THE BIOPSYCHOSOCIAL APPROACH TO PAIN MANAGEMENT

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"For all the happiness mankind can gain,
Is not in pleasure, but in rest from pain"

- John Dryden (1631-1700)

Given that pain affects approximately 50 million Americans, and the costs associated with both the treatment of pain and lost productivity range from $70 to $100 billion annually \(^1\), \(^2\), the pursuit for understanding the underlying mechanisms of pain and identifying the best possible treatment options has prevailed because of these staggering costs. Indeed, in a study released by the Centers for Disease Control and Prevention’s (CDC) National Center for Health Statistics \(^3\) 1 in 4 U.S. adults reported a pain experience that lasted a full day during the previous month, and 1 in 10 reported an experience of pain lasting a year or more. The study also revealed that one-fifth of adults over the age of 65 reported pain that lasted more than 24 hours, with three-fifths of these older adults reporting that their pain had lasted for more than 1 year.

Although pain research has traditionally focused on the sensory modalities and the neurological transmissions identified solely on a biological level, more recent theories (integrating the body, mind, and society) have been developed. The most heuristic perspective is known as the biopsychosocial model, with pain viewed as a dynamic interaction among and within the biological, psychological and social factors unique to each individual. Indeed, as reported by Gatchel \(^4\), Figure 1 presents a conceptual model of these interactive processes involved in health and illness. Pain is not purely a perceptual phenomenon in that the initial injury that has caused the pain also disrupts the body’s homeostatic systems which, in turn, produce stress and the initiation of complex programs to restore homeostasis (to be discussed later in this article). In this paper, we will also examine the following: the evolution of the biopsychosocial perspective from earlier pain theories; the fundamental attributes associated with
chronic pain conditions; and the biopsychosocial approach to the assessment and management of pain.

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PROGRESSION THROUGH THE EARLY THEORIES OF PAIN TO THE BIOPSYCHOSOCIAL MODEL

The earliest theories of pain had focused primarily on the understanding of the biological or pathophysiological component of pain. *Cartesian Dualism,* or separation of the mind and the body, dates back to the 17th century when Rene Descartes conceptualized pain as an exclusive process within the sensory nervous system\(^5\). At that time, diseases and illnesses were described purely as mechanistic biological processes. Even without empirical evidence, it was conceived that the experience of pain was conveyed directly to the brain from the skin, without any psychosocial interplay. Termed *biomedical reductionism,* this point of view remained constant through the late 19th century. During the late 1800s, two additional theories arose, providing a clearer conceptualization of the biological view of pain. The *specificity theory of pain,* put forth by Maximilian von Frey in 1894, proposed that there were subcutaneous receptors unique to the different types of sensory input\(^6\). The distinctions between these receptors varied with respect to their functionality, such that they were designed explicitly to allow for the interpretation of sensations such as touch, temperature, pressure, or pain.

The *pattern theory of pain,* presented by Goldschneider in 1894, differed from von Frey’s theory by stating that, not only were all subcutaneous receptors were alike, but the unique
patterns of stimulation at the nerve endings were what distinguished the variability in the interpretations of the sensory signals. It was assumed that the central nervous system was responsible for coding these nerve impulse patterns that resulted in the pain experience. Although this theory helped to explain incidences of phantom limb pain, which is described as experiencing pain after the termination of the input, the pattern theory of pain disregards receptor and fiber evidence which has come to fruition in recent developments.

Today, there is much more known about the different types and functions of receptors, such that mechanoreceptors respond to touch and pressure, while thermoreceptors activate in response to changes in temperature. Nociceptors are affiliated with pain perception and, depending on the specific fiber (Aδ or C) associated with the type of nociceptor (mechanical, thermo-mechanical, or polymodal) stimulated, the perception of pain can range from sharp and prickly, to burning or freezing.

