences requires accurate memory for two distinct events and memory for reactions to these events. While the scores for the measures of the two pain experiences are statistically distinct, and fit a rational- intuitive model of expected scores, the study has no other way of checking the validity of these scores, and this is a considerable concern for the measure. The two obvious problems are that a subject may have an inaccurate recollection of either the pain experience or the reaction to it. One possible partial solution for future research would be to have a controlled pain experience, such as the ergometer ride, and have the subjects rate it immediately and then later, using the PHQ, to determine if there is consistency across time.

One final criticism about the measures is a problem for virtually all of the self-report measures, and has been well documented in other pain research. As was mentioned earlier in the study when discussing measurement issues in pain, the covert and multidimensional nature of pain makes it very difficult to validate externally. Despite the attempt to put individuals in the same situation during the ergometer ride, it was unique for each individual. Even physiological measures of effort and exertion may be impacted by cognitive and affective processes, and thus one relies upon the perceptions and reports of the subject for a sense of what the experience was for each.
In addition to the limitations of the current measures, it is important to emphasize that the very nature of the study, in its use of self-report questionnaire data, puts limitations upon statements of generalizability. Self-reports tend to correlate with one another, which accounts for some of the shared variance. In addition, correlations of .3 to .4, for example, while significant, account for only 9 to 12 percent of the shared variance of the variables. Thus, it is important to avoid suggesting that even significant results can explain the complex human behavior under study.

The last general area of criticism involves the use of the ergometer ride as a methodology for non-athletes. The primary question is whether non-athletes will be motivated to efforts on the ergometer that will result in discomfort and pain. Although the athlete group did spend more time on the ergometer, and did report greater perceived exertion and pain levels, the non-athlete group were surprisingly motivated, at least based upon the subjective comments of the subjects. The subjects were interested in their performance, and worked quite hard, as measured by their final heart rates, blood lactate levels, and perceived exertion scores. These efforts came despite explicit instructions that they could choose to stop at any time. While the ergometer ride may not achieve the same levels of pain for non-athletes that it does for motivated athletes, it appears to have produced significant efforts from the non-athletes involved in the study.

While the ergometer protocol produced significant physiological output from the non-athlete subjects, it is less clear what the psychological impact of the ergometer was for these subjects. One question in regards to the ergometer portion of the study is whether there were demand characteristics which affected the self-reports of pain and cognitive strategies. It may have been that the novelty of the experience or some other experimenter effect impacted the non-athlete's self-report measures. As was mentioned in the results, the athlete group's MPQ scores on the ergometer were correlated with their MPQ scores for the PHQ,
while the non-athlete's showed less consistent pain ratings. PB theory would predict that the athlete's different learning histories had produced familiar sensorimotor and language-cognitive pain BBR's that enabled them to maintain more consistent ratings across pain experiences.

Thus, when analyzing the utility of the ergometer protocol in pain research with non-athletes, one must weigh the evidence of significant physical effort, with the uncertain relationship between pain reports on the ergometer and other pain reports. Since consistency of pain-measures across alternate pain experiences has not been a focus of previous research, however, it is unclear whether this same criticism may be applied to all laboratory research with novel pain stimuli such as muscle-ischemia pain or cold-pressor pain.

**Summary of Results**

A test of the study's four major hypotheses (as shown in Table 17) revealed: 1) that the pattern of increased associative pain strategies in situations of increased pain was found in subjects' self-report pain histories; 2) that these historical assessments of pain and responses to pain are correlated with current assessments of and responses to a laboratory based "sport" situation on a bicycle ergometer ride; 3) that the sample of non-elite athletes did not use significantly more associative pain strategies during the bicycle ergometer ride than non-athletes, and; 4) that earlier studies with elite athletes finding increased association in response to increased pain on a bicycle ergometer ride were not replicated with the study's non-elite athlete and non-athlete sample.
### Table 17. Summary of Hypotheses and Study Findings

<table>
<thead>
<tr>
<th>HYPOTHESIS</th>
<th>FINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Self-reported association levels would be higher for historical Worst pain experiences than for historical Minor pain experiences-Across Subjects.</td>
<td>I. SUPPORTED</td>
</tr>
<tr>
<td>II(A). Self-report pain ratings for historical pain ratings would be correlated with pain ratings for the ergometer ride-Across Subjects.</td>
<td>II(A). SUPPORTED</td>
</tr>
<tr>
<td>II(B). Self-reported association levels for historical pain experiences would be correlated with association levels on the ergometer ride-Across Subjects.</td>
<td>II(B). PARTIALLY SUPPORTED</td>
</tr>
<tr>
<td>III. Athletes would have higher self-reported levels of association than non-athletes on the ergometer ride.</td>
<td>III. NOT SUPPORTED</td>
</tr>
<tr>
<td>IV. Association levels for the ergometer ride would be higher when the ride was harder than when it was easier-Across Subjects.</td>
<td>IV. NOT SUPPORTED</td>
</tr>
</tbody>
</table>
The Pain History Questionnaire used in the current study was primarily an exploratory measure, with no prior use or prior models upon which to base its construction. Although a pilot study had demonstrated reasonable test-retest reliabilities for recalling one pain experience, it was unknown whether individuals would be able to reliably recall, assess, and describe two distinct and specific pain experiences as was asked in the current study. Given these significant pre-study questions, the PHQ results were quite encouraging. Pain descriptions and assessments for the two different pain experiences were quite distinct and face valid. Worst pain experiences lasted significantly longer and were accompanied by significantly higher MPQ pain assessment ratings than Minor pain experiences. This construct support of the PHQ makes the finding of significantly greater self-reported use of association in the Worst pain experience more significant. This occurrence of a phenomenon previously described only in the sport psychology literature suggests that the association-dissociation variable may be central to pain coping and not simply an anomaly found in athletes.

The second major finding, that subjects’ descriptions of the two pain history experiences are correlated with subjects’ descriptions of the ergometer ride, lend additional support to the contention that sport psychology research is relevant to other pain research. In addition, the results are concordant with a paradigmatic behavioral model of learned pain personalities with individual consistency across pain situations, as well as the potential for individual differences in pain personalities due to varying learning histories. For example, the overall results for pain assessment consistency found positive correlations between all MPQ subscales for the ergometer and MPQ subscales for both Minor and Worst pain experiences. This result is an argument for consistency in pain assessment but further analysis following
division into athlete and non-athlete groups reveals an interesting addition.

It appears that the overall sample's positive correlations in pain assessment may be due to the very high positive correlations for the athlete sub-group. The non-athlete group's assessments of the PHQ pain experiences were generally not correlated with the ergometer ride assessments. One possible explanation for these differences is that the decreased range in MPQ scores on the ergometer ride for the non-athletes resulted in lowered correlations. An alternative explanation supports the PB model of learning-based pain personalities. Perhaps the unique learning histories of the athletes has resulted in a familiarity with the sensations of the ergometer ride so that pain assessment patterns for these specific sensations are well established and are little different than pain assessment for other types of pain experiences. It may be that pain assessments reflect the sensorimotor and language-cognitive BBR's that are components of the athlete's pain personality. For many of the non-athletes, however, the sensations of pain which accompanied the ergometer ride may have been novel and not yet part of an established pain assessment pattern.

Patterns of association and dissociation were less consistent across the various pain experiences, with correlations between A/D scores on the PHQ and the ergometer pain experiences suggesting that an individual might use an associative pattern in one pain experience and a more dissociative pattern in another. In particular, it was found that the athletes' association levels when the ergometer ride was easier were negatively correlated with association levels for these athlete's worst historical pain experience. In other words, athletes who reported paying a great deal of attention to their body during their worst historical pain experience were likely to dissociate during the easy part of the ergometer ride. Refinements in the measurement of association/dissociation may help to determine the cause and significance of this result.
The third major finding of the study was that the athlete group did not demonstrate more association on the ergometer ride than the non-athlete group, either when the ride was easier or harder. This result is in apparent contrast to earlier research with elite athletes that found more successful endurance athletes used more association than less successful endurance athletes (Morgan and Pollack, 1979; Silva & Applebaum, 1989). There are a number of possible explanations for the lack of difference between groups. Of course one explanation that must be considered is measurement error. It may be that the psychometric properties of the association/dissociation measure used in the study were not solid enough to allow discrimination between groups. Since between group differences has not been a focus of previous research in this area, it is uncertain if the association measures used have discriminant validity.