Although the specificity and pattern theories of pain were fundamental in the development of the understanding of biological modalities, the detachment from this dualistic view corresponded with the lack of integration of mind-body phenomena. The lack of adequate explanations for pain and suffering spurred the next advance in our understanding of nociception and the individual experience of pain. In the 1960s, Melzack and Wall postulated a more integrative model—The Gate Control Theory of Pain. Although the underlying mechanisms of this proposed theory are often debated, the implications that there is an interaction between the psychosocial and physiological processes have been widely accepted.

The gate control theory of pain emphasized the significant role that psychosocial factors potentially play in the perception of pain. The term gate-control refers to the proposed mechanism of the substantia gelatinosa located in the dorsal horn of the spinal cord. Melzack and
Wall \textsuperscript{8} claimed that this gate-like function modulated the amount of afferent impulses from the periphery to the transmission cells (T-cells) of the dorsal horn through inhibitory processes at the neuronal level, and thereby controlling the quantity and intensity of the signals to the central nervous system. Furthermore, it was posited that higher cortical functions contribute to this gating mechanism, which allow for psychological phenomena to directly affect the subjective experience of pain.

From a clinical perspective, Gatchel \textsuperscript{5} suggests that the psychosocial component in the gate control theory contributes a great deal in treating patients with pain. Negative states of mind, such as helplessness, hopelessness and anger, tend to amplify the intensity of the sensory input, while strategies focusing on coping and stress reduction help to “close” the gate. Also, behaviors found to facilitate keeping this gate “open” include poor eating habits, smoking, inadequate sleep, and lack of exercise. By promoting positive health behaviors, proactive choices can be factors in lessening the perception of pain.

Compared to the earlier dualistic approaches to understanding pain, the gate control theory can be viewed as the first mind-body perspective to introduce the integration of the central nervous system with cognitive processes. An extension to this theory, termed the \textit{Neuromatrix Model of Pain}, was proposed by Melzack in 1999. The neuromatrix theory incorporates the stress component into the pain equation. Based on the original work put forth by Selye\textsuperscript{9}, stress serves as a mechanism of adaptation, such that the body will respond to challenging or dangerous situations in an attempt to lessen any problematic consequences. The two neuroendocrine systems, the sympathetic-adrenomedullary system and the hypothalamic-pituitary-adrenocortical axis (HPA), serve to activate this fight or flight system\textsuperscript{10}. However, hyperactivity of the HPA system can be seen to intensify the pain condition. When dealing with
chronic pain, individuals experiencing elevated levels of stress may actually exacerbate the pain experience. As stress intensifies pain, the increased level of pain, in turn, inevitably becomes a stressor that continues to threaten homeostasis. Based on the theory provided by Melzack 11, each individual’s distinct neuromatrix, comprised from genetics, sensory modalities and memory, determines the overall interpretation of the experience of pain 12.

THE BIOPSYCHOSOCIAL PERSPECTIVE OF PAIN

As the gate control and neuromatrix theories provided the opportunity to explore how the mind-body relationship relates to the pain experience, the biopsychosocial perspective has become the most heuristic approach to truly understanding the concept of pain. This approach views a physical disorder as the result of an intricate and dynamic interaction among biological, psychological and social factors that can often antagonize the pain condition. Individuals tend to express variability in their pain experiences due to the range of physiological, psychological and social factors that interact, which thereby modulate the interpretation of symptoms 5, 12.

The biopsychosocial model was first introduced in medicine by Engel 13 when he highlighted the fact that, as a medical illness became more chronic in nature, then psychosocial “layers” (e.g., distress, illness behavior and the sick role) emerged to complicate assessment and treatment. Subsequently, Loeser 14, applied this model to pain (Figure 2). From this perspective, there were four dimensions related to the idea of pain: nociception, pain, suffering and pain behavior 5.

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Nociception refers to the physiological components associated with sensory input, such as nerve receptors and fibers; and pain is described as a subjective perception resulting from sensory input. While nociception and pain provide methods of communication to the central nervous system, suffering and pain behavior, on the other hand, are described as reactions to those signals that can be influenced by both previous experiences and anticipation of potential consequences. Suffering can be seen as a negative affective response to nociception or pain. Oftentimes, individuals who experience a painful encounter will exhibit various emotional responses such as depression, anxiety and fear. Pain behavior is described in one’s actions while suffering from pain. For example, fear of recurrence of injury often leads to inactivity which, in turn, can delay the progression of recovery.