An alternate explanation might be the composition of the study's two groups: perhaps the athlete sample was not "elite" enough, or perhaps the quite healthy but non-competitive non-athlete sample was too "athletic" to provide a sufficient contrast group. Unfortunately, previous studies on association have focused upon either elite-athletes or non-athlete samples, without comparing the two. Thus, it is unclear how non-elite athletes relate to either group in terms of association and dissociation.

Another potential explanation is that the novelty of the specific pain sensations of the ergometer ride for the non-athlete group increased association to the pain levels. It is also possible that the increased time on the ergometer for the athletes allowed more time for dissociative pain coping.

A final alternative cause of the lack of differences between the athlete and non-athlete groups is that the theoretical foundation for the hypothesis is wrong or ill suited to the current study conditions. Recent work with endurance athletes has found consistent increases in association with increasing effort and pain (Schomer, 1987; McCann & Murphy, 1989), and it may be that the
task demands were great for both groups and required associative coping equally for both groups. It may be that the ergometer protocol differs from lengthier competitive endurance races in which varying cognitive strategies have been found (Silva & Applebaum, 1989).

The final piece of the study was an attempt to extend earlier exercise-based research with elite athletes, by using a non-elite athlete sample. In earlier research, elite athletes had shown a tendency to increase association as effort and pain increased (McCann & Murphy, 1989; Schomer, 1986,1987). In the current study, both athlete and non-athlete groups increased association levels from the easier part of the ride to the harder part of the ride, but the increase was not significant for the athlete group and approached significance for the non-athlete group. The lack of significant effects may be explained in a number of ways.

As always, the most obvious explanation for the lack of significance is a lack of power in the measurement device used. This explanation is supported by the fact that both groups did increase association levels, but not significantly. In addition, the wide variance shown in the A/D measure suggests that a group design like that used in the current study may mask subtle findings. A strong argument can be made for a thorough N-of-1 study to investigate the properties of the A/D scale more adequately.

Another explanation for the lack of increased association is that the subjects in the current study lack the learning history of elite athletes who train and race more frequently and with greater intensity. Perhaps there is a minimum exposure to high levels of exercise-related pain that is necessary before an individual can develop the repertoire of associating to the body during increased exercise-induced pain.

A third explanation for the current results is that the subjects did not expend enough effort, experience enough pain, or spend enough time on the ergometer, and thus they did not need to use
more association. In an earlier study, elite athletes using a similar protocol and showing increased association did spend more time on the ergometer (McCann & Murphy, 1989). Despite this, a post-hoc analysis of the current study found no significant relationship between association levels at the end of the ride and time on the ergometer.

Supporting the contention that the subjects would have used more association if they had experienced more pain, the results of the comparison of association levels from the PHQ and the ergometer ride were quite interesting. The finding that MPQ assessment of pain levels increased as association levels increased, across historical and current pain experiences, is an important support for the model. This finding also suggests that learning history may not be the sole or even the primary mechanism for producing increased association in response to increased pain. It may be that sensory and affective pain sensations are the dominant determinants of associative or dissociative cognitions. Thus, individual or group differences in association may be masked by situational determinants such as pain intensity. Further study of this question is necessary to determine if cognitions "come before" sensations, if sensations "lead to" cognitions, or if both of these formulations are evident in an interactional phenomenon.
Implications of the Study for Sport Psychology Research

The study of association and dissociation to pain in endurance athletes began with the work of Morgan and his associates, who found that top marathon runners did not distract themselves from pain, but instead paid closer attention to their pain levels when competing than did runners who ran slower (Morgan et al., 1979). At that time, this finding was quite a surprise and Morgan hypothesized unique personality traits in these elite runners that enabled them to pay attention to their pain. More recent research with elite athletes suggests that association to pain increases across the elite athlete population as a function of increasing effort and pain levels (Schomer, 1987, 1988; McCann & Murphy, 1989).

The current study, with a non-elite athlete and non-athlete population, extends previous sport psychology work in two primary ways. It suggests that the patterns of increasing association in response to increasing effort and pain during exercise, found in elite athlete populations, may be less strong in non-elite athlete populations. In contrast, however, the study suggests that these patterns may not be unique to the environment of sport, and may in fact be mirrored in historical and non-sport pain experiences as well.

The lack of strong patterns of increasing association in response to effort and pain with a non-elite athlete population can be interpreted two ways: either elite-athletes are a unique population, or the methodology of exercise studies is only likely to find strong patterns of increasing association with those individuals who experience greater pain. Both prior research, and this study's results finding increasing association across pain situations (historical pain experiences as well as the ergometer) suggests that the latter explanation is most likely. As Schomer (1986), suggests, top endurance athletes associate more because they push harder. Extending laboratory pain research and attempting to teach distraction as a means for improving athletic performance (Okwumbua et al., 1983; Pennebaker & Lightner, 1980) is likely to
be less useful as performance and pain levels increase. The situation for applied sport psychologists is thus similar to that of clinicians working with pain patients.

Implications of the Study for Clinical Pain Research and Treatment

As was discussed earlier in this paper, the cognitive behavioral treatment of pain problems by psychologists has relied heavily upon the findings of laboratory pain research (Turk et al., 1983). Specifically, laboratory studies finding that distraction techniques sometimes help subjects tolerate pain longer have led to applied studies of distraction with a number of clinical populations, including acute and chronic pain populations (Turk and Meichenbaum, 1989). The consensus of clinical research opinion appears to be that teaching distraction is ineffective for many clinical pain syndromes and that use of distraction may actually predict poor clinical outcome (Rosenstiel & Keefe, 1983). This has lead a number of researchers to recommend a focus upon behavioral techniques and to avoid teaching cognitive techniques due to the failure of distraction techniques (Turner & Clancy, 1983). The results of the current study suggest that a rejection of cognitive techniques due to the failure of distraction may be throwing out the baby with the bathwater.

The evidence suggests that cognitive strategies solely utilizing distraction techniques are likely to become less and less effective as pain levels increase. Cognitively based pain interventions which only teach distraction may be setting individuals up for failure and inadvertently produce the type of catastrophizing thought processes shown to result in the worst outcomes for pain patients (Turk et al., 1983). As an alternative, preparing the patient for the tendency to associate as pain levels increase, and avoiding catastrophic thoughts of treatment failure may be a very useful approach. Certainly, this approach is worth exploring given the ineffectiveness of current distraction techniques for most clinical pain problems. At the very least, it is
critical to begin exploring individual differences in pain-related BBR's in order to determine if tailoring individual treatments to individuals will increase the effectiveness of cognitive behavioral interventions.

It is important to emphasize that preparing individuals to pay attention to their pain levels may not be appropriate for a number of clinical pain problems. In particular, pain problems being treated with powerful analgesics such as narcotic medications which attempt to eliminate nociception would be unlikely to benefit from an approach which prepares for increasing pain levels. Examples include many burn pain problems, cancer pain, and most acute pain from operative procedures. There are, however, a number of clinical pain problems where preparation for inevitable pain might be useful, such as pain during physical rehabilitation from injury, pain from a chronic arthritic condition, and perhaps surprisingly, recovery from chronic pain problems.

Observation of the University of Washington's Pain Center Chronic Pain program reveals that the heart of the treatment for chronic pain is quite relevant to this study. A great majority of the patient's time in this program and most other inpatient pain programs is spent in a structured program of physical reactivation. Deactivation and disuse effects are prominent contributors in most chronic pain patients' pain complaints. These individuals are generally quite frightened about the inevitable pain of reactivation, due to the labelling of the pain as a harmful occurrence. Like endurance athletes, however, successful patients learn "the difference between hurt and harm" (Fordyce, 1989), and learn that some types of pain are actually indications of progress and strengthening (Loesser & Egan, 1989).

By paying closer attention to pain rather than anxiously avoiding pain, chronic pain patients can learn important distinctions between pain sensations and damage sensations, and they can increase their functional performance. Specific preparation for this process may help chronic pain patients
develop a model to explain their pain condition and, to use the terminology of the cognitive-behavioral approach, may help patients reconceptualize their response to pain (Turk & Meichenbaum, 1989). A PB interpretation of this process would focus on the language-cognitive BBR's required in this process of change, but would also point out the importance of the emotional-motivational BBR's being classically conditioned and operantly reinforced during the change.

**Relationship of the Results to Current Psychological Pain Theories**

The results of the current study are relevant for the operant approach to pain, the cognitive-behavioral approach to pain, and the paradigmatic behavioral approach to pain. As was mentioned above, the operant pain approach, by definition, focuses its treatment efforts upon operant learning and on reducing observable pain behaviors, and points to changed pain behaviors as evidence of its success (Fordyce, 1989). Proponents of the operant approach have pointed to the mixed and sometimes negative results of teaching pain distraction techniques as evidence that cognitive approaches to pain treatment are unnecessary (Turner & Clancy, 1983; Rosenstiel & Keefe, 1983). The study results suggest that, while learning is critical in pain, individual cognitive responses to pain may also be learned as pain behaviors are learned.