Similar to the distinction between nociception and pain, Turk and Monarch identify the differences between disease and illness in chronic pain patients. The term disease describes an altered condition resulting from the disruption of normal physiological systems and is considered to be an “objective, biological event.” Illness, on the other hand, refers also to the “subjective experience” associated with the disease state represented by a unique interaction among biological, psychological and social factors. Chronic pain is viewed as an illness which cannot be cured, but only managed. Therefore, the biopsychosocial perspective is directed at the illness, rather than the disease, and this approach focuses on the diversity and the individual differences in the overall pain experience. Thus, a management, rather than a merely curative, approach is taken. Indeed, most chronic illnesses, such as diabetes mellitus, asthma, essential hypertension, etc. cannot be cured, but only managed.

Knowing that not all individuals who experience an injury develop a chronic pain condition, it is important to recognize how an acute situation transitions to a chronic pain state.
Acute pain is generally viewed as an indicator of tissue damage and is interpreted through noxious sensations. In general, as the level of nociception decreases, the acute pain state diminishes. While the individual experiencing acute pain may report an increased level of anxiety, it is typically temporary. Anxiety, fear and worry in acute pain situations are often viewed as being adaptive in that the negative emotions influence proactive recovery behaviors, such as seeking medical care and attending to the injury.

An intermittent stage occurs following the acute phase, such that the pain condition is seen to last for two to four months post injury. During this stage, the patient is described as experiencing more psychological and behavioral distress, such as anger, somatization and learned helplessness. Chronic pain typically lasts for at least six months past the injury, which surpasses the time for which general musculoskeletal disorders heal sufficiently. Syndromes producing long-term pain conditions are often associated with depression and resentment. Chronic pain patients frequently develop a “physical deconditioning syndrome” for which atrophy, reflected by a decrease in strength, flexibility and stamina, is the product of neglect of the injured area. Along with the physical deconditioning component, chronic pain patients can also be characterized with a “mental deconditioning” dilemma. As their emotional well-being is compromised, these chronic pain patients often become avoidant and lose touch with their daily responsibilities so that others in their social group need to not only “pick up the slack,” but also, by doing so, reinforce the avoidant behaviors. In this type of situation, chronic pain patients are seen to lose motivation, specifically with their family, in their physical activities, and within their careers. When the lack of motivation interferes with their occupation, the chronic pain patient may also experience a significant financial burden, which can exacerbate the affective state as well.
The interwoven affiliation of the biological, psychological and social elements unique to each chronic pain patient must be attended to if a full understanding of the situation is warranted. Standard treatment protocols are found to be deficient if any one of these components is ignored. Because patients with the same diagnosis can respond differently to a standard treatment protocol, the goal in the biopsychosocial approach to assessment and management is to tailor the treatment to the specific needs of the individual.

**THE BIOPSYCHOSOCIAL APPROACH TO PAIN ASSESSMENT**

The biopsychosocial approach to understanding pain has been identified as the most successful model to date, in that it encapsulates the broader issues embedded in the interactions among the biological, psychological and social components unique to each individual. Thus said, the concept of pain cannot be broken down into discrete physical or psychosocial elements. Rather, the complexity of pain manifests not only within the range of psychological, social and physical attributes, but also with respect to chronicity, such that these intertwined components are seen to modulate the patient’s perception of pain and disability. The biopsychosocial model, therefore, uses physical, psychological, social, cognitive, affective and behavioral measures, along with their interactions, to best assess the individual’s unique pain condition.

A recent enhancement of this model is reflected in the better understanding of how the neuroendocrine system affects the chronic pain condition. In addition to the impact of general emotional distress, elevations of stress hormones produced by the hypothalamic-pituitary-adrenocortical (HPA) system, such as cortisol, have been found to exacerbate pain conditions (Figure 3). Earlier, McEwen had highlighted the importance of evaluating cortisol dysregulation under condition of allostatic load increases due to stress. Underlying mechanisms
related to the HPS axis may therefore help to explain individual differences in stress and pain, as well as other medical condition such as fibromyalgia. Indeed, several recent studies have associated HPA dysfunction with chronic pain conditions, such as fibromyalgia, chronic fatigue syndrome, chronic pelvic pain, temporomandibular pain disorder (TMD), rheumatoid arthritis and multiple sclerosis.

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Furthermore, growing technologies have allowed for a better understanding of the pain experience through various modalities, such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET). These types of imaging techniques focus on the displacement of blood flow within specified regions of the brain. Although there is some controversy regarding the implications derived from imaging procedures, these non-invasive technologies have provided knowledge about the anatomy and pathways related to the central nervous system. In addition to the brain imaging techniques, other developments in pain research have been found in areas of genetics, electrophysiology, molecular biology and pharmacology. The unification of disciplines focused on pain provides the most effective methods to understanding pain because it gives a comprehensive view of how the nervous system perceives, deciphers and responds to pain.

When attempting to assess an individual’s pain condition, there are two essential confounds or “traps” to avoid. First, although there are numerous pain assessments available, the practitioner cannot assume that any one assessment will have more validity or reliability than another measure. Secondly, while physical measures of pain are more objective than self-report
instruments, both must be taken under consideration in the evaluation of the pain condition.

Regardless the level of accuracy in the objective analysis of pain, the interpretation on the part of the health care professional must be considered for an adequate diagnosis to be made.

Furthermore, the individual’s psychological state can influence the performance on a physical assessment, such that fear of re-injury and lack of motivation may affect the outcome measures.

When considering the types of assessments to use, the measure is only valid if it is aligned with the purpose at hand. Assessments used in chronic pain populations that focus solely on biological and physiological aspects may not be valid in predicting impairment or disability. Not only is it important to consider each measure to be used but, moreover, to be able to identify how the various tools assimilate into a complete analysis of the individual’s pain condition. A step-wise approach to assessment has been advised, beginning with a general evaluation of the factors under consideration, leading up to a more definitive diagnosis. By taking this multidimensional view, the biopsychosocial approach to assessment will lead not only to a better understanding of the patient’s pain condition, but ultimately will lead to a comprehensive treatment protocol customized to the individual’s unique situation.

**THE BIOPSYCHOSOCIAL APPROACH TO PAIN MANAGEMENT**

As noted earlier, similar to other chronic illnesses, such as diabetes or asthma, a chronic pain condition cannot be cured, but it can be managed. Due to the heterogeneity with respect to the biological and psychosocial elements within a chronic pain population, not only is greater diversification of treatment options necessary, it is essential to properly match the treatment to the patient. Because two patients with the same diagnosis differ in physical, social and
psychological compositions, “lumping” these patients into the same treatment program will not likely produce the best outcomes compared to a tailored treatment regimen.  

The overall outcome goal when treating patients which chronic pain conditions is improving functional capacity, which correlates with better physical strength and mobility, along with an improved affective state and self-esteem. Depending on the circumstances and duration of the injury, there are different levels of care, specifically primary, secondary and tertiary care, for patients experiencing pain. The focus of primary care is to relieve the symptoms associated with the acute pain condition while increasing movement and functionality in the affected area. In general, the psychological factors addressed in primary care settings correspond to alleviating any anxiety or fear associated with the occurrence of pain. At this phase, it is important to educate the patient about medication compliance and following the prescribed exercise protocol in order to expedite the healing process.

Most patients who incur an injury recover well following the primary care treatment. When psychological factors and social issues merge with the physiological impairment, though, a more integrated rehabilitation process is necessary to help the patient avoid entering into a full chronic pain condition. Commonly, a subset of the injured population finds recuperation to be difficult at the level of primary care, and will therefore require an expanded treatment program for their injury, which is called secondary care. At this level, an interdisciplinary team works together to help the patient to prevent physical deconditioning and to reduce psychological barriers that interfere with recovery. Most patients for whom primary care is not sufficient experience positive outcomes following secondary care.  