The current study results speak more directly to the cognitive-behavioral approach to pain, as they challenge the assumption that successful cognitive coping strategies will all use some form of distraction or dissociation. As has been demonstrated in previous sport psychology literature, association to pain is a coping strategy used by elite-athletes during exercise-induced pain. The current study extends earlier work by finding initial evidence that association to increasing pain levels may also occur to some extent by non-elite athletes during exercise induced pain. In addition, evidence from an exploratory pain history
questionnaire suggests that the cognitive patterns described for non-sport pain experiences mirror the findings from sport psychology. Overall, these results point to a reconsideration of the unitary distraction approach seen as the sole option for pain coping by leading cognitive-behavioral theorists (Turk and Meichenbaum, 1989).

Finally, the study results are relevant support for the paradigmatic behavioral (PB) approach to pain. Specifically, the initial finding of individual pain personalities with some consistency across pain experiences, as well as the finding of individual differences in pain personalities as evidenced by differences between the athlete and non-athlete groups, both support predictions of the PB model. The study also speaks to the continuing question of trait versus state behavior, that has long been a focus of PB research. The study results suggest that the pain behavior may be best explained by a combination of trait-like BBR's and state situationalism. Further study investigating more specific predictions of the model is warranted.

Potential research directions utilizing a PB model include: N-of-1 studies to more accurately describe the phenomenology of association; a more detailed look at the affective learning of emotional-motivational BBR's in association, and; treatment studies with athletes and non-athletes, in order to determine if associative strategies can be taught effectively. Long term pain treatment implications may include the need to assess individual pain coping BBR's prior to a cognitive intervention, in order to individualize cognitive coping strategies for best results.

**Future Research Directions**

The questions raised by the results of the current study suggest a number of potential directions for future research, with an ultimate goal of understanding the attentional and interpretive processes which occur with pain. Some of the research goals are
refinements of current questions, and others are new areas of exploration.

One research area is an extension of the current study, and would simply attempt to determine the accuracy and reliability of retrospective pain histories. As stated above, one method would be to use the ergometer ride to establish an observed pain experience, and then determine how time affects recollections about past pain experiences. If the validity of the PHQ or a similar measure could be established more firmly, the measure could be used in a number of situations, including work with clinical pain populations.

Another potential outgrowth from this study would be to attempt an intervention study, determining the effect of teaching associative pain strategies to athletes. While Schomer (1987) did a series of case studies showing increased performance following instruction in association, a more controlled laboratory procedure with a larger sample would be useful in determining specific performance gains.

Two other important areas for study are gathering association/dissociation data from clinical populations, and attempting to intervene with these populations. One interesting interdisciplinary bridging study might be to work with athletes recovering from injury who are undergoing a process of physical rehabilitation. In addition, treatment studies which have previously compared "cognitive" treatments consisting of teaching distraction, with behavioral treatments, could be repeated with the addition of an associative coping treatment.

Future work with chronic pain patients might consider the origins of "abnormal" or dysfunctional pain strategies. In particular, researchers might gather baseline data on association and dissociation in pain patients, and determine if some pain syndromes cause or result from dysfunctional dissociative strategies. Interesting work by Schwartz (1988) on Repressive Coping and illness behavior fits nicely into this research area.
Two quite relevant yet relatively unexplored areas are the relationship of associative pain strategies to the psychoneurophysiology of pain, and the development of pain strategies in children. To understand why increasing pain levels result in increasingly associative cognitive processes, understanding the interplay between neural physiology and cognitive processes seems critical. The work by Birbaumer (1989) on the EEG's of individuals with outstanding pain coping ability is directly relevant and fascinating. To understand how these patterns develop, one other route of exploration is to determine the development of pain coping strategies in children. Pediatric pain research is still quite undeveloped, yet there is growing evidence that theories of adult pain need to be modified with children (Ross & Ross, 1989).