Some patients do not respond well to either primary or secondary care for reasons relating to poor physical and psychological recovery, or other factors such as legal and work-
related issues that may contribute to more pronounced emotional distress. Functional restoration, which is a form of tertiary care, has been developed for this chronic pain population. The focus of functional restoration is to avert permanent disability by utilizing a biopsychosocial approach. Within the scope of this treatment, the patient receives assistance from an interdisciplinary team of health care professionals, often including, but not limited to, a primary care physician, a psychiatrist or psychologist, a physical therapist, an occupational therapist, and a disability case manager. Together, this team develops a comprehensive plan to help the patient not only regain mobility and function, but also to teach the patient stress management techniques and coping skills necessary for dealing with any lifestyle or work issues that develop as a result of the pain and impairment. Oftentimes, chronic pain patients admitted to a tertiary care program are found to be reliant on their pain medications. Although relief from pain symptoms is an appropriate course of action in the primary and secondary care programs, substance use, specifically opioid dependency, is far too common. In most functional restoration programs, detoxification is found to be an essential part of treatment which is found to produce positive lifetime outcomes.

Following sufficient assessment measures and the resultant tailored treatment regimen, it is necessary to routinely evaluate the progress of the patient and amend or modify the program when deemed appropriate. The interdisciplinary team should meet together on a regular basis to discuss each patient’s progress. It is through effective communication, not only within the medical team, but also with the patient, that the biopsychosocial approach to pain management is successful.

Functional restoration programs have repeatedly been shown to produce positive outcomes within the chronic pain population. It is through this biopsychosocial approach to pain
management that patients experiencing chronic pain are able to regain mobility and function, to improve psychological conditions such as depression and anxiety, and to allow the patient to return to normal life activities. Besides decreasing self-reported pain and disability, as well as increasing physical functioning, this functional restoration approach (first developed by Mayer & Gatchel\textsuperscript{18}) has also produced substantive improvement in various important socioeconomic outcome measures (e.g., return-to-work and resolution of outstanding medical issues). For example, in patients who were chronically disabled with spinal disorders, Mayer, Gatchel et al.\textsuperscript{30} found that 87\% of the functional restoration group was actively working two years after treatment, as compared with only 41\% of a non-treatment comparison group. Moreover, about twice as many of the comparison group patients had both additional spine surgery and unsettled workers’ compensation legal cases, relative to the treatment group. The comparison group continued with an approximately five-times-higher rate of patient visits to health care professionals and higher rates of recurrence or re-injury. Thus, these results displayed the striking impact that a functional restoration program can have on these important measures in a chronic pain group consisting primarily of workers’ compensation patients (traditionally the most difficult cases to treat successfully).

The effectiveness of this original functional restoration program has been independently replicated by Hazard et al.\textsuperscript{31} and Patrick, Ahmaier, and Found\textsuperscript{32} in the United States. Randomized controlled trials demonstrating positive outcomes include: Bendix et al.\textsuperscript{33} and Bendix and Bendix\textsuperscript{34} in Denmark; Hildebrandt, Pfingsten, Saur, and Jansen\textsuperscript{35} in Germany; Corey, Koepfler, Etlin, and Day\textsuperscript{36} in Canada; Jousset et al.\textsuperscript{37} in France; and Shirado, Ito, Kikumoto et al.\textsuperscript{38} in Japan. The fact that different clinical treatment teams, functioning in different states and different countries, with markedly different economic and social conditions
and workers' compensation systems, produced comparable positive outcome results speaks highly for the robustness of the research findings and utility, as well as the fidelity, of this approach to pain management in occupational settings. Gatchel and Mayer have further reviewed this evidence.

This functional restoration approach has also been found to be effective with chronic upper extremity disorders. In addition, this type of approach has been found to be an effective early intervention treatment for preventing chronic disability. For example, in a randomized controlled study, acute low-back-pain patients who were identified as “high risk” for developing chronic back pain disability were randomly assigned to an early functional restoration group or a treatment-as-usual group. The functional restoration group displayed significantly fewer indexes of chronic pain disability at 1-year follow-up on a wide range of work, healthcare utilization, medication use, and self-reported pain variables. For example, the functional restoration group was less likely to be taking narcotic analgesics (odds ratio = 0.44), and also less likely to be taking psychotropic medications (odds ratio = 0.24). Moreover, the treatment-as-usual group was less likely to have returned to work (odds ratio = 0.55). The cost-comparison savings data from this study were also quite impressive: The treatment-as-usual group cost twice as much as the functional restoration group over a 1-year period.

Besides functional restoration, there have been a host of other studies demonstrating the treatment effectiveness of interdisciplinary pain-management programs (based on the biopsychosocial model) in general in successfully treating various other prevalent chronic pain syndromes. In fact, Gatchel and Okifuji comprehensively reviewed the literature in demonstrating the therapeutic- and cost-effectiveness of such comprehensive programs, relative to simple, single-modality approaches such as pharmacotherapy, surgery, injections, etc., on a
number of measures (see Table 1), as well as on the important variable of return-to-work (see Table 2).

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This has led Guzman and colleagues 43 to conclude, on the basis of a comprehensive Cochrane Review, that

“There was strong evidence that intensive multidisciplinary biopsychosocial rehabilitation with functional restoration improves function when compared with inpatient or outpatient non-multidisciplinary treatment.”

CONCLUSIONS

Due to the high prevalence of chronic pain conditions, that results either from injury or disease, identifying and implementing the most effective treatment options available is a primary concern. Although the biological mechanisms associated with pain have been recognized and accepted, the biopsychosocial approach to understanding and managing pain is the most heuristic approach available. The pain experience can be viewed from a systematic perspective, so that as the biological condition worsens, psychological and social factors follow, that need also be managed. It emphasizes the unique interactions among biological, psychological, and social factors that need to be considered to better understand pain syndromes. Thus, treating the “whole” person is far more important than focusing merely on a disease. Managing the illness is the most appropriate approach to take. By using the appropriate assessments to adopt the most suitable interdisciplinary treatment program, the chronic pain patient is far more likely to regain function and to show vast improvements in his/her quality of life. Indeed, this biopsychosocial
approach to pain has led to the development of the most therapeutic- and cost-effective interdisciplinary pain management programs, that far exceed in their effectiveness any of the earlier overly simplistic biomedical reductionist approaches to the treatment of pain.
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cost-effectiveness of comprehensive pain programs for chronic nonmalignant pain.

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44. Turk DC. Clinical effectiveness and cost effectiveness of treatment for patients with

45. Turk DC. Treatment of chronic pain patients: Plus ca change, plus c'est la meme. Paper
presented at: Taking the Pain out of Complex Pain Management: Practical Approaches
for Improved Services across the Continuum of Care, 2008; Edmonton, Alberta, Canada.
Table 1. Outcomes for Interdisciplinary Pain Rehabilitation Programs (IPRPs) Compared to Other Care (from Gatchel & Okifuji, 2006 and Turk, 2002, as summarized by Turk)

<table>
<thead>
<tr>
<th>Criteria</th>
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<td>Pain reduction</td>
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<td>±</td>
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<td>Reduction of medication</td>
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<td>Reduction of health care</td>
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<tr>
<td>utilization</td>
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<tr>
<td>Return-to-work</td>
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<td>Increased activity</td>
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<td>Cost benefit</td>
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Table 2. Rates of Return-to-Work for IPRP

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<td><strong>Total</strong></td>
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Figure 1

![Biopsychosocial Pain Management Diagram]
Figure 2.

ENGEL'S
CONCEPTUAL MODEL OF ILLNESS

Sick Role
Illness Behavior
Distress
Physical Problem

LOESER'S
CONCEPTUAL MODEL OF PAIN

Pain Behavior
Suffering
Pain
Nociception
Figure 3.