As is evident from the manifest and manifold suggestions for future work listed above, the current study does little to remedy the need for answers to unresolved questions in the two main research areas it tried to bridge—sport psychology, and pain research and treatment. The results provide some initial evidence, however, that cross-pollination between the two areas might be quite useful. The finding that association to pain is not simply an anomaly found in elite athletes, is important for research in the psychology of pain and raises significant pain treatment issues. The study suggests that psychologists may have an alternative to teaching distraction as a method for cognitive pain coping, and—given the disappointing results for distraction—this is encouraging.
APPENDIX A

MATERIALS FOR THE INITIAL CONTACT:
AGREEMENT TO PARTICIPATE, DEMOGRAPHIC AND MEDICAL
HISTORY, SPORT HISTORY QUESTIONNAIRE, STAI TRAIT ANXIETY
MEASURE, PAIN HISTORY QUESTIONNAIRE-
MINOR PAIN & WORST PAIN
AGREEMENT TO PARTICIPATE IN
Psychology of Exercise Study

This study has two parts. The first involves filling out questionnaires, and the second requires riding an exercise bicycle and filling out further questionnaires. Each of the two parts should last about 30 minutes. The first part is attached to this consent form. The second part, including the ride on the exercise bicycle, will be scheduled with consideration of your personal schedule. The actual ride on the exercise bicycle is based on a test developed at the US Olympic Training Center, and will last from three to fifteen minutes. During the ride, subjects may become tired and subjects may consider the ride to be painful. Following the ride, the subject's fingertip may be pricked in order to take a drop of blood. This sample will be analyzed to determine the effects of the exercise.

Participation in this study is completely voluntary, and you may withdraw from this study at any point. This study, and its results, are confidential. This page, which includes your identification, will be removed by the experimenter from the rest of the materials. The subject should understand that if he or she is injured in the course of the research procedure, he or she alone may be responsible for the cost of treating any injuries. If the subject is interested in the results of the study and would like a fuller explanation of the study, results will be made available through the mail following completion of the study.

I certify that I have read and that I understand the foregoing, that I have been given satisfactory answers to my inquiries concerning project procedures and other matters and that I have been advised that I am free to withdraw my consent and discontinue participation in the project or activity at any time without prejudice.

I herewith give my consent to participate in this project with the understanding that such consent does not waive any of my legal rights, nor does it release the principle investigator or the institution or any employee or agent thereof from liability for negligence.

If you cannot obtain satisfactory answers to your questions or have comments or complaints about your treatment in this study, contact: Committee on Human Studies, University of Hawaii, 2540 Maile Way, Honolulu, Hawaii 96822. Phone 948-8658

____________________________________________________________________

Signature of participant

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**Background Information**

AGE: ____________

SEX: (Male)_______ (Female)_______

ETHNICITY:______________________

EDUCATION:
- Less than 12 years______________
- 12 years (high school grad)_______
- 12 to 16 years___________________
- 16 years or more (college grad)___

MARITAL STATUS:
- Married______________
- Single_______________
- Other_______________

**Medical and Injury History**

1) Do you have any illnesses, cardiorespiratory problems (e.g. heart murmurs, asthma, arrhythmias, etc.)? If your answer is YES, please explain.

2) Have you recently had any musculoskeletal injuries (e.g. muscle pulls, ligament damage, broken bones, etc.)? If your answer is YES, please explain.

3) Are you currently under medical supervision or regularly taking medications? If your answer is YES, please explain.

4) Do you have a history of biomechanical problems or any childhood diseases (rheumatic fever, etc.) that might put you at any risk during a ride on an exercise bicycle? If your answer is YES, please explain.
SPORT HISTORY QUESTIONNAIRE

1) Have you ever competed in sports?
   YES__________
   NO__________

2 a.) If yes to question #1, what sport(s)?

   ______________________________________________________
   ______________________________________________________

   ______________________________________________________

2 b.) When did you compete in these sports? (e.g. 1989, 1975-80, etc.)

   ______________________________________________________

3) Have you ever competed or participated in an endurance sporting event such as a run, a swim, or a bike race?
   YES__________
   NO__________

3a) If yes, what kind of endurance activity was it?

   ______________________________________________________
   ______________________________________________________

3b) If yes, when was the most recent endurance event you competed in?

   ______________________________________________________
SPORT HISTORY QUESTIONNAIRE (continued)

4) How often do you exercise?
   a. once or more daily________
   b. at least four times a week____
   c. two or more times a week____
   d. weekly____________________
   e. two or more times a month____
   f. monthly____________________
   g. less than once a month_______

4a) What is your most common form of exercise (e.g. swimming, golf, surfing, walking, etc.)

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________
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130-131 Self-Evaluation Questionnaire STAI
   Form Y-2
132-137 Pain History Questionnaire: Minor Pain

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APPENDIX B

MATERIALS FOR THE ERGOMETER RIDE:
COMPETITIVE STATE ANXIETY INVENTORY (CSAI-2),
ERGOMETER PROTOCOL SHEET, BORG PERCEIVED EXERTION SCALE,
POST-ERGOMETER QUESTIONNAIRE WITH A/D SCALE
ERGOMETER PROTOCOL

LOAD LEVEL | HEART RATE
-----------|-----------
1          |           |
2          |           |
3          |           |
4          |           |
5          |           |
6          |           |

MAX HEART RATE________

Lactate:
1 min________
PERCEIVED EXERTION SCALE

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>VERY, VERY LIGHT</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>VERY LIGHT</td>
</tr>
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<td></td>
</tr>
<tr>
<td>11</td>
<td>FAIRLY LIGHT</td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>SOMEWHAT HARD</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
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<td>HARD</td>
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<td></td>
</tr>
<tr>
<td>17</td>
<td>VERY HARD</td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>VERY, VERY HARD</td>
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</table>
PLEASE NOTE

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141 Post-Ergometer Questionnaire

University Microfilms International
5) Using the following scale, rate the ergometer ride in terms of pain:

0 NO PAIN
1 MILD
2 DISCOMFORTING
3 DISTRESSING
4 HORRIBLE
5 EXCRUCIATING

7) During hard efforts and pain encountered during the ergometer ride, some people tend to pay attention to the pain and other people tend to distract themselves from the pain.

Keeping in mind two points during the ergometer ride: WHEN THE RIDE WAS EASIEST, and WHEN THE RIDE WAS HARDEST, please estimate the percentage of time you spent paying attention to the pain and what percentage of time you spent distracting yourself from the pain. Using the scale below, please check a point on the line to represent your estimate, FOR EACH OF THE TWO POINTS DURING THE RIDE.

WHEN THE RIDE WAS EASIEST
DISTRACTION/ATTENTION TIME PERCENTAGE

(100% distraction from the pain) (50% distraction 50% attention) (100% attention upon the pain)

|-----------------|------------------|

WHEN THE RIDE WAS HARDEST
DISTRACTION/ATTENTION TIME PERCENTAGE

(100% distraction from the pain) (50% distraction 50% attention) (100% attention upon the pain)

|-----------------|------------------|

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APPENDIX C

ADDITIONAL ANALYSES:
THE RELATIONSHIP BETWEEN THE SPIELBERGER TRAIT ANXIETY SCALE, THE COMPETITIVE STATE ANXIETY INVENTORY, AND THE STUDY'S ASSOCIATION/DISSOCIATION SCALES
Table 16. Pearson Correlation Matrix for All Anxiety Variables and AID Scores

<table>
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<tr>
<th></th>
<th>SC</th>
<th>CA</th>
<th>SA</th>
<th>STAI</th>
<th>PHQ-M</th>
<th>PHQ-W</th>
<th>ERGO-L</th>
<th>ERGO-M</th>
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<tbody>
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<td>SC</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>-.37*</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA</td>
<td>-.14</td>
<td>.39*</td>
<td>1.0</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>STAI</td>
<td>.05</td>
<td>.37</td>
<td>.29</td>
<td>1.0</td>
<td></td>
<td></td>
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<tr>
<td>PHQ-M</td>
<td>-.09</td>
<td>.18</td>
<td>.18</td>
<td>-.15</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHQ-W</td>
<td>.14</td>
<td>-.13</td>
<td>-.08</td>
<td>-.03</td>
<td>.03</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERGO-L</td>
<td>.09</td>
<td>.18</td>
<td>.18</td>
<td>.15</td>
<td>.29</td>
<td>-.34</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>ERGO-M</td>
<td>-.15</td>
<td>.17</td>
<td>-.12</td>
<td>.21</td>
<td>.32*</td>
<td>.20</td>
<td>-.31</td>
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</tr>
</tbody>
</table>

*p<.05
Note. CSAI-2 Subscales: SC=Self-Confidence, CA=Cognitive Anxiety, SA=Somatic Anxiety
REFERENCES


National Science Foundation (1985). Research briefing on pain and pain management.


